Access and Returns to Education in Kazakhstan

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Abstract

This thesis explores the heavily under-researched topic of returns to education in Kazakhstan and how access to higher education affects them. It starts with an analysis of the returns to education, as estimated by applying pseudo-panel techniques to cross-sectional data for 2002-2016 from the Kazakhstani national statistics. The returns are found to be relatively high and internationally comparable, though they decrease over the period considered. The cohort effect estimated with Mundlak correlated random effects model is found to be negative, suggesting the business cycle impact interpretation: those cohorts whose school-leaving age fell during the 1990s recession, when there was a lack of jobs and increased access to tertiary education, ended up with more schooling, but lower future earnings.

The second and third empirical chapters employ administrative data on 90,329 recent university graduates. I start with an analysis of the returns to attending more selective national universities as opposed to other public HEIs. National universities benefit from relatively higher public funding, administrative support and higher tuition fees. In 2012, they were forced to increase the minimum admission test score in order to improve the quality of their student intake. With a fuzzy regression discontinuity design, this chapter revealed no returns premia was gained by attending a national university, at least during the first year in employment and for the first affected cohort. Alternative explanations for this could arise from problems with the methodology or data constrains.

The final chapter examines the effects of tightening access to higher education, which occurred in 2012, on programme-level enrolment, student quality and the affected cohort's labour market outcomes. Although the entry test is unified, I expect the impact of tightening entry requirements to depend on the proximity of the pre-treatment quality of the student intake to the test cut-off point. I exploit this variation in treatment intensity to apply difference-in-differences estimation. I found that the enrolment per programme has decreased for the worse-quality programmes relative to the better-quality ones only at public universities, which is likely due to differences in the subject composition and the intervening effect of the increased test cut-off point at the national universities. However, the student quality was found to decrease in relatively better programmes for all universities. This possible long-term trend might reflect adverse demographic conditions and increased competition, with HEIs maximising profits through enrolment maximisation strategies due to limited alternative sources of funding. Regardless, it does not affect the graduates' further labour market returns, at least during their first year in employment.

Declaration

I declare that the thesis is my own work and has not been submitted for any other degree or professional qualification. Parts of the thesis have been submitted to journals and conferences as noted below.

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Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Motivation and the context

This thesis empirically explores the returns to education in Kazakhstan and how access to higher education affects them.

The economic concept of returns to education assumes an assessment of the marginal increase in the average earnings one gains as a result of increased schooling. Considering only pecuniary private returns, as per the given definition, might be too simplistic and naive, as they obviously extend beyond the financial gains. However, even this simplified assessment allows to understand the incentives of the economic agents at the market of education and equips the relevant policymakers with reasonable information on which to base decisions.

The topic is possibly one of the most researched in the theoretical and empirical economic literature. It started with Becker's pioneering approach to treat the investment in a human capital as being akin to investment in physical capital (Becker 1975) and the empirical model of the returns to education developed by Mincer (Mincer 1974). It has been widely empirically tested in many countries and contexts. Various research designs and econometric techniques have been developed and employed to establish a causal effect and control for a number of the methodological issues that arise with the basic Mincerian specification (Card 1999). Although some of these studies have led to controversial results, and there are still many unknowns, the economic literature has reached a general understanding of the rate of returns worldwide and the mechanisms determining them.

However, the topic is still undeservedly under-researched in the context of the post-Soviet economies. These economies represent unique and interesting cases due to their particular initial preconditions and the rapid transition from them. It is known that the returns to education in countries with different economic structures will themselves vary. For example, in developing countries the returns are normally higher than in developed,

mostly due to lower levels of capital accumulation and limited access to education in the latter. In contrast, the Soviet Union heavily invested in education and, as a result, its population was characterised by relatively high educational attainments. However, the rates of returns in the Soviet economy were very low, labour markets were under-developed, the content of education was purely tailored to fit the planning economic system, and was biased towards industry-demanded (versus services-demanded) skills, blue-collar (versus white-collar) worker training, and a focus on technical skills (versus wider knowledge and life skills, personal development, critical thinking, etc.) (Kapelyushnikov 2008). Accompanying this, under the "'socialist model' with no fees (but limited enrolment)" (Weber and Zgaga 2004, p. 42) access to higher education was very competitive since the higher education supply did not meet the demand (Huisman et al. 2018).

Additionally, the industrialised structure of the Soviet economy was different from that of many developing countries. For example, in Kazakhstan during the pretransition period the second-largest sector of economy in terms of output and employment was the manufacturing and mining industries (20.5% in GDP and 16% of jobs), followed by construction (12% in GDP and 9% of jobs), though the largest was agriculture (34% and 23%, respectively). The share of the service sector was neglectable in the gross output albeit some services absorbed a large share of the labour force (education – 12%, and healthcare and social work – 6%)[1]. This all started to change with the reforms, though at different speeds in different countries. Kazakhstan was possibly more among those with the most rapid economic reforms in the post-Soviet area (IMF 1997).

Following the collapse of the Soviet Union in 1991, Kazakhstan obtained its independence and started the transition towards a modern market economy, with a quite well-educated population as a positive legacy from the former USSR and with other less positive inheritances (OECD 2007, p. 11). In the 1990s, the country experienced severe economic recession. By 1995, real GDP had dropped to 61.4% of its 1990 level[2]; the pre-transition levels of output were surpassed only in 2004 (Ruziev and Majidov 2013). Recession had caused unemployment and poverty, the reduction of real incomes, and contributed to severe income inequality. Against this background, educational attainments witnessed a counter-cyclical increase which was solely driven by higher education attainment growth. The number of higher education institutions grew rapidly from 55 public institutions in 1990/91, reaching its peak of 185 institutions in 2001/02, among which 126 were non-public; the higher education student population grew from 287,367 to 514,738, respectively. For comparison, the number of technical and vocational colleges grew from 247 to 293 with a decrease in the corresponding number of students from 247,650 to 168,189 over the same period[3]. Greater demand for higher education, due in part to the

[1]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.
[2]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.
[3]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

conviction of young people – and indeed their parents – of the career-associated value of a diploma, has led to a dramatic expansion of the enrolment to Kazakhstani universities – the gross enrolment ratio for tertiary education grew from 39.73% in 1990 to 58.19% in 2006[4]. This has mostly occurred in admission on a tuition fee basis, as opposed to the state-funded higher education. The share of privately funded students increased from 47% in 1999 to 86% in 2002 (IAC 2017). On the other hand, this might be driven by easier access to higher education through its 'massification' and 'marketization', with fast emerging, more accessible and affordable private HEIs, and possibly by a lack of jobs due to labour market collapses.

Educational attainments continued to grow with the fast economic growth of the 2000s, as caused by the oil-boom-driven labour markets' revival, though this was mostly through the technical and vocational education and training (TVET) expansion; in 2013/14 the number of colleges increased to 785 with the number of students reaching 557,374, while the corresponding number of HEIs and their student population were 139 and 571,691, respectively[5]. However, the expansion of technical and vocational education was likely driven by the introduction of the higher education entry test in 2004 and a loophole allowing TVET graduates entering higher education without taking the test.

This increase in the quantity of education was not accompanied by an associated increase in funding, which was poor even given the fast economic growth of the first decade of the 2000s. Total public spending for education comprised 3.6% of GDP in 2014, from which only about one-tenth was allocated to higher education – "substantially lower than in many peer countries and far below the average investment in OECD countries" (OECD 2017). Consequently, the higher education institutions were heavily reliant on private funding through tuition fees comprising 70% of total expenditure on education. Along with that, tough competition for the students due to long-term adverse demographic trends and the policy initiatives attempting to improve quality through tightening access to higher education limited the opportunities available to most universities to raise tuition fees. As a result, private funding is limited as well - it made up 0.7% of GDP. 1% of GDP in total "does not bring the country up to levels anywhere near those of most of its peers", as the OECD country report concludes (ibid.).

Partially as a result of under-funding, the average quality of higher education is low, facilities are often inadequate and insufficient, and the content of higher education is widely criticised for being outdated and poor equipped to meet labour market demands. The poor quality of tertiary education was confirmed by the OECD Survey of Adult Skills: Kazakhstan has the lowest gap in proficiency between adults with compulsory secondary and tertiary education among countries surveyed (OECD 2019). Several reforms have been

[4]UNESCO Institute for Statistics Country Data, http://data.uis.unesco.org/.
[5]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

initiated to tackle these challenges, particularly through improving the quality of enrolled students. Researching this issue might shed light on the mechanisms determining the returns to higher education in the current transitional economy and allow the evaluation of the effectiveness of such reforms. This is the motivation behind this thesis.

1.2 The rates of returns to schooling

I start with descriptive analysis of the returns to schooling in Kazakhstan estimated using Mincer's equation on the Household Budget Survey data. The topic is under-researched, and at the time this study was conducted there had been only one previous examination of this area (Arabsheibani and Mussurov 2007) which using the instrumental variables found the returns to increase with the transition to the internationally comparable rates - about 11-14%, as has been observed in other post-communist countries (Fleisher et al. 2005, Barro and Lee 2010). I exploit a different methodology – panel methods with the pseudo-panel constructed from the repeated cross-sectional data – and take advantage of a long period analysed. The key assumption is that though individual heterogeneity is not fully controlled for, the part of it representing the so-called 'cohort effect' is eliminated with the pseudo-panel.

The period under consideration - from 2002 to 2016 - was characterised by the fast though volatile oil boom-driven economic growth, with per capita real GDP doubling from about 5.6 thousand USD to 10.6 thousand USD[6]. Despite its increasing trend, the growth rate plummeted twice over this period: from an average annual rate of 10% in 2002-2007 and 6% in 2010-2014 to 1.2% in both 2009 and 2015[7], due to worldwide economic downturns. The GDP structure by industry has changed during this period in line with the course of transition reforms: shares of wholesale and retail trade and service activities in GDP have expanded by about 5% and 10%, respectively, while the shares in agriculture, manufacture and real estate activities have dropped by around 3-4% each. By the end of the period, the production from services made up 56% of GDP, while the production of goods made up only 37%. Employment changed accordingly; it has grown in the service sector, particularly in education, healthcare, social work, and the financial sector, along with the wholesale and retail trade, and dropped in agriculture[8]. Increased output and changes in its composition could result in increased demand in the educated labour force and lead to an increase in the returns to education. On the other hand, the inflow of people to tertiary education has soared, and this along with its perceived decreasing quality could result in a labour demand and supply mismatch, over-education, and a decrease in returns.

I found the returns to be relatively high and internationally comparable at around

[6]The World Bank data, constant 2010 USD, https://data.worldbank.org/.
[7]The World Bank data, https://data.worldbank.org/.
[8]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

7-13% (the average rate globally is around 10% (Patrinos and Psacharopoulos 2020)); however, they decreased over the period under consideration – in 2016, the returns were 2-5 p.p. lower than in 2002. The cohort effect turned out to be negative, suggesting the interpretation of the business cycle's impact. Apparently, those cohorts whose school-leaving age roughly fell within the period of the 1990s recession with a lack of jobs and increased access to tertiary education ended up getting more schooling, but lower returns to schooling. The chapter additionally reveals the gender gap in the returns; while females tend to earn less, the returns are higher for them, which can likely be explained by gender differences in labour allocation across sectors and industries, and, in turn, explains the higher levels of education amongst women.

1.3 Access to higher education and heterogeneity in the returns to education

The following chapters focus on access to higher education and employ administrative data on the recent university graduates collected by the Ministry of Education and Science (MES). In particular, the institutional chapter describes the country context, institutional framework and the relevant reforms. It additionally describes the data, its limitations and the steps undertaken to manage them. I then present the basic descriptive estimations of the returns to attending different types of higher education institutions, examining the data on 90,329 individuals who graduated in 2014-2016 from four-year full-time Bachelor academic programmes at 104 universities across the country. I found the returns to higher education to vary substantially across the different types of HEI: the highest returns were gained by the graduates of the few most expensive private universities delivering mostly business-focussed curricula. By contrast, the lowest returns were found amongst graduates of the remaining private universities recruiting the least able students, as measured by their entry test scores. Higher education from the public institutions yields somewhat average returns.

1.4 University selectivity and the returns premia

The following chapter analyses the returns to more selective public higher education institutions in the Kazakhstani context. To the best of my knowledge, this is the first such research in the post-Soviet world. Several empirical examinations worldwide found the returns to higher education selectivity to be higher; however, a part of this is attributed to selectivity - the selection of the abler students - in addition to a presumably better quality of more selective university, labour market signals or various peer effects. In 2001, ten public universities in Kazakhstan were granted the status of 'national university', providing

them with access to relatively better funding and administrative support, whilst demanding a better quality of education and research from them. According to these expectations, in 2012, the entry requirements were increased at the national universities to improve the quality of their student intake. This allows me to address the question of whether the increased selectivity could be associated with their graduates' future better salaries compared to other public HEIs, and if so, to what extent are the improved outcomes explained by selectivity. I control for the national universities' selectivity by exploiting the fuzzy regression discontinuity design and the newly established entry test score threshold. Unlike the simple OLS estimations, with FRDD the result did not reveal a returns premia to be gained by attending national universities, at least during the first year in employment and for the first affected cohort. This result was found to be robust via several robustness checks. Alternative explanations for this could arise from the methodological limitations (particularly, from the local nature of RDD) or data constrains (as only the entry salaries of the first affected cohort are considered).

1.5 The effects of tightening the access to higher education

The final chapter examines the effects of a unique policy shock – the tightening of access to all higher education institutions that took place in 2012 - on programme-level enrolment, student quality and the affected graduates' labour market outcomes. This policy was implemented through toughening a centralised entry examination and addressed public concerns over the decreased quality and overproduction supposedly prevalent in higher education. As an overall result, the average country-level test score dropped by almost 20%, the number of fails more than trebled, and the country-level higher education enrolment dropped by 25%. Although the entry test is unified, I expect the effect to vary in different degree programmes depending on the proximity of the pre-treatment quality of their student intake to the test cut-off point, and accordingly exploit this with difference-in-differences with a varying treatment intensity type estimator. I develop three simple indicators of pre-treatment quality at the university-programme level, as measured by freshmen test score. I then use these indicators to compare the relatively poorer-quality programmes' outcomes over the period on the assumption that they should be affected more by the policy since they normally enrol more students with test scores closer to the cut-off point. The better-quality programmes' outcomes serve as the counterfactuals. I found that the number of students enrolled per programme had indeed decreased, as expected, in the worse-quality programmes relative to the better-quality ones, but only at public universities. This is likely explained by differences in subject composition between university types and an intervening effect of a simultaneous policy affecting a group of the national universities (as examined in the previous chapter). Along with this, the results

revealed a decrease in student body quality in the relatively better programmes against the relatively worse ones, as measured by their students' average position in the national test score distribution, regardless of university type. The most sensible explanation for this possible longer trend is decreasing selectivity amongst the better programmes/universities due to adverse demographic conditions and increasing competition between HEIs in Kazakhstan and, indeed, from abroad. However, this does not seem to affect their graduates' further labour market returns, which were not found to show any statistical difference for the affected cohort compared to the previous ones, at least during the first year in employment.

Chapter 2

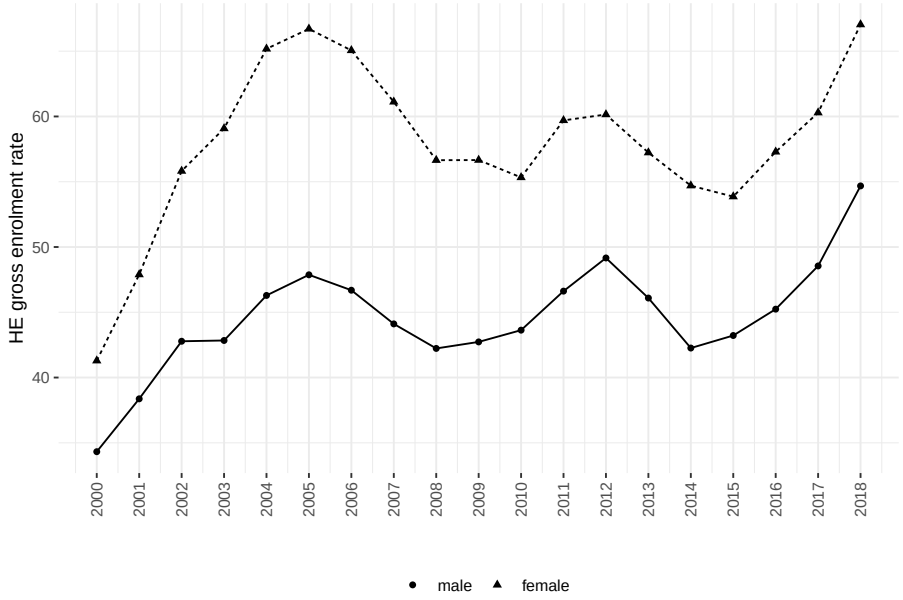
Returns to schooling in Kazakhstan using a pseudo-panel approach

2.1 Introduction and motivation

The 'returns to schooling (education)' concept, as developed by Jacob Mincer in the mid-20th century, was subsequently theoretically enriched and empirically tested in various contexts, and contributed to the evaluation of the economic role of education, labour market conditions and human capital productivity. Although the model in its basic form has certain conceptual flaws - in particular, it ignores bias potentially caused by unobservable factors that can influence both schooling and earnings - methods have been proposed to overcome them such as a use of panel data allowing to explicitly control for unobserved heterogeneity, assuming it is time-invariant. The aim of this chapter is to estimate the returns to schooling in Kazakhstan with the use of repeated cross-sectional data collected by the Household Budget Survey in 2002-2016, as a synthetic or pseudo-panel. The approach proposed by Deaton (1985) suggests adopting a pseudo-panel of cohort means, where a 'cohort' I consider to be a group of people of the same gender born in the same year who are assumed to share some common, unobserved characteristics.

There are no assessments available for the returns to education in Kazakhstan during the Soviet period, but they are believed to be low due to wage levelling, wage 'grids', and the centralised allocation of the labour force (Arabsheibani and Mussurov 2007, Gregory and Kohlhase 1988, Fleisher et al. 2005, Münich et al. 2005). However, according to a few post-Soviet examinations, they soared with the transition. In Kazakhstan, whose independence can be roughly divided into two sub-periods – the severe crisis of the 1990s and the oil boom of the 2000s (figure 2.2) - the later economic growth might additionally

Figure 2.1: Higher education gross enrolment rate



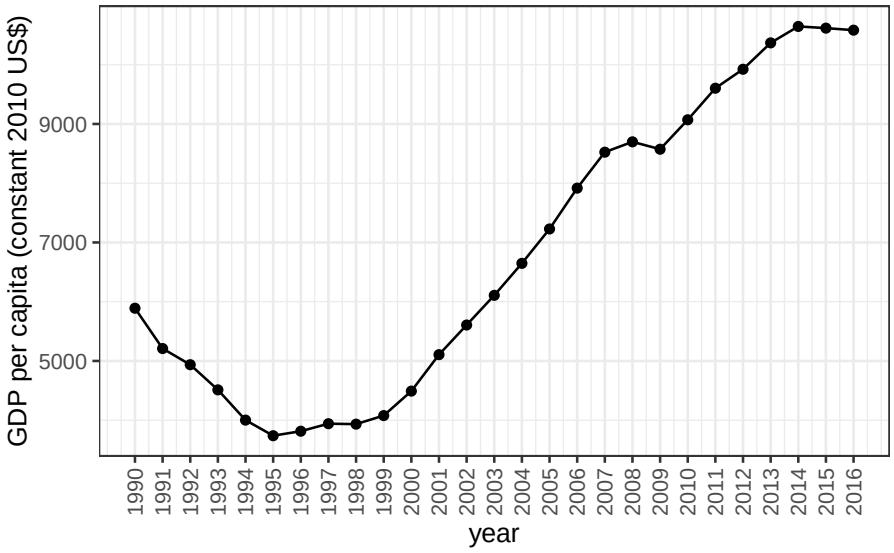
Data source: the Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

have contributed to the increase in returns via several channels. Demand for education consistently grew during the period of independence, with the number of university students increasing from 287,367 in 1990/91 to 542,458 in 2018/19, and the number of college students (technical and vocational education and training - TVET) from 247,650 to 489,818 for the same years, respectively (with a corresponding net increase in population of around 1.5 million).[1] Figure 2.1 depicts the gross enrolment rate of higher education by gender with year computed as the share of full-time higher education students in the total population who are aged 18-22. Despite significant variations across the years, it grew from 34% and 41% in 2000 to 55% and 67% in 2018, for men and women, respectively. There are no national statistics' data on the rate for technical and vocational education. Kazakhstan's educational institutions expanded accordingly: from 55 higher education institutions (HEIs) in 1990/91 to 124 in 2018/19, and from 247 colleges to 769 for the corresponding years.[2]

On the other hand, with this nearly two-fold increase in the inflow of educated people, it might be reasonable to predict a decrease in returns to schooling over time. Additionally, the period under consideration represents the oil boom decade when nominal GDP per capita grew from 1,658.00 USD in 2002 to 13,890.80 USD in 2013,[3], with the slowdown in 2009 and from 2015 onwards when world commodity prices plummeted, dragging down

[1]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.
[2]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.
[3]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

Figure 2.2: GDP per capita, (constant 2010 USD), World Bank data



an economy that was (and still is) highly dependent on oil and gas exports, which might also have intriguing effects.

Knowing the rates of the returns to schooling in Kazakhstan and their underlying mechanisms is crucially important to understand the motivation of students deciding to invest in their education, which I scrutinise in the following chapters. Meanwhile, there is only one previous research effort that has attempted to estimate the returns to schooling in the Kazakhstani context (a brief overview of which follows in the next section). This chapter attempts to partially fill the gap in the empirical analysis of the returns to schooling in Kazakhstan by making use of the pseudo-panel technique in conjunction with national statistics data. The motivation behind the study is to estimate the returns to education, but also to illustrate how the returns evolved over time. Additionally, the pseudo-panel methodology, as stated above, allows one to grasp the differences in the returns across cohorts whose living conditions, as well as educational attainments, differ dramatically from each other.

With the pseudo-panel approach, I found the returns to schooling to be relatively high (7-13% with the fixed effects and 8-11% with the Mundlak random effects, depending on a set of additional control variables) and essentially identical to simple OLS estimates obtained from individual data (8-12% for men and 10-13% for women), which are in turn very similar to the only previous examination that used the instrumental variables approach (Arabsheibani and Mussurov 2007). Though the results for schooling are robust across models regardless of controlling for cohort heterogeneity, with the Mundlak model the cohort effect (between-estimator) turned out to be highly significant and negative: while an increase in cohorts' average schooling over time increases their wages, less educated

cohorts earn more than more educated ones. More educated cohorts in the sample are the younger individuals whose school-leaving age fell roughly within the recession of the 1990s, suggesting the business cycle impact interpretation: cohorts entering the labour market during a recession and facing a lack of jobs apparently end up getting more education and lower lifetime wages. This effect might be exacerbated by perceived declining quality of education.

The study additionally uncovers other curious results. First, though real wages 'rocketed' during the observed period (by about 500-600 p.p. for men and 300-400 p.p. for women), the returns to schooling dropped (by about 4-5 p.p. and 2-3 p.p. for men and women, respectively). Second, the rapid growth in real wages over the period could only partially be explained by the changes in the working population's observed characteristics, including education, by about 30% for men and 40% for women, leaving the remaining part likely due to the oil boom growth. Third, despite females earning less, their returns to schooling were consistently higher for all models. The latter could probably be explained by gender differences in the labour force allocation between industries and sectors, with men mainly employed in market-oriented, riskier, but better paid industries with predominantly private ownership that probably value education less than the public sector and those industries absorbing the female labour force, where a certain level of schooling is often formally required and rewarded. This, in turn, complies with the higher level of education amongst women compared to men due to their rational decisions under the prevailing labour market conditions.

The chapter is organised as follows. The following section discusses the theoretical framework, the pseudo-panel methodology and its possible drawbacks, and briefly reviews its previous applications worldwide. It also details some of the very few research efforts to examine the returns to schooling in Kazakhstan and the region. Section three depicts the sampling methodology and the questionnaire, stating data limitations and caveats with regard to the interpretation of the results so arising. It familiarises the reader with descriptive statistics and visualises the most important individual-level variables disaggregated by gender, as well as the cohort-level data. The following section discusses the main findings from the estimated models and their possible interpretations in the context of the Kazakhstani labour market, as summarised by the conclusions.

2.2 Theoretical and methodological framework, and empirical examinations

A definition of returns to schooling was given by Mincer in 1974 in his seminal work as "a full quantitative accounting of the effects of the distribution of investment in human capital on observed earnings inequality" (Mincer 1974, p. 43). Mincer's earning function,

in its attempt to explain the extent to which earnings depend on schooling or education, is still widely used in many empirical studies as a key concept for the analysis of private returns. As Heckman et al. note, "Mincer's model of earnings... is the framework used to estimate returns to schooling, returns to schooling quality, and to measure the impact of work experience on male-female wage gaps" (Heckman et al. 2003, p. 1). Comprehensive reviews of existing empirical applications are given by Card (1999, 2001), Harmon and Walker (2001) and Dickson and Harmon (2011).

In its basic form, Mincer's model suggests the log of earnings (or wages) to be linearly dependent on either years of schooling or a level of education attained by an individual and other relevant control variables, such as their experience (practically, often substituted by its proxy, age, normally both in linear and quadratic terms to allow for diminishing returns to experience), gender, region and other variables. Depending on what is used as an explanatory variable – schooling or level of education attained – the model estimates the returns to either schooling or credentials.

In this analysis, I start with the 'classical' Mincerian specification, with the age in linear and quadratic terms as the only control variables, further augmenting it with additional controls: region, residence (urban vs. rural) and sector of employment (private vs. public):

$$\log w = \beta_0 + \beta_1 S + \beta_2 A + \beta_3 A^2 + \boldsymbol{X}\boldsymbol{\beta} + \epsilon \tag{1}$$

where
w – real wage
S – years of schooling
A – age
X – additional control variables
ϵ – composite error term.

The biggest challenge with Mincer's specification, as discussed in the academic literature, is that it treats schooling (or education) as exogenous, ignoring any possible endogeneity caused by potential correlation of unobservable factors influencing wages (such as inner ability, motivation or family background) with schooling (education). This strong assumption generates omitted variable bias – so-called 'ability bias' (Griliches 1977) - and methods to deal with it have been proposed and empirically tested. One such is the fixed effects model, the implementation of which requires panel data. Generally, the whole idea behind the use of panel data is motivated by the possibility of being able to solve the omitted variable problem (Wooldridge 2010).

Using panel data – repeated observations of the same individuals over time - allows unobservable variable(s) influencing wages to be held constant while obtaining the partial effects of the observable explanatory variables. With the wage equation:

$$y_{it} = \beta_0 + \boldsymbol{x_{it}\beta} + c_i + u_{it}, t = 1, ..., T \tag{2}$$

where

y_{it} – individual i's wage observed in a period t

x_{it} – observable variables reflecting various factors influencing i's wage in a period t

c_i – time-constant unobserved component

u_{it} – an idiosyncratic error term,

this might be achieved through either differencing or within transformation, with both eliminating the unobserved component (Wooldridge 2010, p. 267):

$$\Delta y = \boldsymbol{\Delta x\beta} + \Delta u \tag{3}$$

$$y_{it} - \bar{y_i} = \boldsymbol{(x_{it} - \bar{x_i})\beta} + u_{it} - \bar{u_i} \tag{4}$$

Both are known as the fixed effects model.

In reality, especially with regard to developing countries, genuine micro-level panel data is rarely available. In 1985, Deaton proposed the use of a time-series of independent repeated cross-sections as a synthetic or *pseudo*-panel. In particular, he "considers the possibility of tracking 'cohorts'", "with a 'cohort' defined as a group with fixed membership" assuming that they share some common characteristics, whilst the use of intra-cohort means represents an alternative to that of individual data (Deaton 1985, p. 109).

This approach has been employed in a number of empirical research efforts (Dickerson et al. 2001, Brunello and Comi 2004, Warunsiri and McNown 2010, Himaz and Aturupane 2016, Bhattacharya and Sato 2017), with the most common treatment of cohorts being those of age and gender groups, as initially proposed by Deaton and as replicated in this study. I argue that although unobserved heterogeneity might not be fully eliminated (since ability or parental background are determined at an individual, not group, level), it will at least be in part. By this, I assume the economic and social conditions witnessed and shared by people of the same generation that can potentially have a similar effect once I account for gender, or the so-called 'cohort effect'. In this case, it includes labour market conditions (demand and supply, institutional framework including labour market policies, and so on), content and quality of education, educational policies and reforms, and possible external shocks, which might be particularly pronounced in the country during the transition from the communist regime to the market economy. Notably, synthetic panel data might even hold some advantages over the genuine panel data, particularly while estimating the returns to schooling. The schooling variable in genuine panel data usually varies only incrementally, where one normally observes an increase in schooling only once for a particular individual. By contrast, this could be rather variable in a pseudo-panel.

Some issues arise with the pseudo-panel methodology, the potentially most serious of

which is the error-in-variables caused by averaging observations at the cohort level, which in turn might create attenuation bias and additional noise. However, Verbeek and Nijman 1992 argue that with a large enough cohort (where by 'large enough' they assume 100 or more individual observations per cohort), the sampling error can be disregarded, and estimates may thus be considered to be unbiased. On the other hand, increasing cohort size results in a decrease in the number of cohorts (which is the number of observations in a pseudo-panel); this, in turn, reduces precision. Thus, empirically, there is always a trade-off between the number of cohorts and their size.

Another problem is heteroscedasticity, which arises with variations in cohort size. The efficient estimator is achieved by weighting each observation by the square root of the cohort size (or any other appropriate weight), as validated by Deaton 1985.

With Deaton's synthetic panel approach, one can adopt any method allowed with the genuine panel data, such as the fixed effects or the random effects methods, with the latter being more efficient since it utilises both the within- and between-group variations; however, it implies a strong assumption of no correlation between explanatory and unobserved variables. Mundlak 1978 suggested a technique justifying the use of the random effects model in situations when one might expect endogeneity. Mundlak's correlated random effects model is essentially the random effects model with added group (cohort) means of the variable(s) which are believed to be endogenous, varying within the group and over time. This 'within-between' estimator is based on the decomposition of the unobserved component from the model (2) as:

$$c_i = \psi + \bar{\boldsymbol{x}}_{\boldsymbol{i}}\boldsymbol{\xi} + a_i, E(a_i|\boldsymbol{x_i}) = 0, \tag{5}$$

which includes correlated (with explanatory variable(s)) and uncorrelated components. Further, substituting equation (5) into the wage equation (2) allows one to reach strict exogeneity:

$$E(y_{it}|\boldsymbol{x_i}) = E(y_{it}|\boldsymbol{x_{it}},\bar{\boldsymbol{x}}_{\boldsymbol{i}}) = \boldsymbol{x_{it}}\boldsymbol{\beta} + \psi + \bar{\boldsymbol{x}}_{\boldsymbol{i}}\boldsymbol{\xi}, t = 1,...T \tag{6}$$

In addition, the degree of statistical significance of the group-mean estimates serves as a test for endogeneity (Mundlak test).

Over the last few decades, a variety of empirical studies have appeared that attempt to establish the causal effect of schooling on earnings. In his famous review of the studies evaluating the returns to schooling in a number of developed countries' databases, Card 2001 implied the returns to schooling found from these studies to be around 7% for OLS estimations and around 9% for instrumental variables (IV) estimations. Overall, the studies employing quasi-experimental designs tend to find higher returns compared with OLS estimations: "average returns to schooling from simple regression methods are around 6%

internationally but over 9% from these alternative methods" (Harmon and Walker 2001, p. 6). This seems not to be the case for pseudo-panel estimations, where the empirical results worldwide are mixed with pseudo-panel models providing both higher and lower outcomes than OLS. However, overall, examinations in developing countries generally show somewhat higher returns coefficients, probably reflecting diminishing returns to education due to the accumulation of human capital in advanced economies as the average level of schooling grows (Psacharopoulos and Patrinos 2004, Patrinos and Psacharopoulos 2020), though some studies reject this (Peet et al. 2015).

In the Soviet and post-Soviet economies, research studies on the returns to schooling have been limited. As Fleisher et al. 2005 remark, prior to the late 1980s reforms, the returns in the USSR were less than 5%, which is explained by the "wage compression imposed by the [wage] grids" (ibid., p. 352), as compatible with the communist ideology of equality and the favouritism of the working class. Kapelyushnikov (2008) reports even lower estimates - at least by the end of the Soviet era, returns to schooling were not more than 1-2%. However, this changed in the post-reform period. According to Fleisher et al. 2005, returns in transition economies tended "to rise almost immediately following reform, albeit at different speeds" (p. 352). There is very little empirical evidence pertaining to Kazakhstan in this regard. Barro and Lee (2010) estimated the rate of returns for an additional year of schooling worldwide, finding it to be a little more than 8% for 'Europe and Central Asia'. Arabsheibani and Mussurov (2007) - having used OLS and IV methodologies (with spouse education and smoking habits as instruments) - indicated that the returns to schooling in Kazakhstan have increased with the transition, with OLS estimations of 8% for men and 11.5% for women and 2SLS estimations of 11% for married men and 13.7% for married women[4].

The debate in Labour Economics with regard to this topic has given rise to a number of hypotheses, among which the 'sheepskin effect' might be considered as potentially promising for testing in Kazakhstan, where the current post-Soviet education system has been widely criticised by society as adding little value in terms of human capital productivity due to overall low-profile staff, outdated content and learning facilities, and poor links to industry. The concept suggests that completing a degree provides better returns than the same years of schooling with no degree awarded (Hungerford and Solon 1987) and echoes the signalling theory, indicating education's filtering and signalling role: in a market of asymmetric information with employers having limited access to information on potential employees and no opportunity to conduct formal tests for productivity, they can only rely on information regarding their level of education as a signal of potential productivity. This, in turn, is the main channel leading from education to the labour market returns rather than the value added by education (Spence 1973, Arrow 1973, Stiglitz

[4]The study employs the same data from the Household Budget Survey, but for 2001 only.

1975). Unfortunately, the quality of the data restricts a possibility to test the sheepskin effect directly, as I do not observe years of schooling but the level of education attained, as explained in the following section.

2.3 Data and descriptive statistics

The study analyses the Household Budget Survey data from the Kazakhstan Committee on Statistics for 2002-2016. The methodology of the survey, first introduced in 2002, has changed several times. Before 2011, monthly data were recorded, whilst after 2011 the survey has been conducted on a quarterly basis. To achieve comparability, the data for 2002-2010 have been aggregated to a quarterly level. According to the current methodology (*CSRK* 2015), the survey is designed in the form of rotating repeated cross-sections with one-third of the 12,000 participating households being replaced at the end of each year[5].

A two-stage stratified random sample design has been adopted for sampling. In the first stage, the population is stratified into 30 strata representing the country's 14 provinces ('*oblasts*') with urban and rural places of residence, and the two biggest cities (the current capital and the previous capital, the latter of which still remains the main financial and business centre in the country) considered separately. 400 territorial units are selected as the primary sampling units (PSUs) with a probability proportional to the stratum size (number of households per stratum). In the second stage, 30 households per PSU are randomly selected for interview from a register of dwellings; the distribution of the PSU by strata is found in Appendix A.1).

In some years, the sample consists of fewer observations (2006, 2007, 2008 and 2010). The final dataset used for estimations is the pooled quarterly data comprising of 588,100 employee-individuals. Unemployed, economically inactive, self-employed and employee-respondents having reached the official state retirement age (63 for men and 58 for women) were filtering off in order to ensure accuracy and better comparability.

The survey consists of questions about employment, household spending and savings, and individual incomes. The question regarding employment changes in 2015: before 2015, the respondents were asked if they had worked for at least one hour during the past seven days and received monetary payment or payment in kind, which allowed them to be considered as employed in accordance with the ILO approach; from 2015 onwards, they have been asked if they have worked at least one hour in the past 30 days. Whether or not both questions may cause inaccuracy is open to question, as no data on hours worked by the individual are recorded. By using wage data aggregated quarterly (not hourly) and with no information on full- or part-time employment, I violate two conditions set by

[5]There are fewer observations appearing in the sample in some years.

Griliches. He suggested, "to use wage rates per hour or week" with the "data on people who have been full-time in the labor market" while estimating wage equation (Griliches 1977, p. 3). Thus, additional caution is required in interpreting schooling and experience estimates.

According to the Committee on Statistics data, part-time employees currently comprise 9.3% of all employees in Kazakhstan: 7.2% for men and 11.6% for women. Part-time employment is more common in rural areas for both genders: 11.1% versus 4.1% (men) and 16.2% versus 8.5% (women). This suggests that with no data on actual hours worked, the estimates for the returns to schooling might be particularly biased for women and rural area residents.

The dependent variable in all models is the natural logarithm of the real wage from employment; thus, other earnings (income from self-employment, benefits, property income and other incomes) are excluded from the analysis. Wages for 2003-2016 are adjusted by the CPI officially reported by the Committee on Statistics, with 2002 as the base year.

Schooling is a derivative variable transformed from the levels of education attained that are recorded in the survey[6], as shown by table 2.1.

[6]The coding for level of education attained in the original dataset changed in 2011, where the coding introduced in 2011 is presented in the text. Before 2011, there was no Master's degree recorded separately, while TVET was classified into two groups: 'initial vocational training' requiring a minimum of 11 years of schooling, and 'secondary vocational education', requiring a minimum of 12 years of schooling.

Table 2.1: Schooling variable and corresponding levels of education

Schooling	**Corresponding level of education**	**Notes**
0	no education	
4	primary education	Four years of compulsory schooling (from the age of 6-7).
9	basic secondary education	Nine years of compulsory schooling.
11	general secondary education and TVET	Nine years of compulsory schooling plus either two years of university-preparatory secondary school or two-three years of specialised technical and vocational training.
15	higher education	11 years of secondary schooling plus a Bachelor's or 'specialist' degree requiring a minimum duration of four years.
16	postgraduate education (Master's degree)	(1) One-year professional Master's degree or (2) Two-year research Master's degree.
18	academic degree ('*uchenaya stepen*')	(1) PhD or (2) 'Candidate of Science' and 'Doctor of Science' degrees from the previously existing Soviet system[a].
Notes: schooling is the minimum number of years required to obtain the relevant level of education.		

[a]'Candidate of Science' degree was a research degree accessible upon completion of the analogue of the Bachelor's degree ('specialist'), requiring a minimum of three years of training and research; the 'Doctor of Science' degree required additional three years of research work.

Therefore, with the given variable, I estimate the returns to credentials rather than the returns to schooling, albeit with its average rate, accepting that, as Harmon and Walker note from comparison between returns to schooling (linear specification) and returns to credentials (with nonlinearities between completion of different qualification assumed) computed for the same sample of individuals, "a linear form seems to be a reasonable approximation" (Harmon and Walker 2001, p. 31).

Summary statistics for the sample, as divided by gender, is reported by table 2.2. The following figures demonstrate summary statistics on gender subsamples and shed some light on the character of employment dissimilarities between the genders.

Table 2.2: Descriptive statistics, pooled individual-level data

Variable	**Male subsample, N=305,990**	**Female subsample, N=282,110**
Schooling:		
min.:	0.00	0.00
median:	11.00	12.00
mean:	11.95	12.57
max.:	18.00	18.00
Age:		
min.:	16.0	16.00
median:	40.0	39.00
mean:	39.6	38.98
max.:	62.0	57.00
Log nominal quarterly wage:		
min.:	6.11	5.70
median:	11.70	11.42
mean:	11.52	11.30
max.:	14.96	14.41
Log real quarterly wage (adjusted by CPI, base year – 2002):		
min.:	5.98	5.55
median:	11.13	10.90
mean:	11.05	10.81
max.:	14.22	13.80
Number of observations:		
Region:		
metropolis:	34,817	36,845
central:	70,566	68,526
north:	52,539	50,817
south:	84,764	69,909
west:	63,304	56,013
Residence:		
urban:	161,414	164,922
rural:	144,576	117,188
Sector of employment:		
public:	85,930	155,401
private:	220,060	126,709

Figure 2.3: Proportions of the respondents by attained level of education in corresponding year

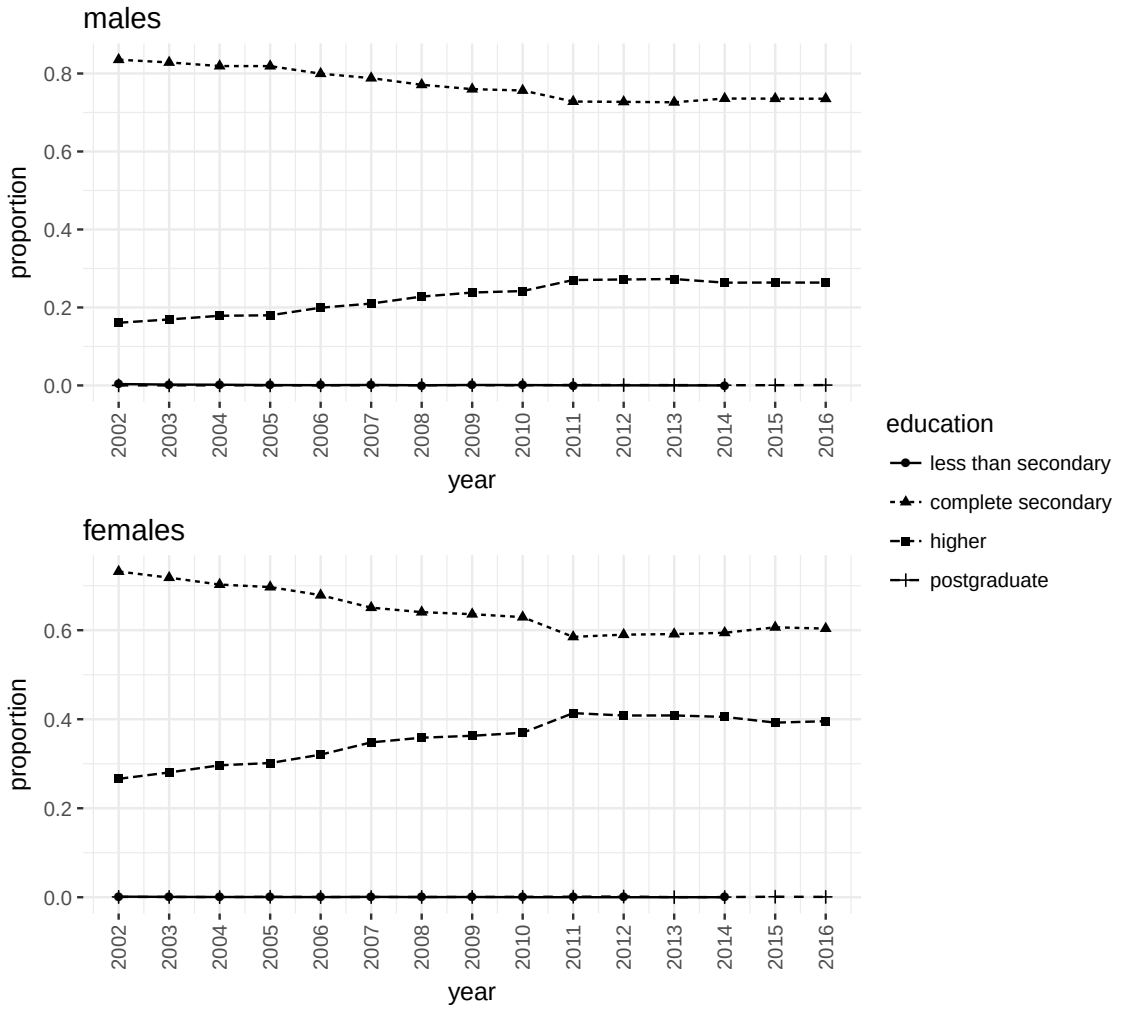
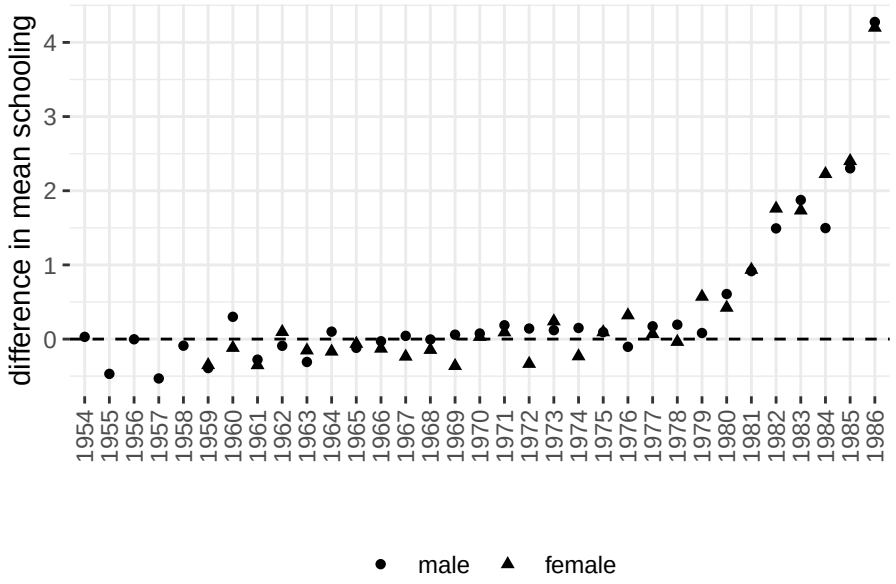


Figure 2.3 describes the distribution of the respondents' highest attained levels of education combined in four wider groups by year of observation. The group 'less than secondary' corresponds to the respondents with reported 'no education' and 'primary education' as per the table 2.1, 'complete secondary' includes both 'basic secondary' and 'general secondary education and TVET', while 'postgraduate' includes both groups with education above higher education. For both genders, the majority of respondents had attained a general secondary education or TVET. The share of respondents with a degree in higher education grew until 2011 and was consistently higher for females each year (mean of schooling in the pooled data is 0.62 years higher for females than males). This corresponds to the official aggregated statistics reporting the share of people having attained at least a degree in higher education as comprising 35.7% of the employed population in 2016 (31.7% and 40.3% for men and women, respectively) (*CSRK* 2017). However, these across-year changes are likely due to increased participation of the relatively younger cohorts (those

whose school-leaving age fell in the post-Soviet era – i.e., born in the mid-1970s and later). This can be seen from the tables showing the higher education rate computed as the share of respondents with this level of education in the total number of respondents for each cohort separately, as shown in Appendices A.2-A.3 [7]. Additionally, I show a more informative plot of the difference in the mean years of schooling between 2016 and 2002 for each cohort and gender - figure 2.4. Regardless of gender, there seems to be a systematic increase in the cohorts' average schooling across the years (positive difference) for those younger cohorts. This might be endogenous in the sense that it is possibly related to unobserved characteristics or labour market conditions driving these cohorts back into education possibly being correlated with their education and/or wages. These effects could be either reinforced or fully driven by the increased access to education, in particular, by the soaring access to the distance-learning programmes observed over the period analysed. The number of people with no schooling and with postgraduate degrees (including academic degrees) is very low for both subsamples, respectively.

Figure 2.4: Difference in the mean years of schooling between 2016 and 2002 for each cohort and gender



[7] I can not show such tables for technical and vocational education because of the changes in the levels of education recorded in the data over years – from 2011 onwards general secondary education and TVET are combined into one group.

Figure 2.5: Proportions of the respondents employed by the private sector in the corresponding year

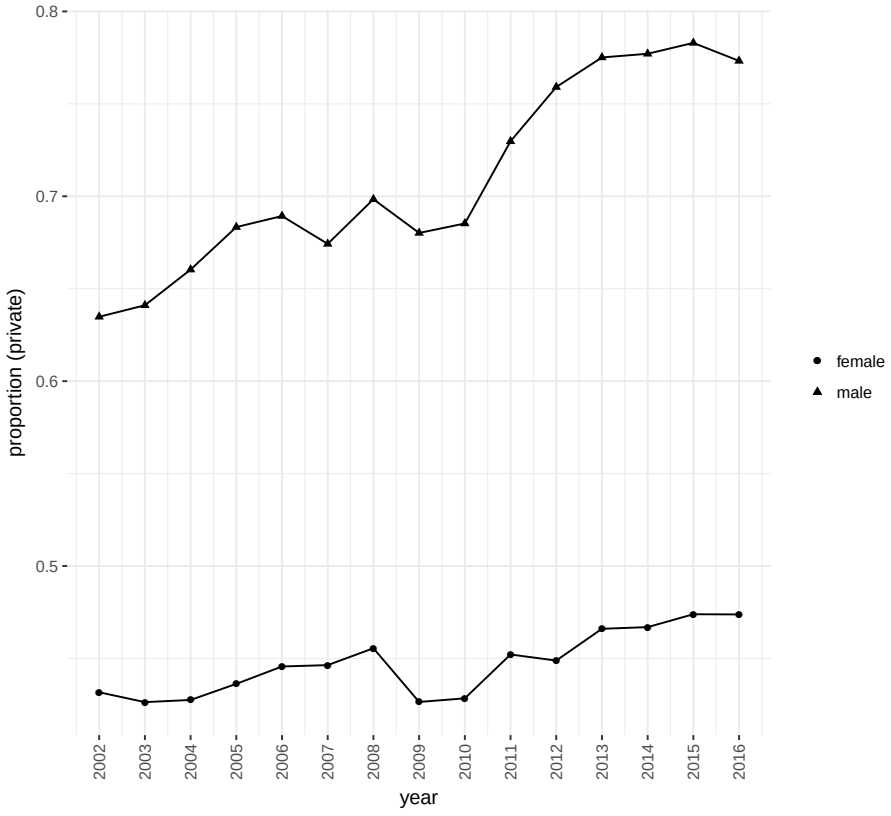
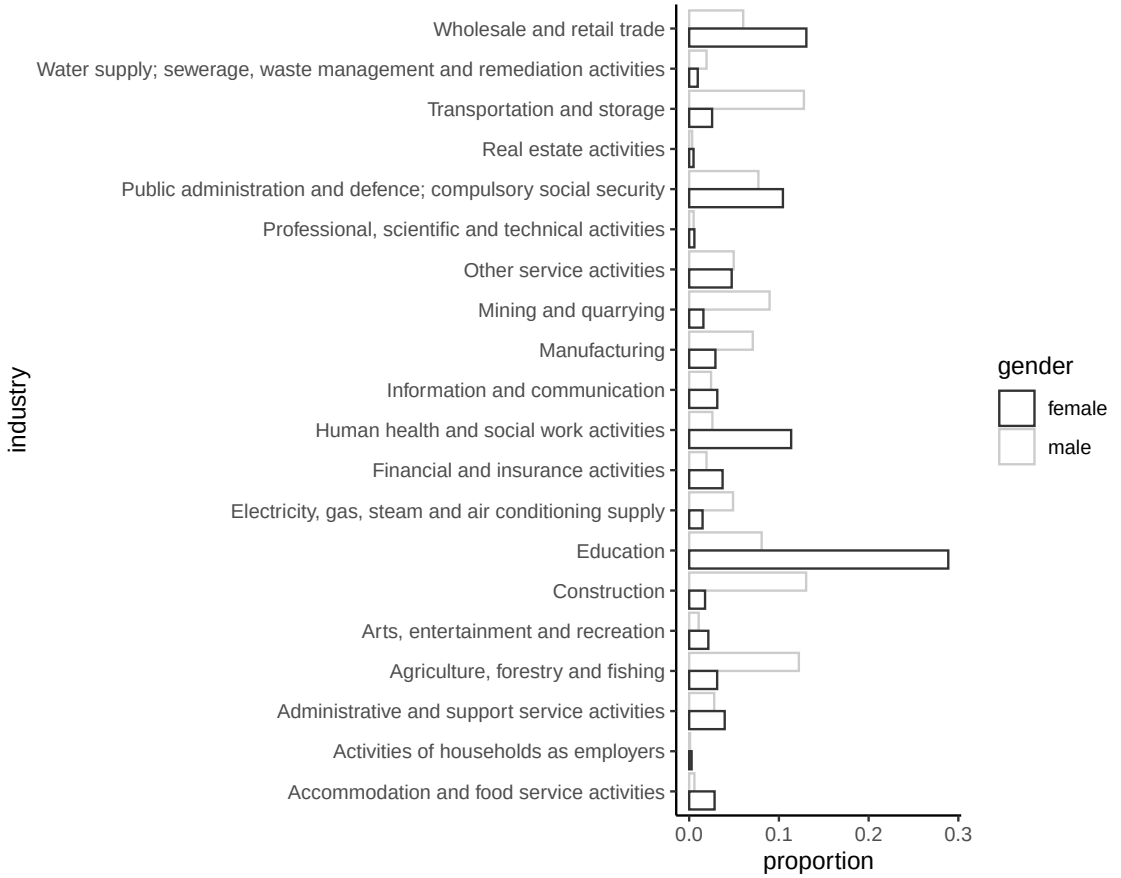


Figure 2.6: Distribution of 2011-2016 respondents by industry



As can be seen from figure 2.5, men are mostly employed by the private sector and the share of such increases over time, while women are approximately evenly distributed between public and private sector employment. It is noticeable that females' employment by sector is almost static. This is also reflected in the industry of employment (more precisely, the 'type of economic activity', which I further refer to as an 'industry'), with plot 2.6 showing the number of employees in different industries built for respondents for 2011-2016 only, since the earlier data does not record industry. Leading industries for male workers are those with primarily private ownership (construction, transportation, mining and quarrying, agriculture), while nearly 30% of working females in the sample are employed in education (with the majority in public secondary education).

Figures 2.7-2.11 document average real wages by the respondents' selected characteristics used as explanatory variables in different specifications, as separately computed from the pooled data for each gender. Region is aggregated into four geographical groups and the 'metropolis' category, which includes the two largest cities having the highest wages, followed by the western regions specialising on oil and gas exports. Sector of employment

is derived from the categories listed in the questionnaire: 'private company employee', 'farm-worker' and 'those employed by individuals', the latter group mainly consisting of shadow (informal) sector wage-earners - combined into the 'private sector', and 'public company employee' comprising the 'public sector'. As seen from figure 2.7, higher educational attainments consistently provide higher wages, on average. Excluding the highest and lowest levels of education (which both have very few observations), the log transformed average real wages demonstrate a somewhat parallel pattern for the two largest groups in each of the genders. There is a gender gap in almost every category for every variable observed.

Figure 2.7: Log mean real wages by attained level of education and year

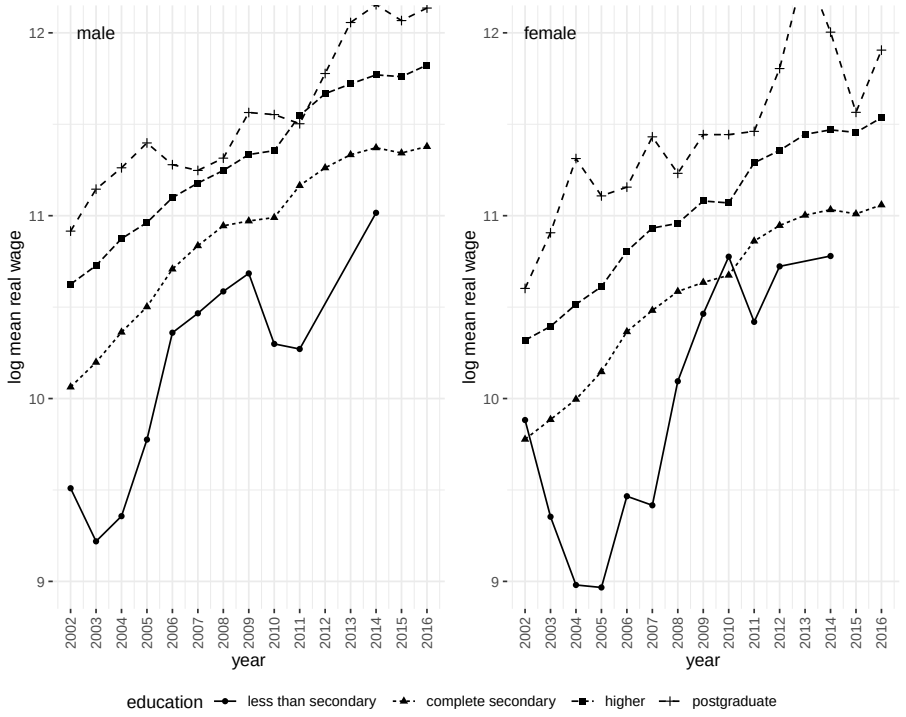


Figure 2.8: Log mean real wages by region and year

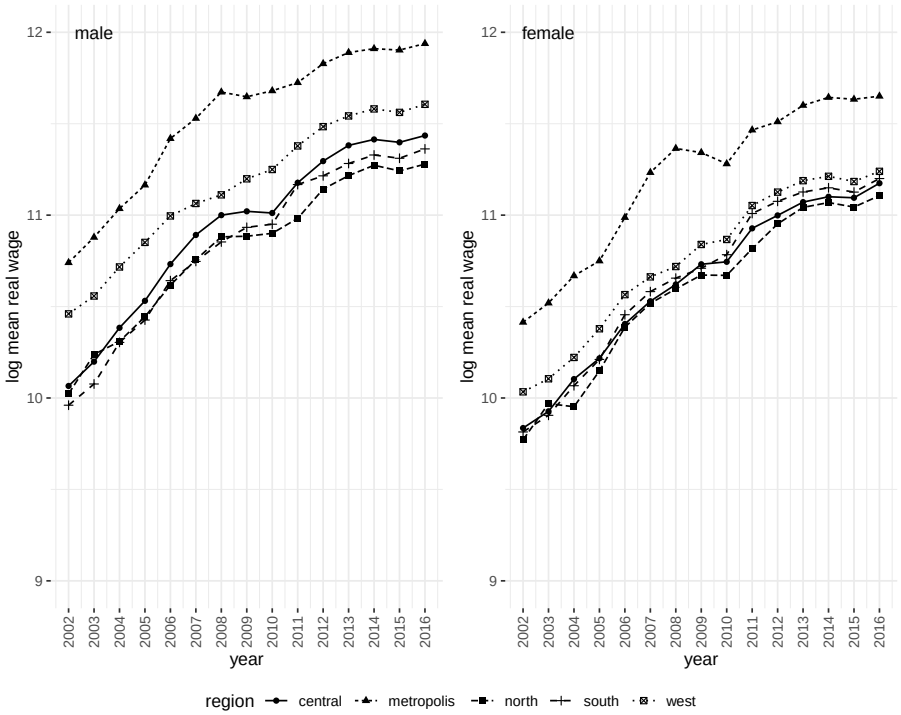


Figure 2.9: Log mean real wages by residence and year

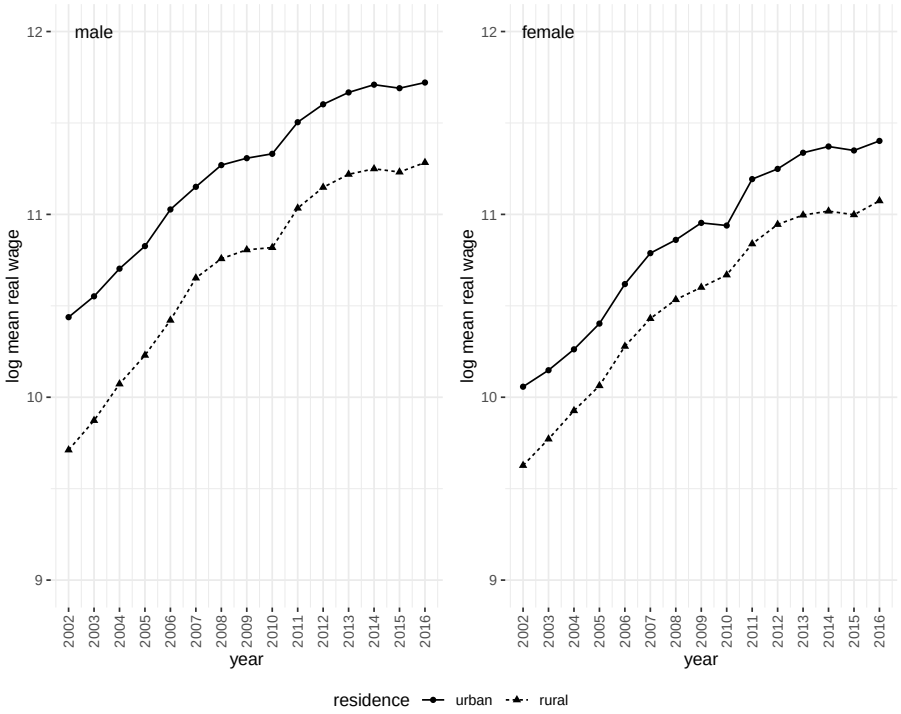


Figure 2.10: Log mean real wages by sector of employment and year

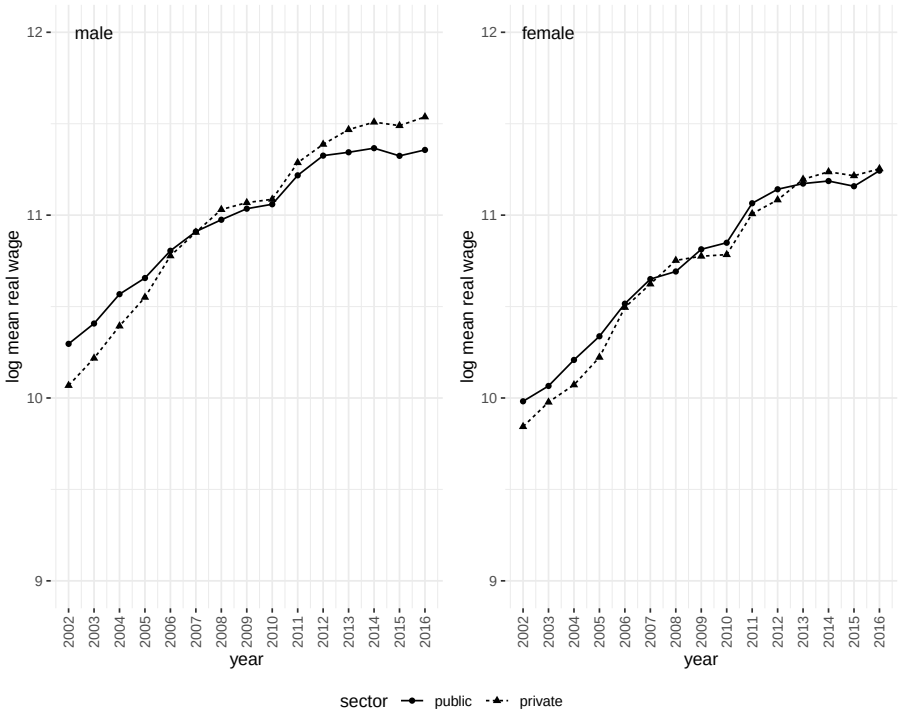
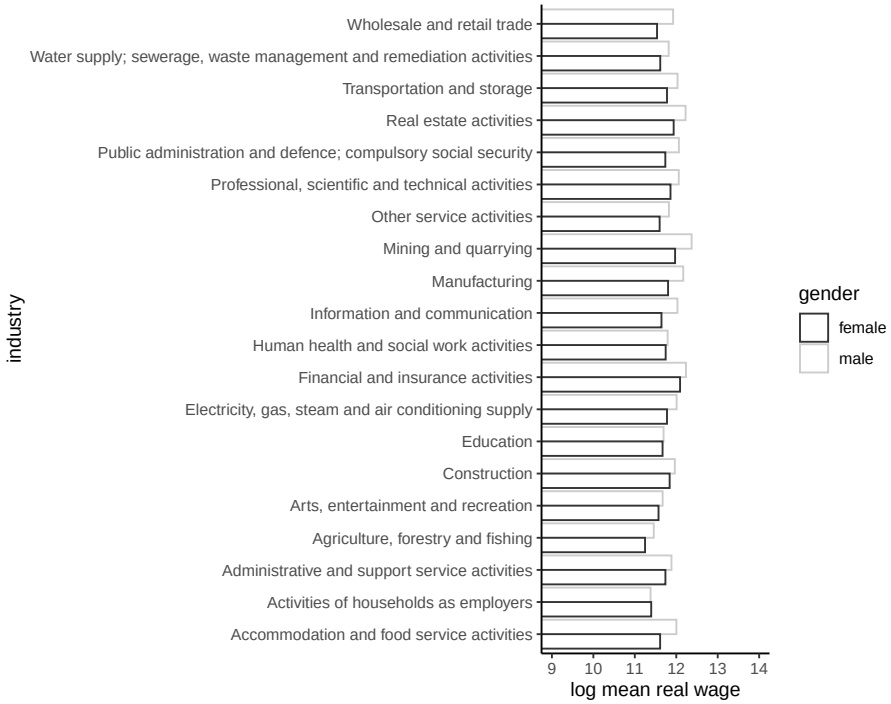


Figure 2.11: Log mean real wages by industry, pooled data, 2011-2016



It should be stressed that although region, residence, and the sector of employment are used as the additional covariates, they be problematic in this regard since any or all of them might be endogenous, that is, correlated with various unobservable factors affecting both education and wage. It is reasonable to expect better-educated people to choose urban residences and regions associated with higher incomes as well as the more profitable sector of employment in Kazakhstan, especially for younger people and males since they are likely more mobile. In other words, these control variables might rather represent mediators (intermediate outcomes) which themselves might be a result of possible differences across the population with different levels of education attained, resulting in bias in schooling coefficients. Therefore, I report specifications with no control variables and with control variables introduced step-by-step in all regression models.

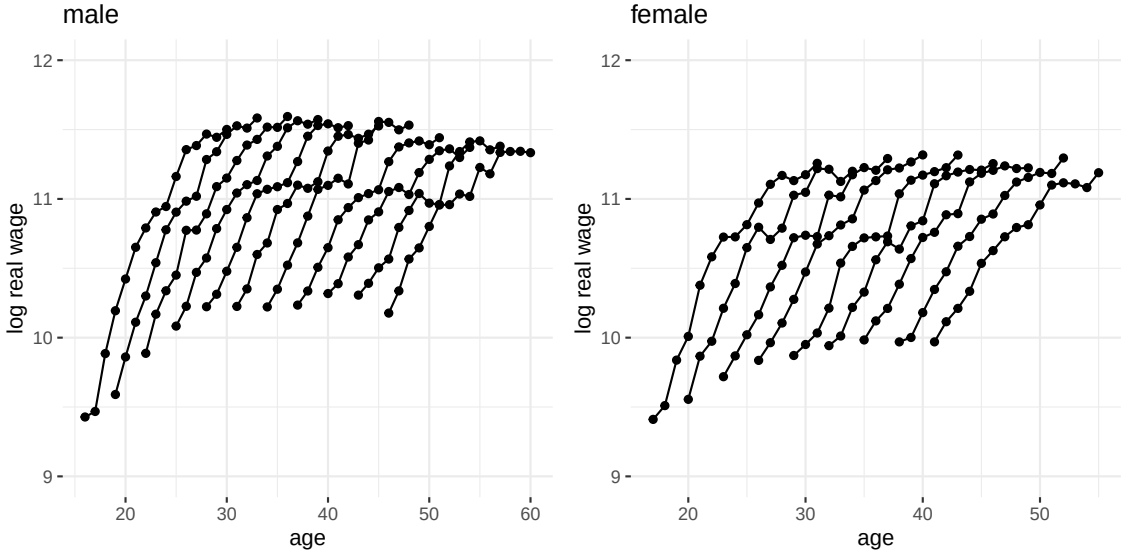
The pseudo-panel was designed from individual data based on the respondents' recorded years of birth and gender. The youngest and oldest cohorts are dropped due to either having only a few or no observations for the particular year(s). The final cohorts are:

- Male cohorts: 1954-1986, one per each year of birth;
- Female cohorts: 1959-1986, one per each year of birth.

The final number of cohorts is 61 (33 male cohorts and 28 female cohorts). The cohort size is sufficiently large, with mean numbers of observations of 9,272 and 10,075 per cohort for the male and female cohorts, respectively, and smallest cohort sizes of 6,352 (male) and 7,156 (female) – see Appendices A.4-A.5. However, the size of the cohort varies substantially over the years, therefore, in accordance with Deaton's approach, observations are weighted in the pseudo-panel data by the square root of the corresponding cohort size in any given year of observation.

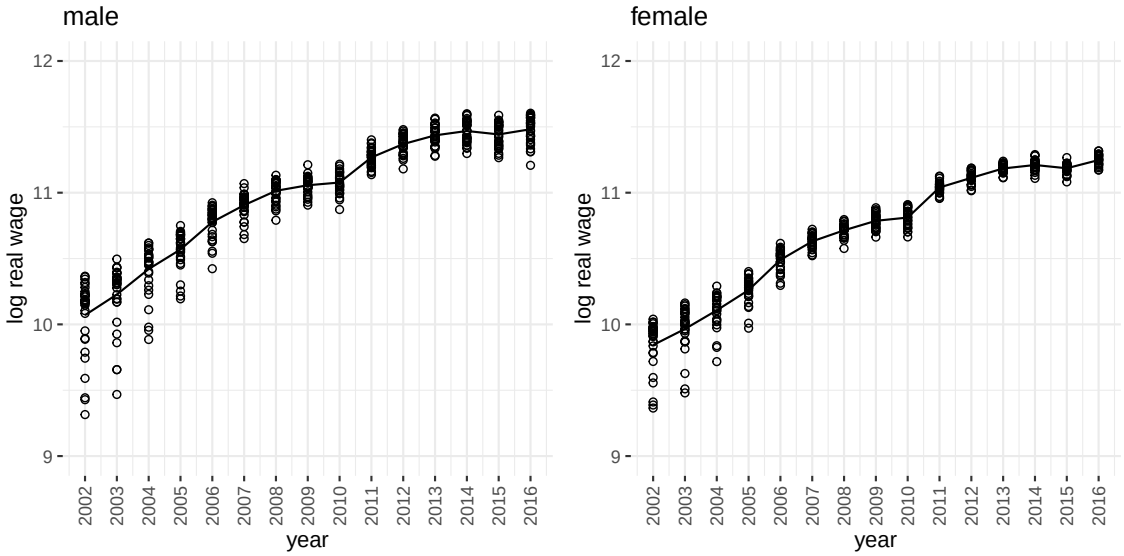
Descriptive statistics on cohort data are given in Appendices A.6 and A.7. Figure 2.12 demonstrates the decomposition of real wages by cohort. Each line represents the evolution of the particular cohort's mean real wages over time; every third cohort is plotted to keep the plot less 'busy'.

Figure 2.12: Decomposition of log real wages by cohort and age effect, for every third cohort



As surmised, the youngest cohorts earn the lowest wages, and the age-wage profile has a somewhat inverted U-shape for both males and females. The picture additionally reflects the recessions of 2009 and 2015 due to the world market commodity bust when all cohorts' real wages dropped slightly. This is also evident from figure 2.13, which shows the year effect, where each dot represents the cohort's mean real wage observed in each year and the line represents the mean of each year's means.

Figure 2.13: Decomposition of log real wages by cohort, year effect



When estimating models, I follow three slightly different approaches. First, I start with

the basic OLS models which do not control for the cohort effect and which, therefore, likely suffer from omitted variable bias. Considering the long series of the repeated cross sections, I further concentrate on the first and the final years and elaborate on the changes that took place over the period in question by decomposing the wage equation using the Blinder-Oaxaca technique. This allows to observe the year effects and, further, I additionally focus on the gender differences in the returns to schooling computed from the individual data. Second, I estimate the fixed effects and the Mundlak random effects models on the pseudo-panel data with cohort means treated as individual observations. Finally, to grasp the returns' variations across cohorts I estimate the OLS model, separately controlling for cohort dummies and their interaction with schooling for individual gender subsamples.

2.4 Outcomes and discussion

2.4.1 Year effects

Tables 2.3-2.4 report the outcomes of the basic Mincer model computed from the pooled individual data with additional control variables introduced step-by-step, separately, for each gender. The returns to additional year of schooling vary from 7.75% to 11.50% for men and from 10.12% to 12.73% for women, depending on specification.

Table 2.3: Returns to schooling estimated on pooled individual data by OLS, men

	Dependent variable:			
	log real wage			
	(1)	(2)	(3)	(4)
schooling	0.109***	0.091***	0.075***	0.075***
	(0.001)	(0.001)	(0.001)	(0.001)
age	0.06257***	0.06363***	0.06454***	0.06457***
	(0.001)	(0.001)	(0.001)	(0.001)
age squared	-0.00076***	–0.00077***	–0.00078***	-0.00078***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
central		-0.461***	-0.307***	-0.307***
		(0.004)	(0.004)	(0.004)
north		-0.577***	-0.387***	-0.387***
		(0.004)	(0.004)	(0.004)
south		-0.575***	-0.335***	-0.335***
		(0.003)	(0.004)	(0.004)
west		-0.261***	-0.079***	-0.079***
		(0.004)	(0.004)	(0.004)
rural			-0.395***	-0.395***
			(0.002)	(0.002)
private				0.003
				(0.002)
constant	7.680***	8.299***	8.452***	8.447***
	(0.020)	(0.019)	(0.019)	(0.019)
F Statistic	9849.2***	10472***	11590***	11178***
N	305,990	305,990	305,990	305,990
Adj. R2	0.385	0.437	0.486	0.486
year dummies	yes	yes	yes	yes
Joint significance of year dummies:				
Wald chi2	132253.4***	128566.2***	153383.3***	150551.9***
F test	9446.7***	9183.3***	10956***	10754***

Notes: (1) OLS computed in R. HC1 robust standard errors computed with 'sandwich' package (Zeileis 2004) in parentheses. Wald statistics computed with 'aod' package (Lesnoff et al. 2012).
(2) Reference categories: metropolis (region); urban (residence); public (sector).
*p<0.1; **p<0.05; ***p<0.01

Table 2.4: Returns to schooling estimated on pooled individual data by OLS, women

	Dependent variable:			
	log real wage			
	(1)	(2)	(3)	(4)
schooling	0.120***	0.106***	0.099***	0.096***
	(0.001)	(0.001)	(0.001)	(0.001)
age	0.03445***	0.03662***	0.03733***	0.03676***
	(0.001)	(0.001)	(0.001)	(0.001)
age squared	-0.00037***	-0.00039***	-0.00040***	-0.00039***
central		-0.442***	-0.374***	-0.379***
		(0.004)	(0.004)	(0.004)
north		-0.483***	-0.394***	-0.400***
		(0.004)	(0.005)	(0.005)
south		-0.440***	-0.330***	-0.340***
		(0.004)	(0.004)	(0.004)
west		-0.332***	-0.248***	-0.256***
		(0.004)	(0.004)	(0.004)
rural			-0.198***	-0.205***
			(0.002)	(0.002)
private				-0.034***
				(0.002)
constant	7.727***	8.228***	8.288***	8.351***
	(0.022)	(0.022)	(0.022)	(0.022)
F Statistic	10906***	10384***	10579***	10139***
N	282,110	282,110	282,110	282,110
Adj. R2	0.417	0.453	0.466	0.466
year dummies	yes	yes	yes	yes
Joint significance of year dummies:				
Wald chi2	121185.1***	121269.3***	129101.9***	129086.0***
F test	8656.1***	8662.1***	9221.6***	9220.4***

Notes: (1) OLS computed in R. HC1 robust standard errors computed with 'sandwich' package (Zeileis 2004) in parentheses. Wald statistics computed with 'aod' package (Lesnoff et al. 2012).
(2) Reference categories: metropolis (region); urban (residence); public (sector).
*p<0.1; **p<0.05; ***p<0.01

To examine the year dynamic, the same models are estimated for each year's sub-samples independently. Tables 2.5-2.6 document detailed outcomes for the first and the final years for men and women, respectively, while Appendix A.8 details the descriptive

statistics for these two years' subsamples.

Table 2.5: Returns to schooling estimated on individual data for 2002 and 2016, men

	Dependent variable:							
	log real wage							
	(1)		(2)		(3)		(4)	
	2002	2016	2002	2016	2002	2016	2002	2016
schooling	0.147***	0.108***	0.129***	0.090***	0.106***	0.077***	0.101***	0.085***
	(0.004)	(0.002)	(0.004)	(0.002)	(0.003)	(0.002)	(0.004)	(0.002)
age	0.112***	0.045***	0.116***	0.040***	0.115***	0.044***	0.113***	0.045***
	(0.006)	(0.004)	(0.006)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
age squared	-0.002***	-0.001***	-0.002***	-0.001***	-0.002***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
central			-0.566***	-0.359***	-0.396***	-0.225***	-0.398***	-0.212***
			(0.019)	(0.011)	(0.018)	(0.012)	(0.019)	(0.012)
north			-0.625***	-0.504***	-0.384***	-0.345***	-0.397***	-0.329***
			(0.020)	(0.012)	(0.020)	(0.012)	(0.020)	(0.012)
south			-0.681***	-0.472***	-0.351***	-0.298***	-0.367***	-0.265***
			(0.017)	(0.010)	(0.018)	(0.011)	(0.018)	(0.011)
west			-0.212***	-0.230***	-0.014	-0.082***	-0.032	-0.073***
			(0.023)	(0.011)	(0.022)	(0.012)	(0.022)	(0.012)
rural					-0.603***	-0.293***	-0.599***	-0.270***
					(0.012)	(0.007)	(0.012)	(0.007)
private							-0.085***	0.161***
							(0.011)	(0.007)
constant	6.439***	9.365***	7.101***	10.018***	7.379***	10.076***	7.540***	9.817***
	(0.100)	(0.091)	(0.097)	(0.089)	(0.094)	(0.087)	(0.097)	(0.087)
F Statistic	830.6***	1372.1***	683.59***	1064.5***	918.72***	1142.6***	831.7***	1082.4***
N	18,999	25,225	18,999	25,225	18,999	25,225	18,999	25,225
Adj. R2	0.118	0.138	0.185	0.211	0.283	0.262	0.285	0.274

Notes: (1) OLS computed in R. HC1 robust standard errors computed with 'sandwich' package (Zeileis 2004) in parentheses.
(2) Reference categories: metropolis (region); urban (residence); public (sector)
*p<0.1; **p<0.05; ***p<0.01

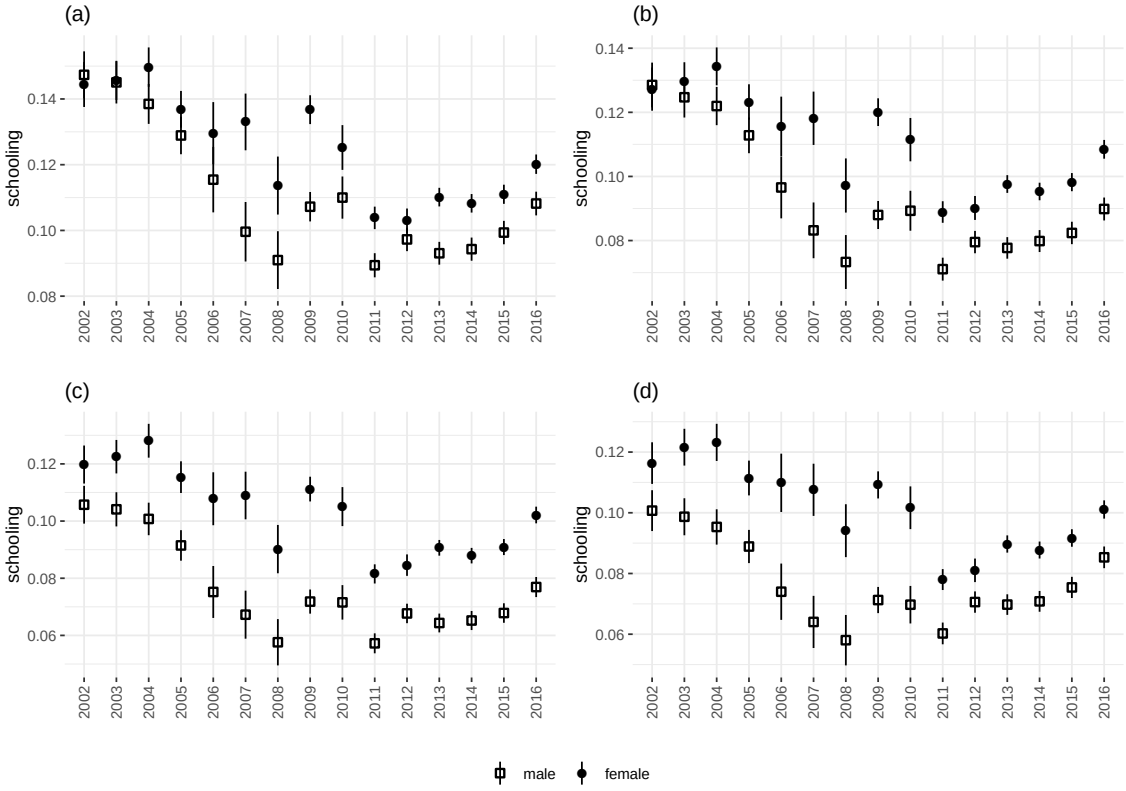
Table 2.6: Returns to schooling estimated on individual data for 2002 and 2016, women

	Dependent variable:							
	log real wage							
	(1)		(2)		(3)		(4)	
	2002	2016	2002	2016	2002	2016	2002	2016
schooling	0.144***	0.120***	0.127***	0.108***	0.120***	0.102***	0.116***	0.101***
	(0.004)	(0.001)	(0.004)	(0.001)	(0.004)	(0.001)	(0.004)	(0.002)
age	0.032***	0.040***	0.042***	0.036***	0.039***	0.039***	0.037***	0.039***
	(0.008)	(0.005)	(0.008)	(0.004)	(0.008)	(0.004)	(0.008)	(0.004)
age squared	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
central			-0.490***	-0.345***	-0.426***	-0.267***	-0.427***	-0.271***
			(0.021)	(0.011)	(0.021)	(0.011)	(0.021)	(0.011)
north			-0.540***	-0.382***	-0.432***	-0.292***	-0.435***	-0.296***
			(0.022)	(0.011)	(0.023)	(0.011)	(0.023)	(0.012)
south			-0.513***	-0.363***	-0.362***	-0.259***	-0.370***	-0.265***
			(0.020)	(0.010)	(0.021)	(0.010)	(0.021)	(0.011)
west			-0.313***	-0.296***	-0.231***	-0.207***	-0.242***	-0.212***
			(0.024)	(0.010)	(0.024)	(0.011)	(0.024)	(0.011)
rural					-0.300***	-0.180***	-0.305***	-0.184***
					(0.013)	(0.006)	(0.013)	(0.006)
private							-0.049***	-0.017***
							(0.013)	(0.006)
constant	7.461***	8.842***	7.917***	9.370***	8.056***	9.388***	8.158***	9.425***
	(0.127)	(0.102)	(0.122)	(0.098)	(0.121)	(0.097)	(0.125)	(0.098)
F Statistic	568.85***	2183.9***	394.96***	1127.6***	429.56***	1142.6***	386.86***	1003.1***
N	14,714	24,972	14,714	24,972	14,714	24,972	14,714	24,972
Adj. R2	0.122	0.204	0.172	0.254	0.200	0.277	0.201	0.278

Notes: (1) OLS computed in R. HC1 robust standard errors computed with 'sandwich' package (Zeileis 2004) in parentheses.
(2) Reference categories: metropolis (region); urban (residence); public (sector)
*p<0.1; **p<0.05; ***p<0.01

For both genders, regional and residency disparities have mitigated over the analysed period, and employment in the private sector has become more lucrative, especially for men. The returns to schooling decreased over the analysed period for both genders, though the difference in the returns' estimates in 2016 versus 2002 is slightly larger for men. This is also seen from figure 2.14, which plots the schooling coefficients with their confidence intervals extracted from the each year's subsamples' models. To test if the difference is statistically significant, I run the models for the pooled data with an interaction between schooling and year (reported in Appendices A.9-A.10) separately for each gender, and found them to vary between -4.23 p.p. and -5.28 p.p. for men and between -2.43 p.p. and -2.71 p.p. for women. For comparison, the differences in real wages in 2016 compared to

Figure 2.14: Returns to schooling with 95% confidence intervals independently computed for each year of observation from models with schooling, age, age squared and: (a) with no additional control variables; (b) region; (c) region and residence; (d) region, residence and sector of employment



2002, as computed from the same models, were 516-610 p.p. and 365-396 p.p. for men and women, respectively. The wages increased dramatically with the oil boom, while the returns to schooling dropped. This might be related to the corresponding increasing trend in years of schooling observed with the descriptive statistics.

Along with this, the returns to age (experience) drop dramatically in males in 2016 compared to 2002, while they are relatively stable for females. A possible explanation for this is the differences in the nature of gender-related employment and oil-boom driven changes in the structure of the country's economy and employment. The returns to experience are usually higher in developed (versus developing) countries with more sophisticated economies, in services (versus goods) production, in cognitive (versus manual) occupations, in the formal (versus informal) sector of employment and in urban (versus rural) areas (Islam et al. 2018). This might suggest a labour force reallocation towards less sophisticated jobs took place over the period under consideration, particularly for men. However, this could not be further tested with the data at hand.

To identify the extent to which the observed characteristics contributed to the change in the real wages of working employees between 2002 and 2016, following Lassibille and

Gomez (1998) I decompose the wage equation with the Blinder-Oaxaca decomposition for these two years for each of the gender subsamples (Blinder 1973, Oaxaca 1973). The decomposition allows to examine which part of the wage difference between the two years can be explained by the changes in covariates and which is unexplained and should be attributed to the "differences in the pay structure" (Lassibille and Gomez 1998, p. 7) or other structural changes over the time period in question. The mean wage difference represents the difference of the log wages between 2016 and 2002, with 2002 being set as the reference year:

$$\Delta log(w) = log(w_{2016}) - log(w_{2002}), \tag{6}$$

and is decomposed with the following formula:

$$\Delta log(w) = \underbrace{(\bar{X}_{2016} - \bar{X}_{2002})\hat{\beta}_{2016}}_{endowments} + \underbrace{\bar{X}_{2002}(\hat{\beta}_{2016} - \hat{\beta}_{2002})}_{pay\ structure}. \tag{7}$$

Variable-by-variable decomposition is estimated with:

$$\underbrace{(\bar{X}_{2016} - \bar{X}_{2002})\hat{\beta}_{2016}}_{endowments} = \underbrace{(\bar{X}_{S_{2016}} - \bar{X}_{S_{2002}})\hat{\beta}_{S_{2016}}}_{schooling} + \underbrace{(\bar{X}_{A_{2016}} - \bar{X}_{A_{2002}})\hat{\beta}_{A_{2016}}}_{age} + ... \tag{8}$$

$$\underbrace{\bar{X}_{2002}(\hat{\beta}_{2016} - \hat{\beta}_{2002})}_{pay\ structure} = \underbrace{\bar{X}_{S_{2002}}(\hat{\beta}_{S_{2016}} - \hat{\beta}_{S_{2002}})}_{schooling} + \underbrace{\bar{X}_{A_{2002}}(\hat{\beta}_{A_{2016}} - \hat{\beta}_{A_{2002}})}_{age} + ... \tag{9}$$

including other covariates.

The results are presented in the tables 2.7-2.8.

Table 2.7: Blinder-Oaxaca decomposition of log real wage differential between 2002 and 2016, men

	Contributions of parameters to log real wage differential		Contribution of parameters as % of total differential	
Parameter	Endowments	Pay structure	Endowments	Pay structure
schooling	0.0260	-0.1883	1.93	-14.00
age	1.1147	-3.0141	82.89	-224.14
age squared	-0.7696	1.5119	-57.23	112.43
central	0.0275	0.0354	2.05	2.63
north	-0.0001	0.0118	0.00	0.88
south	0.0303	0.0198	2.25	1.48
west	0.0003	-0.0144	0.02	-1.07
rural	-0.0330	0.1305	-2.45	9.70
private	0.0299	0.1489	2.22	11.07
constant	0.0000	2.2772	0.00	169.34
total	0.4260	0.9187	31.68	68.32
	1.3447		100.00	
Notes: Blinder-Oaxaca decomposition is computed in R with 'oaxaca' package (Hlavac 2018).				

Table 2.8: Blinder-Oaxaca decomposition of log real wage differential between 2002 and 2016, women

	Contributions of parameters to log real wage differential		Contribution of parameters as % of total differential	
Parameter	Endowments	Pay structure	Endowments	Pay structure
schooling	0.0222	-0.1944	1.68	-14.66
age	1.0810	-0.5957	81.52	-44.92
age squared	-0.6024	0.2190	-45.43	16.52
central	0.0203	0.0353	1.53	2.66
north	0.0041	0.0251	0.31	1.89
south	0.0143	0.0238	1.07	1.80
west	-0.0146	-0.0012	-1.10	-0.09
rural	-0.0088	0.0184	-0.66	1.39
private	0.0035	0.0092	0.27	0.69
constant	0.0000	1.2670	0.00	95.54
total	0.5196	0.8064	39.19	60.81
	1.3261		100.00	
Notes: Blinder-Oaxaca decomposition is computed in R with 'oaxaca' package (ibid.).				

The mean real wage of male employees in 2002 is 10.15 log points, and in 2016 is 11.50 log points. Within the difference of approximately 1.35 log points, only 0.43 log points (or about 32%) is explained by the change in the observed characteristics and 0.91 log points

(or 68%) remains unexplained. Though the log real wages are lower for females for both years (9.92 in 2002 and 11.25 in 2016), the cross year difference is nearly identical at 1.33 log points, but the model turned out to be slightly more powerful in terms of explaining the coefficients dynamic, as almost 40% of the difference is explained. The main contributor to the unexplained part for both genders is the constant term, which likely picks up the oil boom-driven differences in economic conditions over time. Among the observed employees' characteristics, the age in both linear and quadratic terms contributes the most, which is also shown by the variable-by-variable decomposition of the unexplained differentials plotted in figures 2.15-2.16, which might be partially attributed to the observed difference in the age between year subsamples for each gender (average age in 2002 is 34 versus 45 in 2016 for males and 33 versus 44 for females - see Appendix A.8). However, a more interesting and meaningful pattern appears with the schooling coefficient's unexplained part. Since the 2016 sample is more educated (mean of schooling is 11.96 for males and 12.53 for females versus 11.74 and 12.37 in 2002, respectively), the returns to schooling contribute to the observed wage differentials. At the same time, taking 2002 as a baseline year, schooling is significantly 'underestimated' in 2016 for both genders. Other coefficients (except for west region residency) have different patterns. For example, employment in the private sector provided a higher wage premium for men in 2016 than it was otherwise 'expected' to provide, accounting for the difference across years which is likely to be explained by structural changes in the economy during the same period. On the other hand, the interpretation of the nominal variables (region, residence or sector) coefficients' unexplained portion might be biased and meaningless (Jann 2008, p. 461), unlike those for schooling and age having a natural zero point.

2.4.2 Gender effects

If anything, the results presented above reveal systematically higher returns to schooling for females, which are additionally shown in the models run using the pooled data with the schooling-gender interaction term included, as performed as a robustness exercise (Appendix A.11). Male respondents earn about 0.9-1.3 p.p. less premium for each additional year of schooling than the female respondents, depending on specification. This is often the case in developing countries, and is usually attributed to "lower base levels of education of females compared to males" (Warunsiri and McNown 2010, p. 1617). However, this interpretation is hardly appropriate for Kazakhstan with its observed low (or absence of) educational gender disparities during the Soviet period (Graeser 1988, Gerber and Hout 1995, Ganguli 2013, Terama et al. 2014), which turned into the current higher overall level of education amongst females, as may be noted from the analysed database. Along with the overall lower female earnings, this suggests that the observed returns gap might be attributed to the sector-industry allocation of the labour force: as mentioned above, females

Figure 2.15: Blinder–Oaxaca decomposition - unexplained portion in wage differential between 2002 and 2016, men (with 95% confidence intervals, 2002 is the reference year)

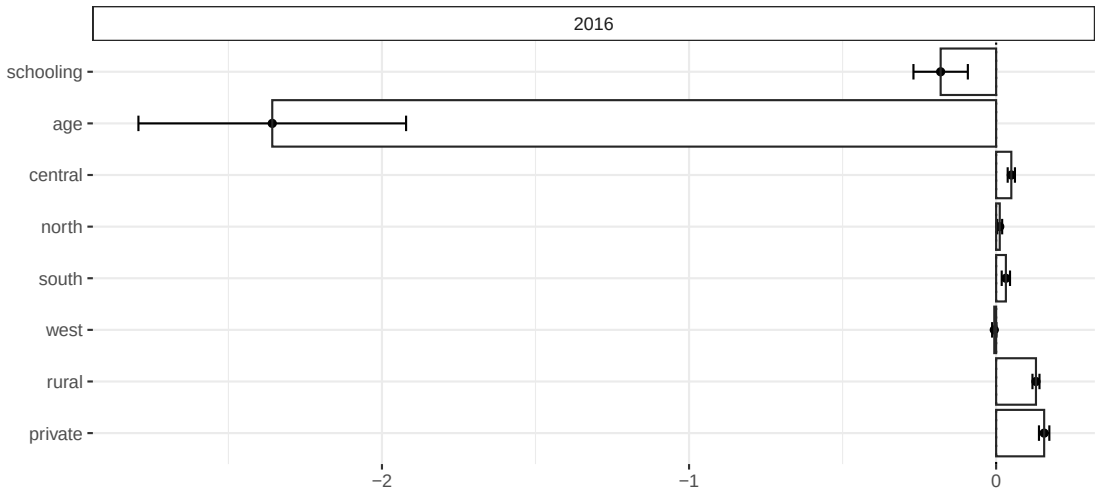
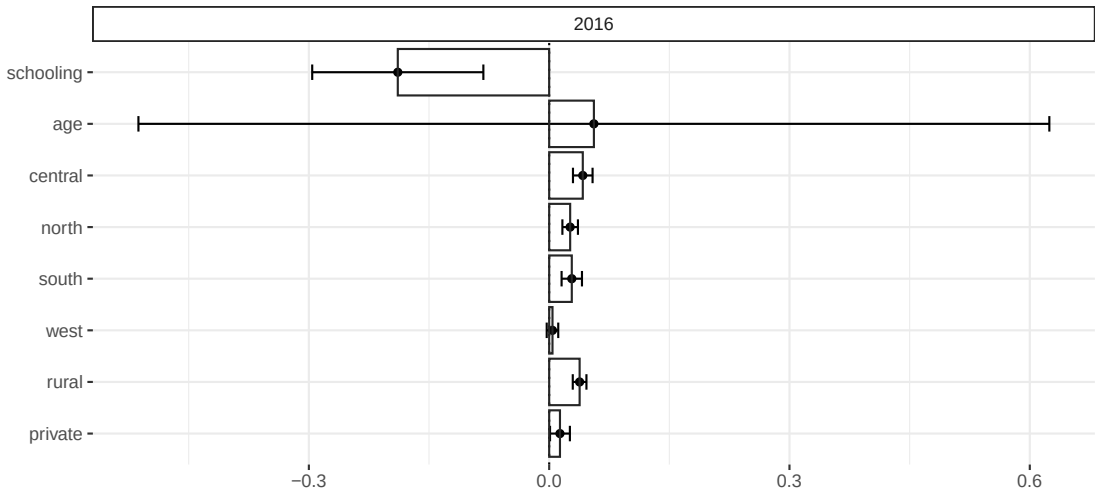
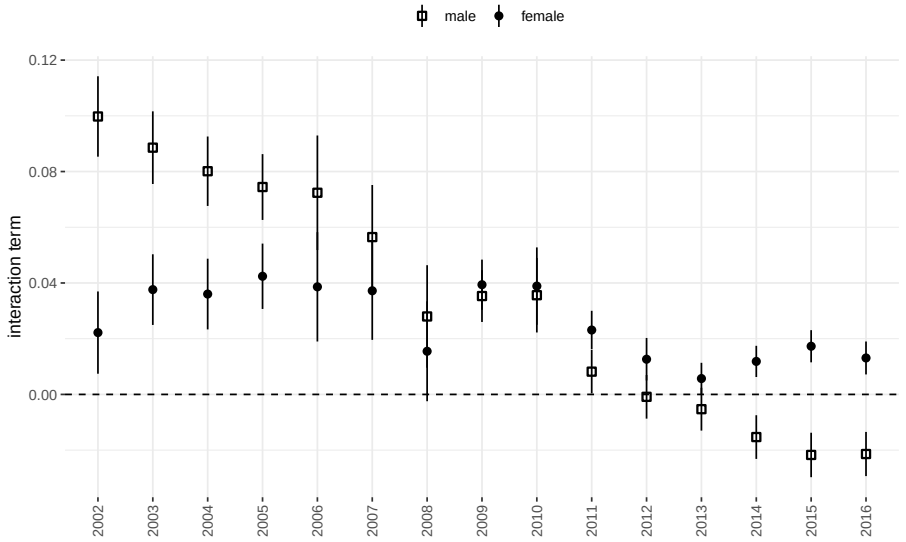


Figure 2.16: Blinder–Oaxaca decomposition - unexplained portion in wage differential between 2002 and 2016, women (with 95% confidence intervals, 2002 is the reference year)



are mostly employed by (less risky but worse paid) industries which are primarily in public ownership. These industries might 'value' education more than the others in the sense that the jobs concentrated in these industries require a degree and provide better degree premiums. This observation might be in line with frequently observed worldwide "gender segregation in occupations, industries, firms, and jobs" (Garcia-Aracil 2007, p. 431; Meng 2004; Bielby and Baron 1986).

Figure 2.17: Returns to schooling in the private sector with 95% confidence intervals computed for each year of observation and gender independently from models with schooling, age, age squared, year dummy and schooling with sector of employment interaction term (reference sector: public)



To test this, I run OLS on individual data gender and year subsamples with the basic Mincerian specification and the interaction term of the years of schooling with the sector of employment - the interaction term estimates are shown in figure 2.17. Despite the fact that for both genders, employees in the public sector are better educated than those in the private sector (the average schooling is 12.50 for men and 12.88 for women in the public versus 11.74 for men and 12.19 for women in the private sector[8]), the returns to schooling in the private sector are significantly higher for women for almost all of the years observed, and higher for men until 2011 though with a clearly decreasing trend over time. The latter, along with the observed shift of the male respondents towards the private sector, likely contributes to the decreasing returns to schooling in males. However, the observed trend does not explain the higher returns to schooling amongst females.

Hypothesizing that the schooling returns premium gap could be better explained by industries rather than private versus public ownership, I compute the same specification models for the industry (instead of the sector) of employment, which appears in the survey from 2011; the associated results are presented in figure 2.18[9], additionally plotting the number of employees in each industry. The least populated industry ('Activities of households as employers') is dropped and 'Education' is assigned the reference category. Additionally, I show the average years of schooling for each industry and gender - see

[8]Computed for the pooled data, the pattern persists in each year.

[9]The results presented are computed for the pooled dataset; I do not report the yearly estimations for simplicity, as the outcomes do not vary significantly across years.

Figure 2.18: Returns to schooling in industry with 95% confidence intervals computed for each gender independently from models with schooling, age, age squared, year dummy and schooling with industry of employment interaction term (reference industry: Education), pooled data, 2011-2016

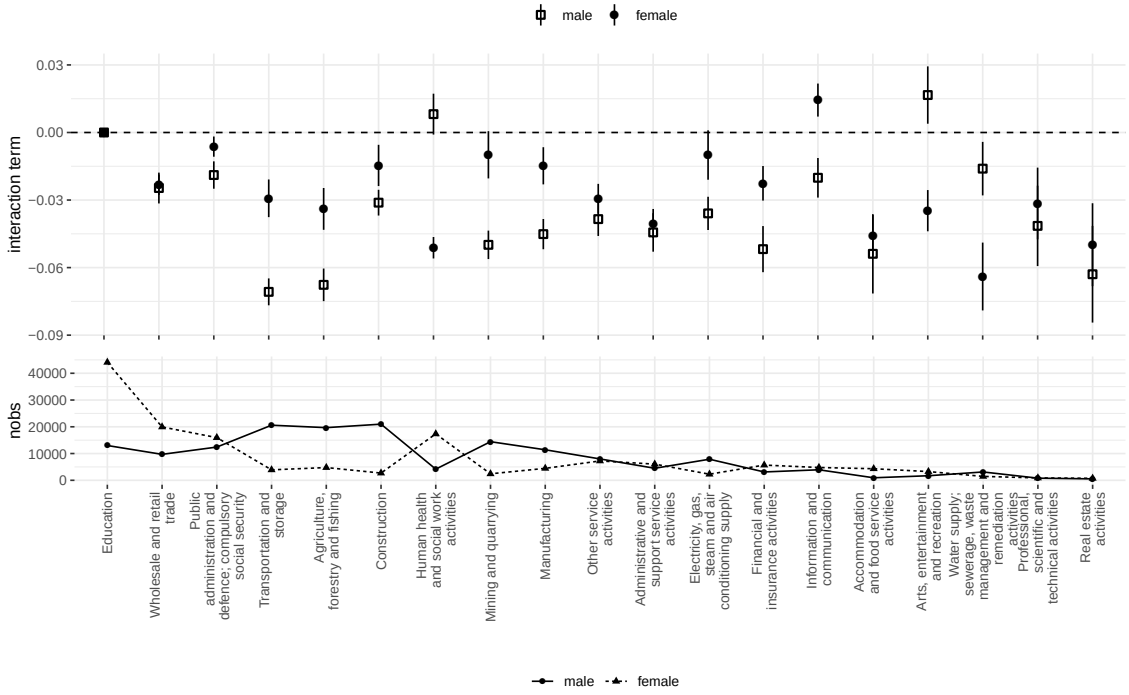
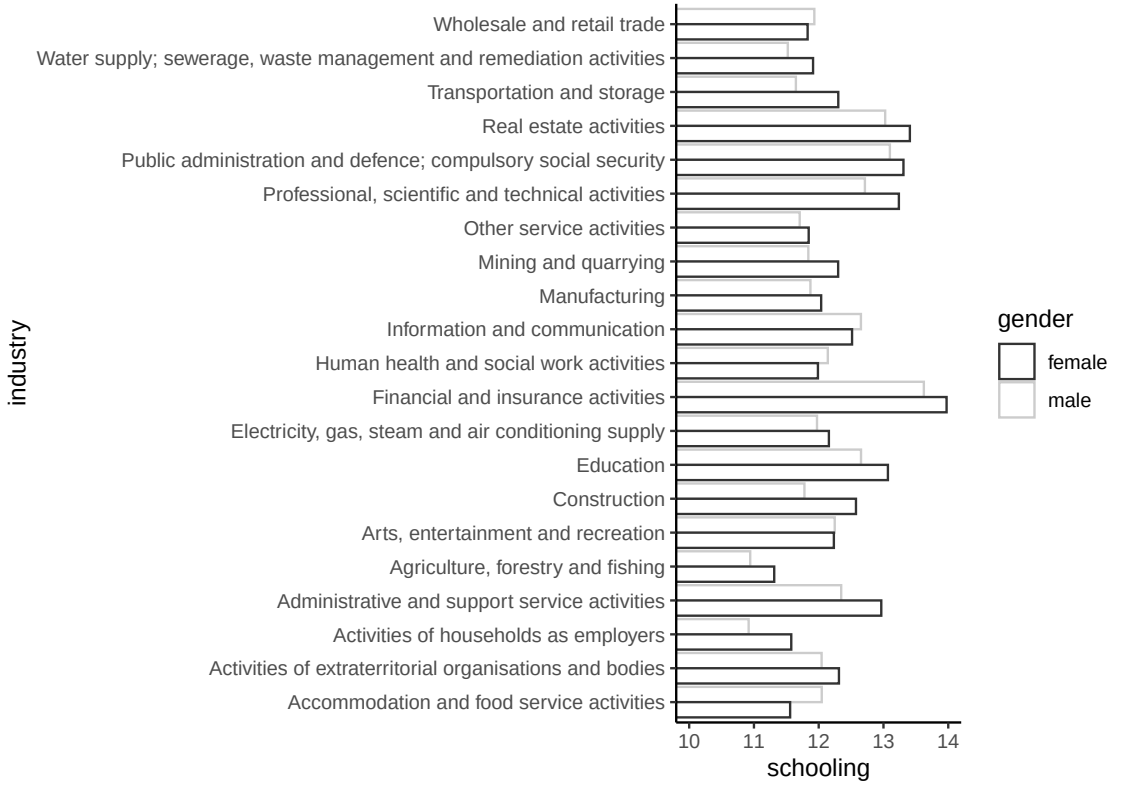


figure 2.19.

Indeed, in the majority of industries, females' returns to schooling are greater than or equal to those of males, although this is not the case for the main female industries of employment. Along with this, for both genders the main industries of employment (according to figure 2.6) are among those with both (gender-specific) lowest returns to schooling and the lowest levels of education attained. The only exemption is 'Education' for females, which provides relatively high returns to schooling and demands relatively more schooling for both genders. At the same time, the industries with the highest wages for each of the genders - particularly, 'Mining and quarrying' and 'Manufacturing' - are predominantly occupied by men. The exception is 'Financial and insurance activities', where there are more females than males observed. Unlike 'Mining and quarrying' and 'Manufacturing', this sector 'requires' more schooling (the highest average schooling in the sample for both genders). This suggests that, possibly for females, a higher attained level of education serves as a pass to at least some of the best-paid industries within the mining-oriented economy. On the other hand, they could additionally choose relatively less demanding (in terms of schooling and probably competition for jobs) but worse-paid economic activities, such as 'Education', 'Human health and social work' or 'Wholesale

Figure 2.19: Average years of schooling, pooled data, 2011-2016



and retail trade'. The former two might additionally provide improved levels of social security.

Interestingly, experience coefficients (as reported in tables 2.3-2.4) are nearly twice as small for females than males; as a result, the age turning point differs with gender: about 41 for males and 47 for females. This might again reflect differences in the nature of employment and social security across genders. The gender returns gap additionally explains higher females' schooling that may be considered as their rational decision based on their expectations about future employment opportunities.

2.4.3 Cohort effects: pseudo-panel models

The results of the pseudo-panel models are introduced in tables 2.9-2.10. Observations are weighted by cohort size, varying with both cohort and year.[10] Both models additionally include year dummies to capture year fixed effects, and other proportional control variables computed as proportions of respondents belonging to a certain group (for example, with

[10]Since there is no option to use weights varying in both - cohort and period - dimensions with the xtreg command, to compute the FE I used the 'regress' command in Stata with cohort dummies and the aweight option, whilst to compute the RE I used the user-written xtregre2 with aweight option (Merryman 2005).

rural versus urban residence) within a cohort in each observed year. I run log and squared transformations before taking means, while constructing the pseudo-panel.

Table 2.9: Returns to schooling estimated on pseudo-panel, fixed effects

	Dependent variable:			
	log real wage			
	(1)	(2)	(3)	(4)
schooling	0.126***	0.114***	0.0938***	0.0679***
	(0.0080)	(0.0080)	(0.0083)	(0.0090)
age squared	-0.0006***	-0.0006***	-0.0006***	-0.0006***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
central		-0.304***	-0.247**	-0.335***
		(0.0819)	(0.0799)	(0.0788)
north		-0.274**	-0.187*	-0.261**
		(0.0898)	(0.0879)	(0.0863)
south		-0.437***	-0.262**	-0.386***
		(0.0825)	(0.0836)	(0.0834)
west		0.0049	0.0938	0.0453
		(0.0905)	(0.0887)	(0.0866)
rural			-0.369***	-0.419***
			(0.0507)	(0.0499)
private				-0.298***
				(0.0437)
constant	10.05***	10.46***	10.75***	11.33***
	(0.147)	(0.172)	(0.172)	(0.187)
year dummies	yes	yes	yes	yes
cohort dummies	yes	yes	yes	yes
F Statistic	1242.19***	1270.72***	1333.91***	1390.15***
N	915	915	915	915
Adj. R2:	0.990	0.991	0.992	0.992

Notes: (1) Fixed effects computed in Stata with regress command with analytical weights. Standard errors in parentheses.
(2) Reference categories: metropolis (region); urban (residence); public (sector).
(3) Age in linear term is omitted to avoid collinearity
p<0.05, ** p<0.01, *** p<0.001

Table 2.10: Returns to schooling estimated on pseudo-panel, Mundlak random effects

	Dependent variable:			
	log real wage			
	(1)	(2)	(3)	(4)
schooling	0.108***	0.0883***	0.0709***	0.0764***
	(0.0081)	(0.0083)	(0.0087)	(0.0096)
age	0.0484***	0.0511***	0.0518***	0.0552***
	(0.0021)	(0.0021)	(0.0021)	(0.0021)
age squared	-0.0006***	-0.0007***	-0.0007***	-0.0007***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
central		-0.309***	-0.252**	-0.215*
		(0.0889)	(0.0872)	(0.0909)
north		-0.282**	-0.198*	-0.171
		(0.0979)	(0.0965)	(0.101)
south		-0.395***	-0.233*	-0.162
		(0.0899)	(0.0918)	(0.0967)
west		0.0514	0.133	0.163
		(0.0978)	(0.0964)	(0.0998)
rural			-0.333***	-0.300***
			(0.0553)	(0.0575)
private				0.160***
				(0.0426)
mean(schooling)	-0.484***	-0.473***	-0.480***	-0.419***
	(0.0168)	(0.0149)	(0.0149)	(0.0193)
constant	13.77***	14.06***	14.36***	13.33***
	(0.196)	(0.193)	(0.198)	(0.318)
year dummies	yes	yes	yes	yes
Wald chi2	76465.61***	75566.87***	79688.86***	72545.22***
N	915	915	915	915
R2:				
within	0.9904	0.9911	0.9916	0.9909
between	0.7517	0.7610	0.7548	0.8031
overall	0.9733	0.9747	0.9747	0.9779

Notes: (1) Random effects computed in Stata with xtregre2 with analytical weights (Merryman 2005). Standard errors in parentheses.
(2) Reference categories: metropolis (region); urban (residence); public (sector).
* p<0.05, ** p<0.01, *** p<0.001

Interestingly, the fixed effects and the Mundlak random effects models produce results that are nearly identical to the individual data models, which are also very similar to the previous examinations that used the IV approach (Arabsheibani and Mussurov 2007).

Attempts to control for cohort effects do not noticeably change estimations for the returns to schooling, only slightly decreasing the Mundlak model's estimates. At the same time, the mean of schooling estimate in the Mundlak model is highly significant, suggesting an unobserved cohort effect (from comparison of FE and RE). Although the value of the estimate is large, this represents the change resulting from the entire cohort increasing their education by one year for every year of the data - a substantial increase in education – and must be interpreted with this in mind. It is also negative, where this should be interpreted as follows: though the increase in the cohorts' average level of schooling over time resulted in an increase in the average level of their earnings, the cohorts with higher average levels of schooling earned less in comparison to those with lower levels.

The figures in Appendices A.12-A.13 show that the more educated cohorts are the younger cohorts in the sample[11]. Thus, the negative relation could indicate a business cycle impact; the cohorts who entered the labour market during the 1990s recession and faced a lack of jobs apparently ended up getting more education and – because of worse economic conditions - lower lifetime wages, and vice versa (Betts and Mcfarland 1995, Dellas and Sakellaris 2003, Kahn 2010, Clark 2011, Oreopoulos et al. 2012, Liu et al. 2016). The other possible explanation could be a widely perceived difference in the quality of education and its link to the labour market between the Soviet and post-Soviet eras; however, this could not be further tested with the data at hand.

While OLS estimates reported in the previous sections have the expected signs and magnitudes, some of the additional control variables' estimates from the pseudo-models look rather controversial. This might reflect an error-in-variables bias generated by errors in the survey data, as noted by Griliches: "in cross-sectional household interview data all of the variables are subject to some error. Even if errors are small, their effect will be magnified as more variables are added to the equation in an attempt to control for "other possible sources of bias"" (Griliches 1977, p. 12). Regardless, the schooling coefficients are fairly robust and consistent in all models.

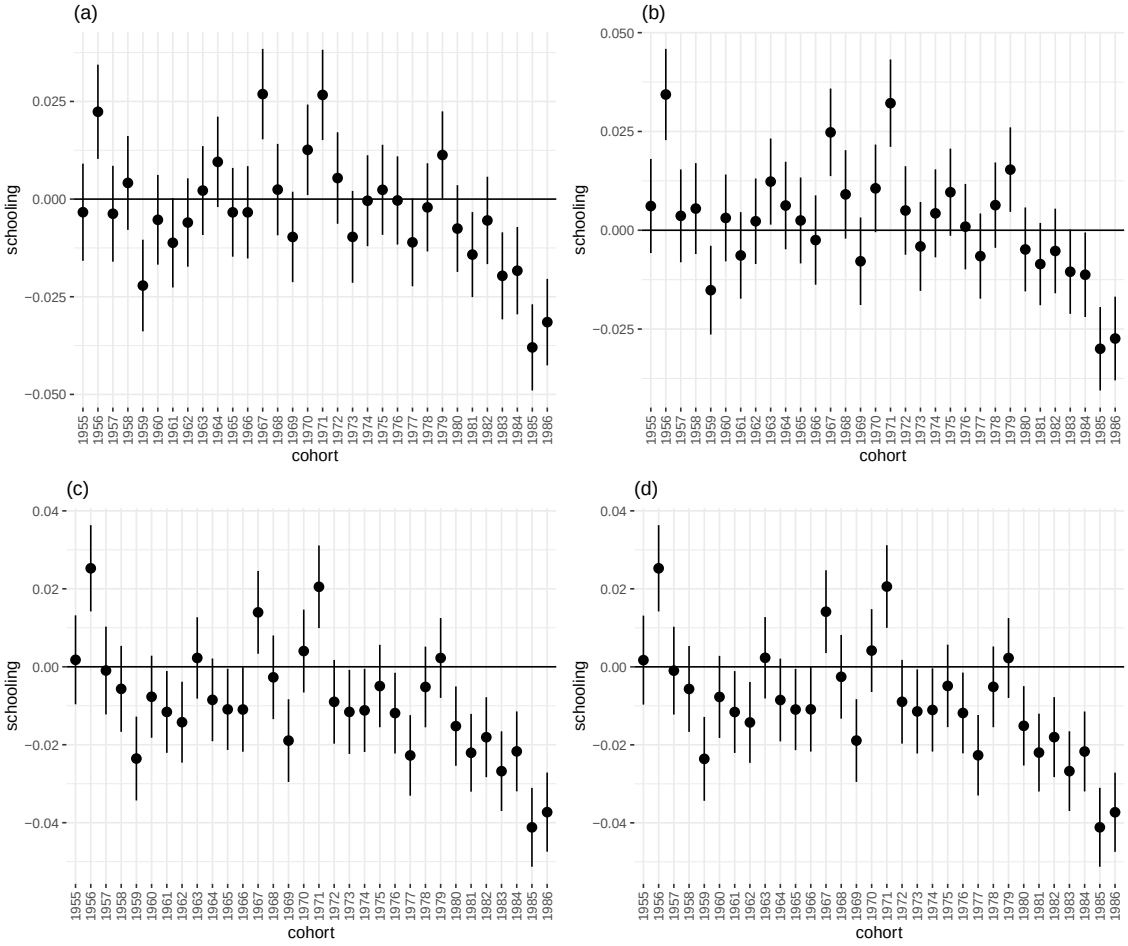
2.4.4 Cohort effects: individual level models

Finally, to detail how the returns to schooling vary across cohorts, I set up individual-level OLS models controlling for the set of cohort dummies and an interaction term between schooling and cohort dummies, as well as the other control variables, separately for each gender. The coefficients for the interaction terms with their confidence intervals for four specifications are shown in figures 2.20 and 2.21. The baseline category is the first (the oldest) cohort: the 1954 cohort for men and the 1959 cohort for women.

For men, with some few exemptions and for the youngest cohorts (born after 1983),

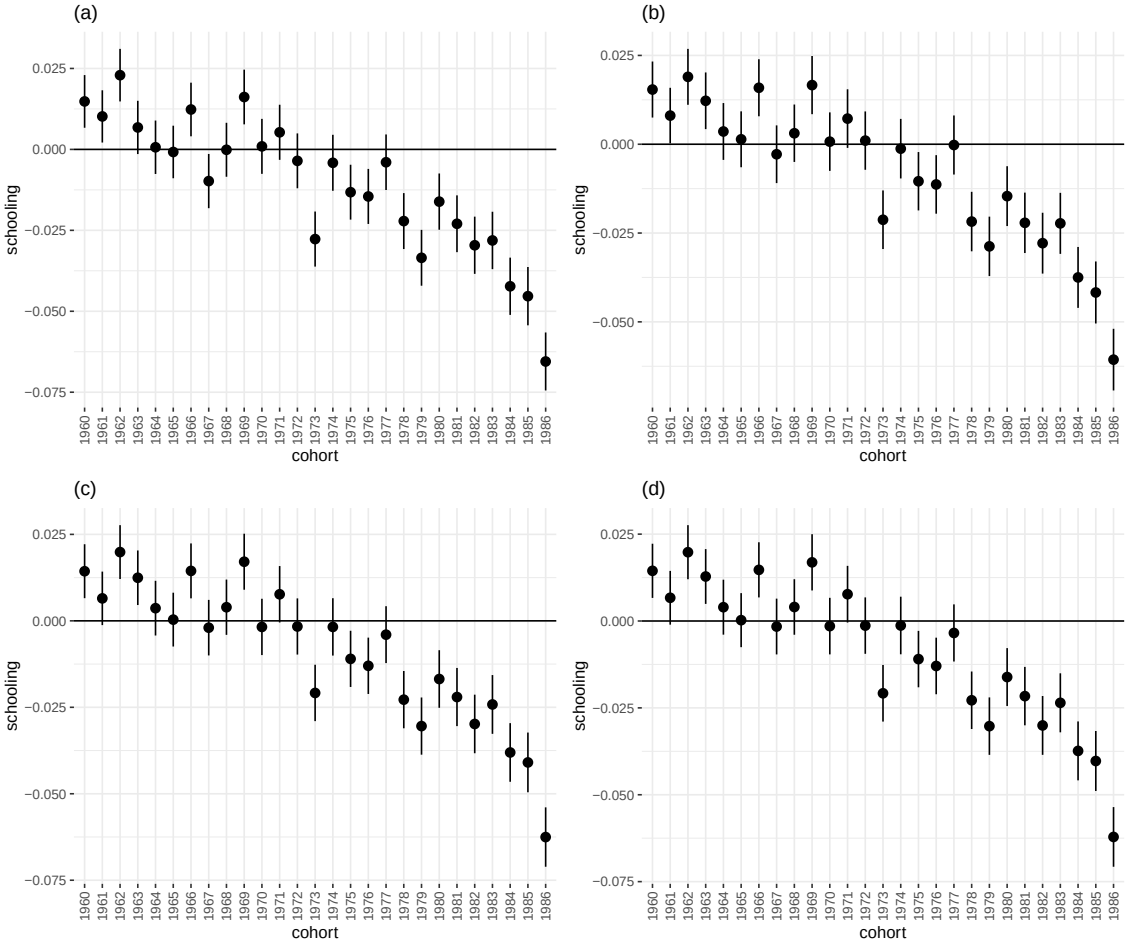
[11]With the exception of the very youngest who had not completed their education on the date of the survey.

Figure 2.20: Male cohorts: Returns to schooling for each cohort with 95% confidence intervals from model with schooling, age, age squared, cohort, schooling*cohort and: (a) with no additional control variables; (b) region; (c) region and residence; (d) region, residence and sector of employment



the difference in the returns across cohorts seems to be statistically insignificant. Minor fluctuations observed in the returns look somewhat similar to the business cycle fluctuations and might reflect the external backgrounds (economic conditions, unemployment rate, labour market conditions and policies, skills mismatch, external shocks) cohorts are faced with when entering the labour market and over their life-time cycle accordingly impacting their returns. However, for females this variation appears to be somewhat more systematic, with higher rates for the older cohorts and a downward trend towards the younger ones, namely those who entered the labour market after the collapse of the Soviet Union. This might mirror the different nature of employment for the genders, as referred to above: particular industries could be more sensitive to over-education or to perceived differences in Soviet-type and post-Soviet-type education. On the other hand, this could reflect (or be contaminated with) the age effect.

Figure 2.21: Female cohorts: Returns to schooling for each cohort with 95% confidence intervals from model with schooling, age, age squared, cohort, schooling*cohort and: (a) with no additional control variables; (b) region; (c) region and residence; (d) region, residence and sector of employment



To separate the possible age (experience) effect, I ran the models estimated on the subsample of individuals observed at different years at the age of 35. It is a sample of 18,936 individuals (9,419 males and 9,517 females) born between 1967 and 1981 observed over 15 years (from 2002 to 2016). The results from these models should not be contaminated either by age effect (as I observe them at the same age) or by year effect (as I explicitly control for the year in a linear form). Figures 2.22-2.23 report interaction term coefficients.

In line with the main models and their interpretations, the returns are lower in younger cohorts for both genders, however, for females the pattern looks more systematic: the cohorts born after the mid-1970s (those who entered the labour market and/or got their post-secondary education after the collapse of the Soviet Union) always have lower returns than the older ones.

Figure 2.22: Male cohorts: Interaction term coefficients from models with schooling, year, cohort, schooling*cohort and: (a) with no additional control variables; (b) region; (c) region and residence; (d) region, residence and sector of employment

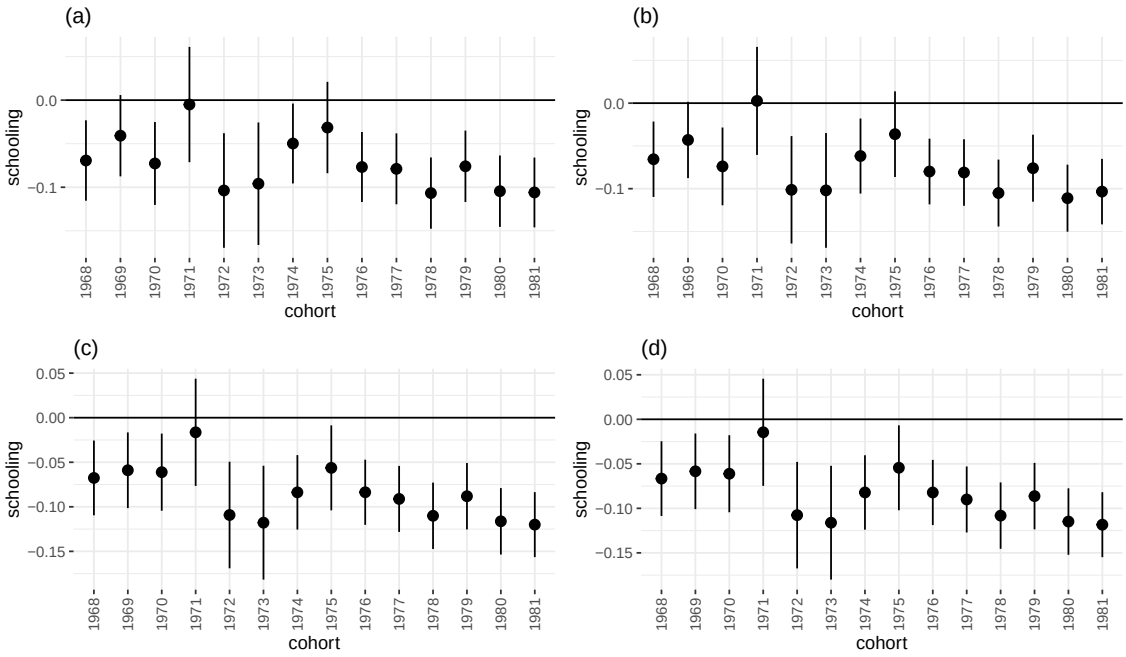
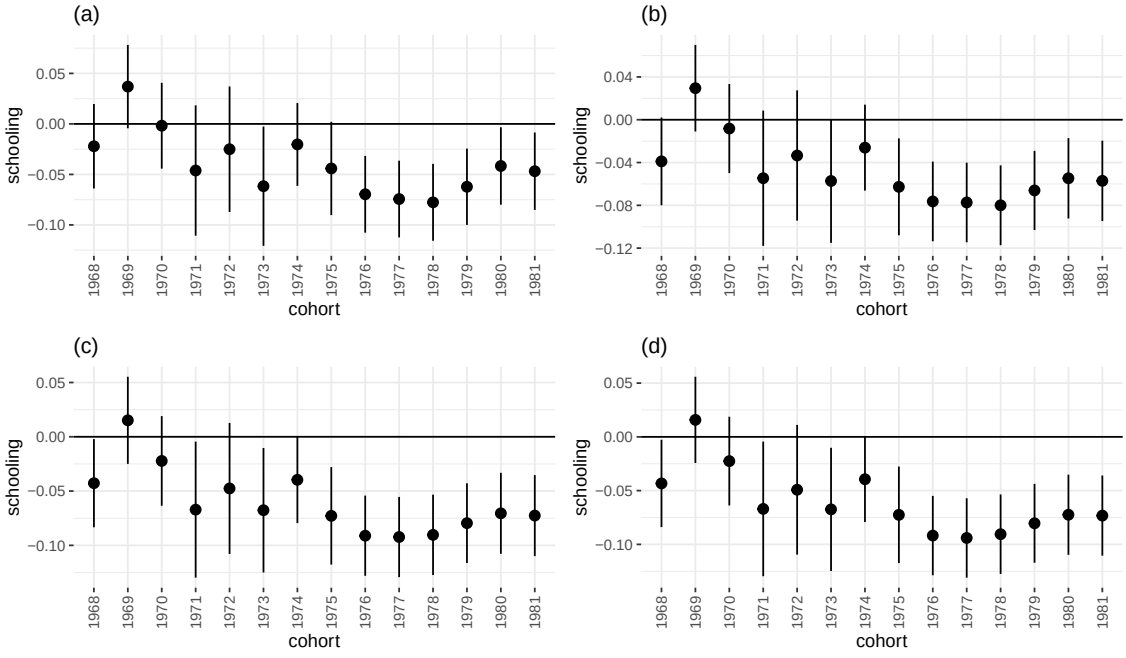


Figure 2.23: Female cohorts: Interaction term coefficients from models with schooling, year, cohort, schooling*cohort and: (a) with no additional control variables; (b) region; (c) region and residence; (d) region, residence and sector of employment



2.5 Summary and conclusions

This chapter represents the first attempt to employ a long series of repeated cross-sectional data from the Kazakhstani National Statistics to estimate the returns to schooling. The few such previous examinations found that the returns immediately increased from the very low rates typical of the Soviet era to internationally comparable rates with the transition.

Using the Household Survey data for 2002-2016, I found three- to six-fold growth in the real wages observed over this period. However, this dramatic growth in wages in real terms is only partially explained by the improvement in the observed labour force characteristics (education, residency and the sector of employment), by around 30% for working men and 40% for working women. The unexplained part can probably be attributed to the external economic background - fast economic growth due to the oil boom with the GDP growing by 6% on average annually[12]. This growth in the GDP could have resulted in the increase in demand for a more educated labour force; on the other hand, with the associated dramatic increase in schooling, one might expect a corresponding decrease in the returns to schooling over the years.

With the various models developed, the results revealed the returns to be robust across models and specifications, statistically significant and relatively high, though decreasing over the analysed years despite the economic boom and with the magnitude of this decrease being larger for men. Albeit that the estimates do not particularly change with the pseudo-panel data, the comparison between the fixed effects and the Mundlak random effects models suggests the presence of the cohort effect. I tend to interpret the negative sign of the mean of schooling estimate as an effect of the business cycle phase which cohorts are faced with at their school-leaving age: a downward swing with a lack of jobs leaves them with a little choice but to get more schooling which, however, in turn provides them with lower returns (compared to older cohorts).

I found – at least, with the data at hand – gender differences in the nature of employment: while men prefer employment in the private sector with higher wages and apparently more uncertainty, women seem to be inclined towards worse-paid, but more secure industries and the public sector. This trait represents a likely explanation for the higher rates of the returns to schooling observed for females. I argue that some particular jobs, mainly in the public sector, formally require certain level of schooling and, accordingly, value schooling to a greater degree than the private sector, possibly due to the wage grid still being persistent to some extent. These jobs tend to be occupied by females, which, in turn, reasonably explains their higher levels of education. On the other extreme, the females employed by the best-paid industries, as heavily dominated by male employees, have systematically higher levels of schooling (than males), which seems to serve as a pass to

[12]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz

at least some of the best-paid industries for women within the mining-oriented economy.

Finally, I uncovered a downward trend in the returns pattern across cohorts, with younger cohorts demonstrating lower rates of returns (confirming the Mundlak model outcomes), which might reflect a decrease in returns to schooling due to a labour market glut but that might also reflect business-cycle impact the younger cohorts faced with in their school-leaving age or decrease in the average quality of education in the post-Soviet period. This feature is more pronounced in females, which might again point to gender differences in the nature of employment. At the same time, for males, variations in the returns rates across cohorts can likely be explained by external economic conditions, such as labour market oscillations and the business cycle. Overall, the mechanisms determining the returns to schooling in Kazakhstan are probably more complicated and require more sophisticated and detailed data to fully establish.

Chapter 3

Higher education in Kazakhstan: institutional framework

3.1 Higher education system and an overview of reforms

The current higher education system in Kazakhstan appeared, and was shaped, during the country's Soviet era, when it was "built into a larger economic planning system" (Huisman et al. 2018, p. 7). There was no higher education institution (HEI) in Kazakhstan up to the 1920s, but by 1975 the number of HEIs had reached 47, and the student's population around 200,000, and the number of different degrees awarded was 175 (ibid., p. 201). Academic programmes and curricula were "in many ways predominantly vocational" (ibid., p. 8), applied, and highly biased towards particular subjects considered to be more important to the Soviet economy, and separated from science and research which was conducted in the special research institutions not involved with teaching and/or training.

Although there never was a centralised examination in the USSR, higher education admission was highly centralised and subordinated: the number of HEIs, academic programmes taught, and the students enrolled were all dictated centrally. Higher education was free of charge and access was highly competitive: in Kazakhstan, during the Soviet era, there were 226 higher education admission applications per 100 places (ibid., p. 9). This dramatically changed with the disintegration of the Soviet Union and following 'massification' (Roshchin and Rudakov 2015) and 'marketization' of higher education, with its agenda of departure "from total state control to autonomy, from uniformity to diversity, from the engineering and vocational bias towards greater humanitarization and personal development" (Huisman et al. 2018, p. 12).

In Kazakhstan, the speed and magnitude of the reforms were among the most rapid of all post-Soviet countries (Smolentseva 2012, Huisman et al. 2018). The number of HEIs grew rapidly from 55 public institutions in 1990/91 to 122 public and private institutions

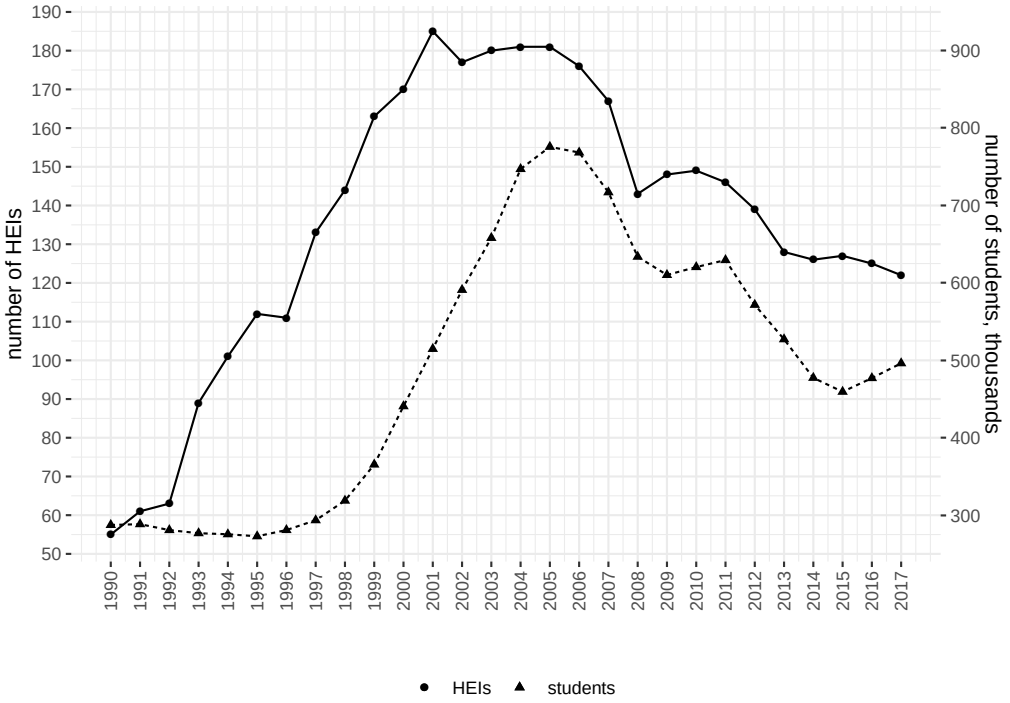
in 2017/18, with the corresponding number of students growing from 287,367 in 1990/91 to 496,209 in 2017/18, with both experiencing significant fluctuations over the period - see figure 3.1. Currently, more than half of HEIs are non-public, and the share of students attending them is greater than in any other former Soviet bloc country[1] - 47% versus around 16% on average in the others in 2009 (Smolentseva 2012); according to the Ministry of Education and Science data, in 2014 the proportion of full-time students studying at non-public HEIs was 41%, while the share of those on distance-learning programmes was 57% (computed from the data in IAC 2015b).

Eventually, among the post-Soviet bloc countries Kazakhstan appeared as the country with the greatest higher education enrolment (Smolentseva 2012); however, this was extensively driven by the soaring distance-learning (extramural) enrolment which later declined, mostly due to the newly introduced restrictive government policies aimed at improving the quality of the degrees awarded - see figure 3.2. The widening participation increased public concerns with regard to the quality of higher education. This perception is to a certain extent confirmed by the associated official data: the OECD Survey of Adult Skills documents the increased completion of tertiary education by 25- to 34-year-olds (50% versus 27% for 55- to 65-year-olds) which has not "translated [to] a corresponding increase in the skills of the adult population, possibly because of a decline in the quality of education" (OECD 2019, p. 24). Kazakhstan is the country with the smallest difference in performance between tertiary-educated adults and adults with below upper secondary education among those reported, and this is attributable to the low proficiency of the former (ibid.).

Figure 3.3 illustrates levels of education in accordance with *Education Act* 2007 and their corresponding European Qualification Framework (EQF) levels. Compulsory education starts from the age of six and includes primary and basic secondary education. Along with the general secondary (university-preparatory type) education, compulsory education is provided by comprehensive secondary schools, gymnasiums, lyceums or specialised schools. Technical and vocational education and training (TVET), together with the recently introduced post-secondary education, are supplied by colleges. Higher and postgraduate education programmes are delivered by HEIs - universities, academies, institutes, and conservatories. The classification of HEIs depends primarily on the number and scope of degrees awarded; for simplicity, I further interchangeably refer to them as '(higher education) institutions (HEIs)' or 'universities'. Admission to higher education is possible upon completion of one's general secondary education, or TVET. The duration of study is 3-5 years depending on previous education; most typically - for those entering higher education upon completion of secondary school and for the vast majority of subjects - four

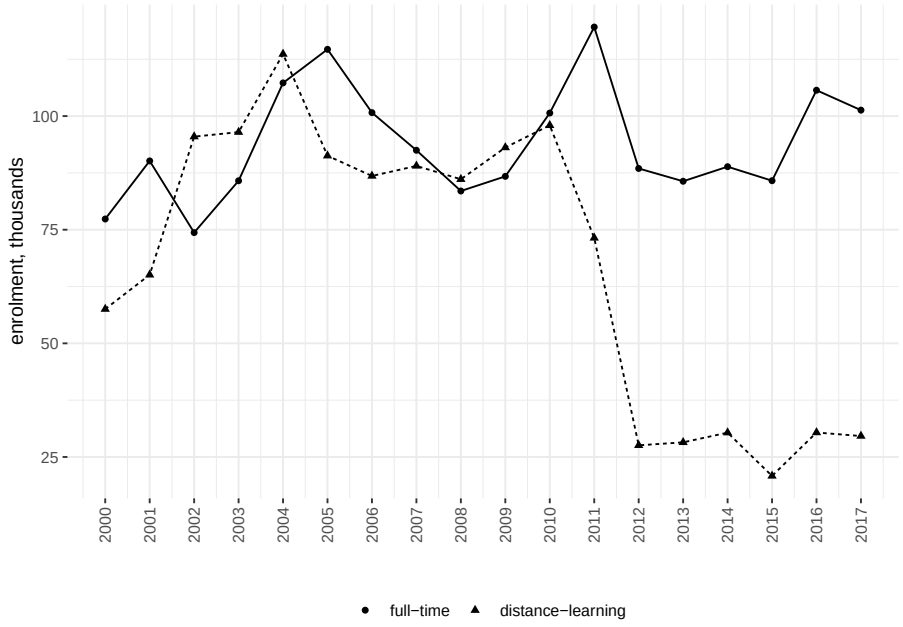
[1] Excluding the Baltic countries.

Figure 3.1: Number of HEIs and total number of students



Data source: the Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

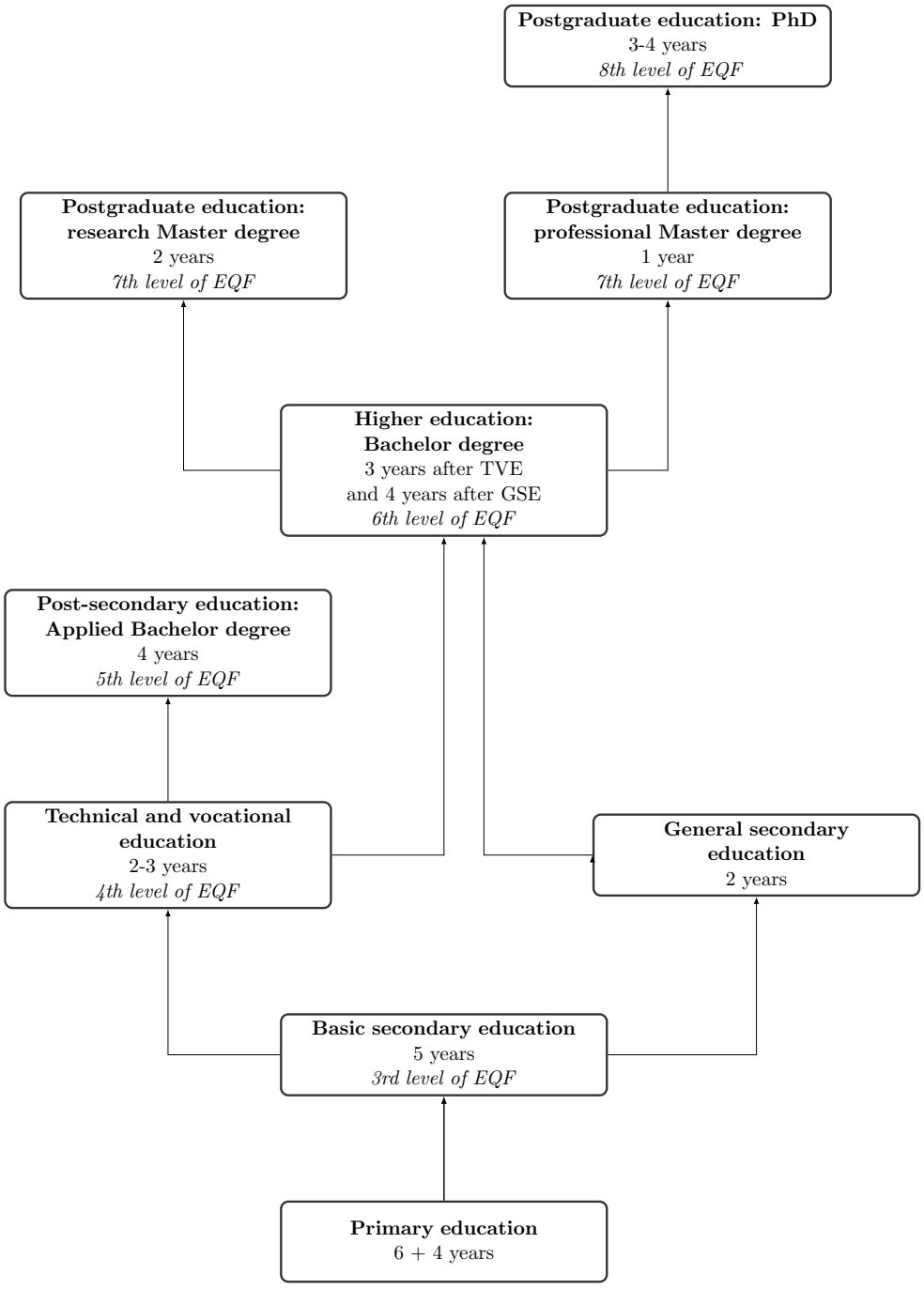
Figure 3.2: Number of newly enrolled students, thousands



Data source: the Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

years, requiring one to obtain 240 ECTS[2] credits.

Figure 3.3: Levels of education



Source: *Education Act* 2007, EACEA 2017

During the Soviet era, higher education admission, at least for the most prestigious

[2]ECTS - European Credit Transfer System.

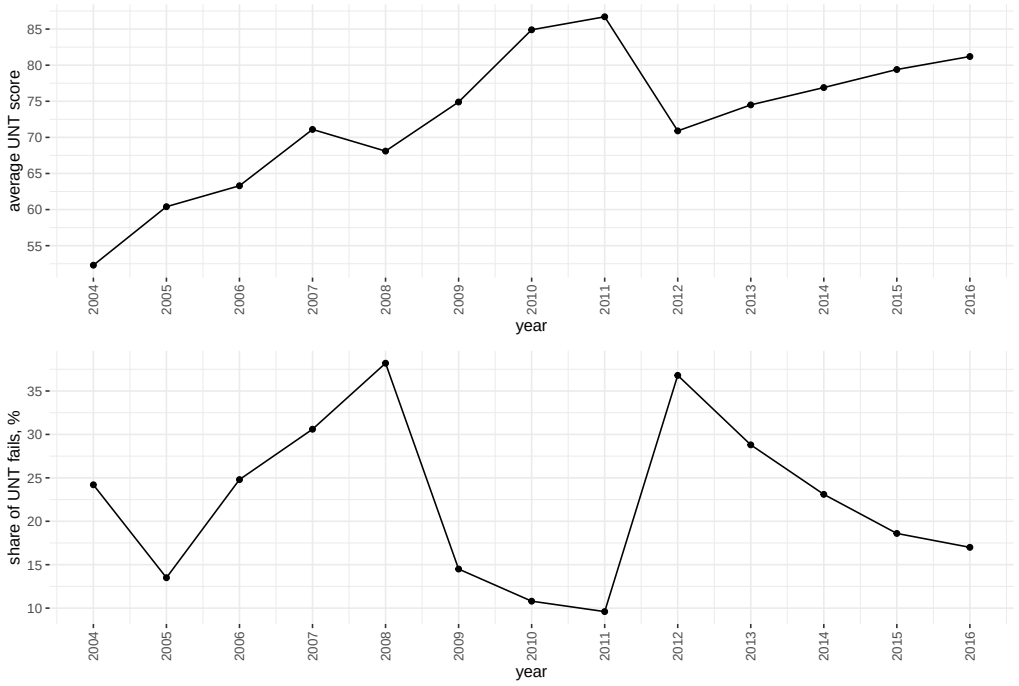
universities and academic programmes, was corrupt and lacking in transparency (Huisman et al. 2018), and this did not change with the increased access and participation of the 1990s. In 2004, with the aim of reducing the corruption associated with higher education enrolment and to unify the minimum requirements to ensure the 'quality' of the student intake, Kazakhstan switched to centralised higher education admission through the Unified National Test (UNT), which is an examination for secondary school leavers that allows them to enter HEIs upon gaining the required score. The test additionally serves as grounds for the voucher-type public funding available through the scholarship allocation scheme ('*obrazovatel'niy grant*').

The introduction of the UNT contributed to a subsequent increase in the number of technical vocational educational institutions ('colleges') and of college students since they had an exemption from the UNT while entering higher education up to 2012 when the separate examination was announced. Until the centralised test for college graduates that only allowed them to enrol at university by gaining the required score was set, the UNT exemption created a 'gap' that allowed an easier route to higher education for the college graduates through internal university examinations and the reduced period of study (three years versus the normal four years). However, the centralised Complex Test (CT) introduced in 2012 significantly decreased the number of college leavers enrolling in higher education – for instance, in 2012, only one-third of examinees could pass it, whilst in 2015 the share increased to 57%[3]. The CT's content is essentially the same as that for the UNT; both include 125 questions covering five subjects: mathematics, the history of Kazakhstan, first language (Kazakh or Russian), second language (Kazakh or Russian) and an elective subject depending on the examinee's career choice, with each correct question earning one UNT score.

Figure 3.4 documents the dynamics of the country-level average UNT score, along with the share of fails among examinees. The average test score grew consistently over the period from 52.3 UNT scores in 2004 to 81.2 UNT scores in 2016, though 2008 and 2012 are omitted due to changes in the test format, content, and associated regulations. The increase in the test score can likely be explained by the fact that only 15-20% of the test questions are replaced every year, while a small part of the current test questions becomes available for future examinees with the mock UNT exam. In 2008, the total number of questions (and maximum score) increased to 125 from 120 and the number of subjects changed from four to five (initially, the UNT included four subjects with 30 questions in each). In 2012, a policy change was introduced which dropped the average test score and substantially increased the share of fails among examinees (its effects on the programme-level outcomes are analysed in chapter five of this thesis). Fluctuations

[3]Data revealed by the MES authority during the interview on TV when commenting the CT results // https://www.ktk.kz/ru/news/video/2013/07/23/23605/ (visited on 02/02/2020).

Figure 3.4: Country-level UNT statistics



Data source: MES 2013b, MES 2012, MES 2013a, MES 2014, IAC 2015a, data for 2016 - the National Testing Centre, http://www.testcenter.kz

in the share of fails generally reflect the changes in the minimum entry score policy over time. For example, in 2006, the minimum required UNT score increased from 40 (which was the initial entry test score) to 50 UNT scores, while in 2009, it was decreased to 45 UNT scores, and in 2010, it was increased to 50 UNT scores again.

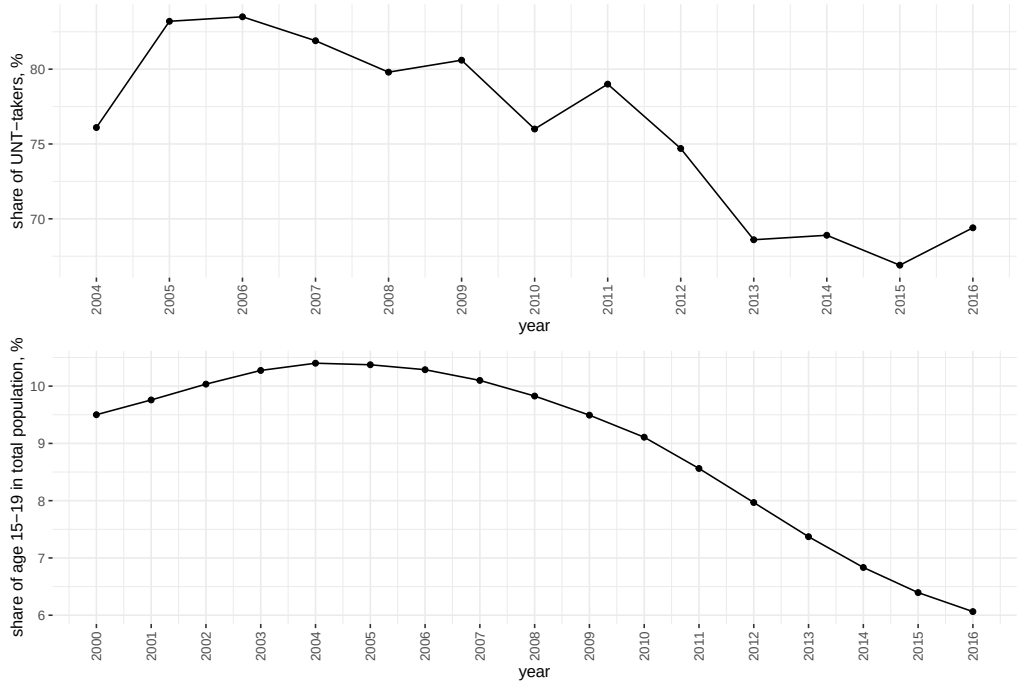
The changes in the UNT policy likely affected the share of those sitting the UNT among secondary school leavers, which dropped from 76.1% in 2004 to 69.4% in 2016, as shown by figure 3.5. Students refusing to take the UNT are generally those who either complete their education, or continue it abroad or at the TVET level, which does not require they gain the UNT certificate. For example, there was a drop in 2013 which might reflect the effects of the test tightening shock of 2012. All these notably took place against the background of the adverse demographic trend (illustrated in the lower panel) due to the sharp fall in birth rates during the 1990s recession.

The current higher education hierarchy[4] includes 47 public institutions, among which are 10 national universities and 37 state HEIs (including 14 military and law enforcement academies), and 75 non-public institutions with various ownerships, with the latter further referred to as 'private' for simplicity[5]. 53 out of 122 HEIs are located in the two biggest

[4]Data as of 2017. The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

[5]The Nazarbayev University established in 2010 is excluded from this analysis due to lack of appropriate

Figure 3.5: Share of UNT-takers among secondary school leavers and demographic trend



Data source: UNT statistics - MES 2013b, MES 2012, MES 2013a, MES 2014, IAC 2015a; share of population ages 15-19 in total population - the World Bank national accounts data, https://data.worldbank.org.

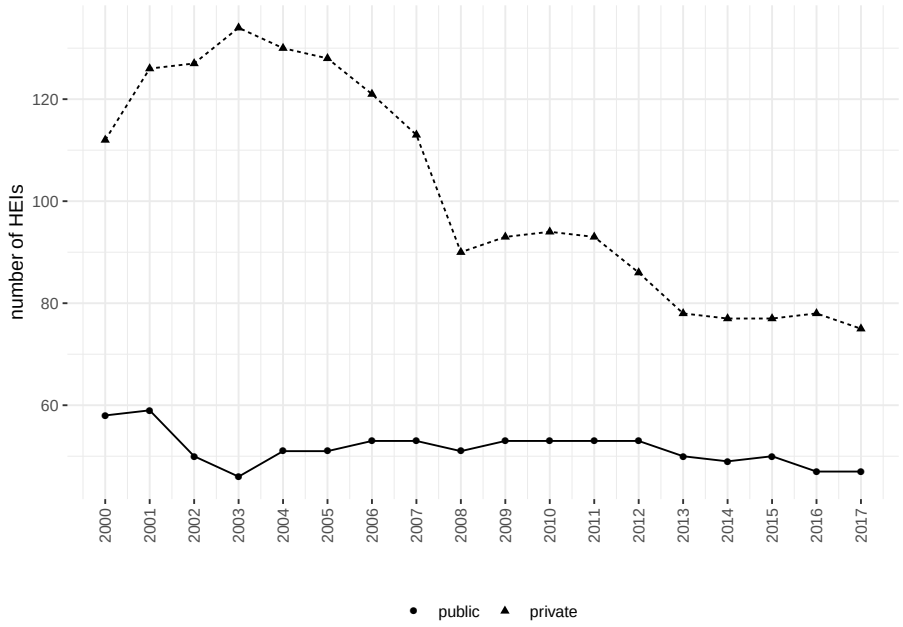
cities - the current capital and the previous capital - the country map shown in appendix B.1 marks them in red.

In 2001, *'national university'* status was granted to nine large public "HEIs considered as having the best potential for training and research" (OECD 2007, p. 169), in return for relatively better public funding and additional administrative support. A tenth national university was established in 2015. As opposed to the 'national' epithet, other public universities are referred to as 'state HEIs'.

While the public HEIs are those inherited from the Soviet era, the majority of the private universities have appeared after the independence. They have been either newly established or have appeared with the privatisation and corporatisation of the public institutions, separation of their faculties (Smirnova 2010), or even the upgrade of former TVET institutions, often without regard to their capabilities. One of the reasons for the increased provision of private higher education in Kazakhstan was the attempt to mitigate the pressure on the public budget: setting tuition fees lower than the public universities, they were believed to play a social role of widening access to higher education in the 1990s and early 2000s (ibid.) in the face of declining jobs, decreasing population income, and credit constraints (the student loans scheme launched in the mid-1990s despite its generous

data.

Figure 3.6: Public and private HEIs



Data source: the Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

terms caused social discontent and was ultimately wound up (Makridi 2007)[6]).

As can be seen in figure 3.6, the number of private universities has grown up to early 2000s reaching its peak of 134 in 2003 and then dropped, which is likely the result of various restrictive government policies aimed at improving the quality of higher education, which seems to target primarily private higher education providers. These include tightening the HEIs' licensing requirements, state accreditation, measures to reduce poor quality distance-learning programmes, and the introduction of the centralised entry examination and changes in its policies. Listed policies affected public universities as well, as their number also dropped from 58 in 2000 to 47 in 2017[7]. Despite the soaring number of private universities, up to 2012, the total number of students at them was lower than at public universities, as seen from figure 3.7.

To capture the heterogeneity of private higher education providers, I reshape the official higher education hierarchy by separating a group of 'elite' private universities from the other private universities as based on tuition fees[8], as those with tuition fees greater than the eighth decile of the national tuition fees distribution in 2018, or above 605,400 KZT (approx. 1,800 USD by 01/2018 exchange rate[9]) per academic year. The tuition fee is

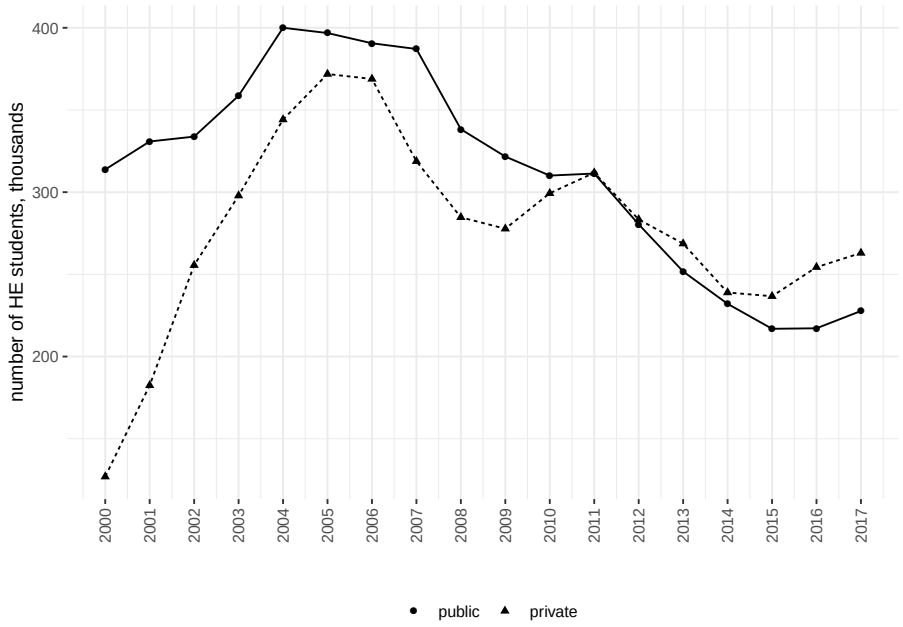
[6]New student loans scheme was introduced recently.

[7]It is possible that some of them were privatised over this period, no data available for this.

[8]The data on tuition fees for undergraduate programmes in 2018 is provided by the Ministry of Education and Science upon request. Programme level tuition fees are averaged across universities.

[9]For comparison: the average country-level nominal monthly per capita population income in 2018 was

Figure 3.7: Total number of higher education students by university ownership



Data source: *CSRK* 2019

the only criterion used; this hierarchy does not necessarily match the perception of an average person in Kazakhstan about the 'elite' status of a university. According to this classification, there are 10 'elite' private universities. As well as the national universities, they are situated in the country's two largest cities - the current and the former capitals and the centres of financial and business activity with essentially the highest population incomes. Both national and 'elite' private universities attract students from all over the country, unlike regional state and private HEIs accommodating students mostly from their localities.

Table 3.1 documents selected national statistics for four types of HEI. The national universities are the largest, and have the smallest share of the distance-learning students and the largest share of students granted public scholarships and relatively high tuition fees. The 'elite' private by given definition have the highest tuition fees with the most expensive reaching nearly 7,000 USD per academic year (for comparison, median country-level tuition fees were around 1,230 USD in 2018)[10]. State and other private universities are comparable in terms of their student intake and tuition fees, though the latter have the smallest proportions of scholarship holders. This framework generally reflects the

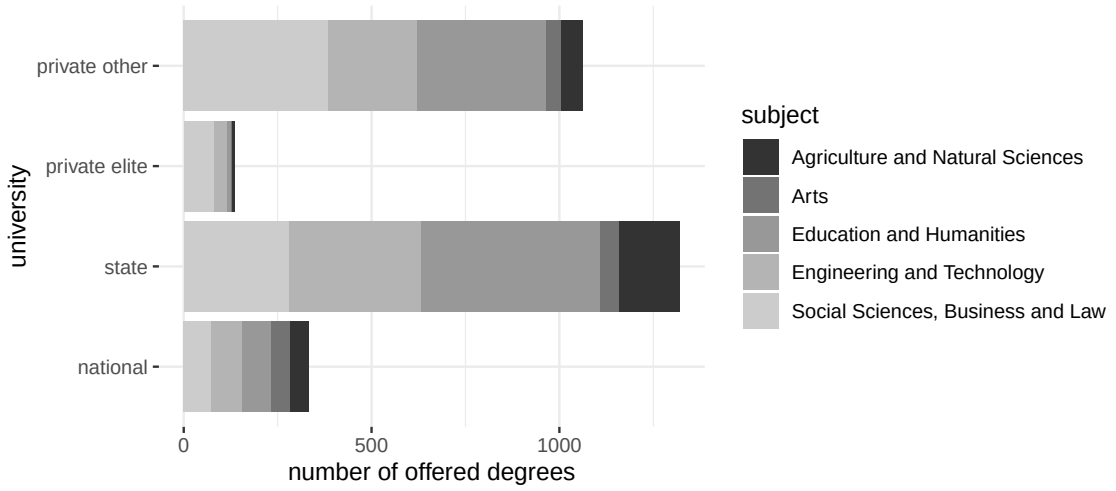
93,135 KZT or about 280 USD, varying from 43,938 KZT (approx. 132 USD) to 185,036 KZT (approx. 560 USD) depending on region, the Committee on Statistics data. KZT – Kazakh Tenge, the national currency, 380 KZT is approx. 1 USD (Sep. 2018).

[10]According to data on tuition fees for 2018 and the 01/2018 exchange rate.

Table 3.1: Average number of students, share of distance-learning students and state funded scholarship holders and tuition fees by university type

University type	Average total number of students in 2014 (1)	Average share of distance-learning students in 2014 (2)	Average share of state scholarship holders in 2014 (3)	Mean tuition fee in 2018, KZT (4)
national	6,881	0.03	0.70	697,802
state	4,880	0.17	0.45	414,235
'elite' private	2,958	0.08	0.22	1,020,110
other private	3,256	0.21	0.05	389,837
Data source: (1-3) computed from IAC 2015b; (4) provided by the Ministry of Education and Science upon request.				

Figure 3.8: Number of undergraduate degrees offered by the universities



Data source: *AHEI RK* 2014

relative quality of the institutions, which I further measure by the entry test score of their students available from the data used for the analysis. Finally, the four types of institutions are heterogeneous in their subject compositions with the 'elite' private offering the smallest variety of the subjects and being the most oriented towards the most lucrative and attractive. This can be seen in figure 3.8, which shows the composition of the subjects they offer united in wider subject groups (the offered subjects do not necessarily match the subjects they actually run, for which I do not have the country-level statistics).

The larger proportion of students granted state-funded scholarships at public versus private institutions is likely driven by the existing scholarship allocation scheme putting them in a favourable position. Initially, the centralised examination was introduced with the aim (among others) to gradually move towards a voucher scheme of funding higher

education and promoting competition among all HEIs for state-funded students, and, accordingly, improving institutional quality. However, to date scholarship places are first distributed centrally across HEIs among which eligible applicants can further make their choice. This allocation is based on certain criteria supporting larger public institutions with more diversified curricula and less attractive subjects. On the other hand, more scholarship places ensure better student quality, and this probably plays a further role in favouring public institutions in the subsequent allocation of scholarships, and so on. Although relatively more scholarship places improve the competitive positions of the public universities, they still need to compete for both scholarship allocation-related government transfers (mostly with each other) and for privately funded students (with each other and with the private universities), and accordingly the competition for students in Kazakhstan's higher education setting is fierce. The Herfindahl Index, computed as the sum of squared market shares measured by the number of all (including distance-learning) students for the 50 largest universities was 0.012 in 2014, which is small though nevertheless somewhat internationally comparable (Toutkoushian and Paulsen 2016) (computed from the data in IAC 2015b).

Public and private HEIs in Kazakhstan differ in their objective functions. Unlike private HEIs, which are heavily market-focussed and for-profit, public institutions are better defined as non-profit organizations.

A rationale for an education institution as a non-profit organisation is the asymmetry of information, putting a buyer in a vulnerable position and limiting their opportunity to make an informed decision (Hansmann 1981; Winston 1999). Winston (ibid.) considers two conceptual sources of funding for non-profit organizations – "charitable donations" and "sale of goods or services" – and identifies universities as having access to both sources or being "donative-commercial non-profits" (ibid., p. 16). It is important that by "charitable donations", it is not just donations themselves that are assumed, but also the taxpayers' 'donations' through public funding under the assumption that education is to the public good. The latter determines the non-profitable nature of a public HEI in Kazakhstan, which often offers subjects that are in less demand from the market and for which it attracts students through the availability of publicly-funded scholarships. This, however, does not imply that the non-profit organization should not and will not make profits; rather, it means that these profits are distributed within the organization or reinvested as there is no owner – this phenomenon is known as the "non-distribution constraint" (Hansmann 1981). In turn, the non-distribution constraint results in "fuzzy objectives of non-profit" (Winston 1999, p. 15). Along with this, even in this context, universities are keen to maximise revenues to cover their costs and, ideally, to make a profit to be able to reinvest in their quality.

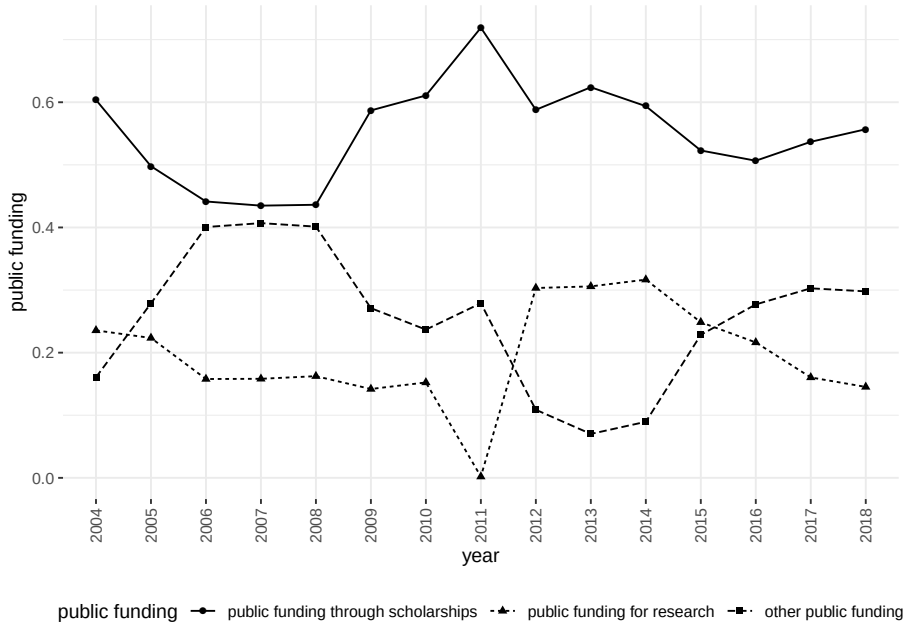
In the Kazakhstani higher education setting, all universities regardless of ownership

typically maximise their revenues through the simple expedient of maximising the number of students that attend them. The reason is that their funding is heavily dependent on funding related to teaching due to limited alternative sources of funding. Around 60% of public funding is allocated to teaching through the scholarship scheme, as shown in figure 3.9. At the same time, as the OECD country report states, public funding comprises not more than 30% of the total higher education funding (and only 0.3% of the country's GDP), the main source of which is privately funded tuition fees (OECD 2017, p. 53). This is noticeable in figure 3.10, which documents the total number of higher education students (full-time, part-time and distance-learning) funded by the state scholarship and privately funded through tuition fees. In addition, the amount of state scholarship is rather low and leaves little possibility to maximise profits without maximising the number of students, at least for the subjects that are relatively expensive to run, though it is almost twice as high for the national versus other HEIs. In turn, the state-funded scholarship serves as a price ceiling for the tuition fees set by the public and the majority of private institutions, considering the homogeneity and tough competition among them. Until 2018, the scholarship also comprised a price floor as mandated (Mhamed et al. 2018, p. 24) to prevent dumping; therefore, variation in tuition fees between the state and the vast majority of the private universities is small.

Moreover, though public universities are given disproportionally more scholarship places (relative to private universities) and on average have better reputations and better student bodies, this still does not guarantee their desired enrolment numbers in a very competitive environment. There is anecdotal evidence that even for the very prestigious and attractive universities in Kazakhstan, the upper limit of the student intake has never been discussed within the admissions context as it is unlikely reachable in the situation when too many universities chase too few applicants.

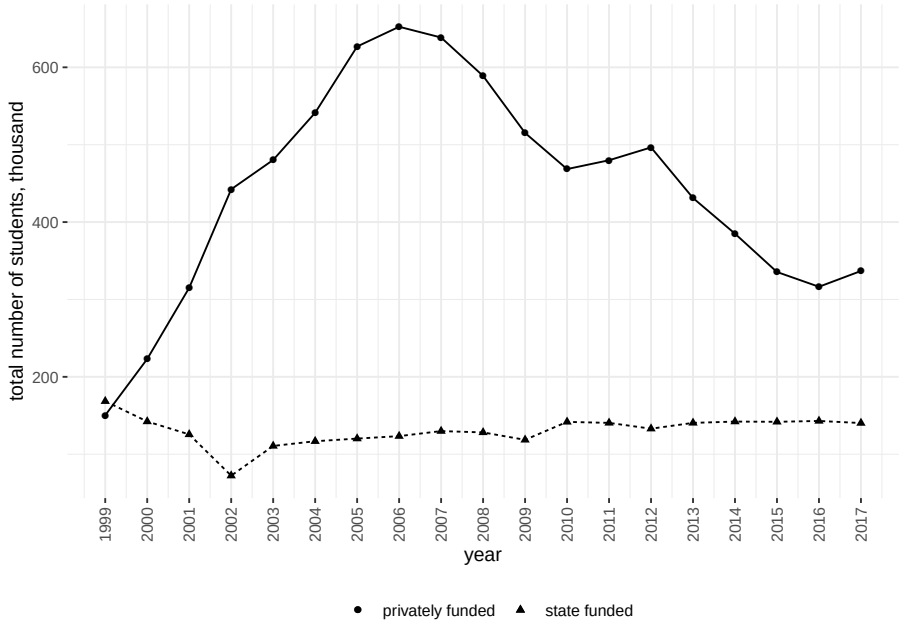
No higher education institution in Kazakhstan likely approaches the economies of scale which is believed to be reachable with much larger outputs. The use of comprehensive worldwide cross-section data indicated average costs dropping with the enrolment of 10,000 students (Lee 1984). Having limited opportunity to gain advantage from the economies of scale increasing the number of students, universities might seek to benefit from the economies of scope by delivering a wider range of subjects and decreasing average costs by exploiting complementarity. Table 3.2 shows the average number of programmes delivered by the universities, average number of students per programme, and curriculum diversity, that is, the number of programmes offered per 1,000 students (Brinkman 1981). It is likely that only the 'elite' private universities could attempt to benefit from the subject-specific economies of scale and scope with fewer and usually related subjects offered and relatively more students enrolled in each. This could partially be true for public universities, though their curricula are much more diversified. However, the remaining private universities

Figure 3.9: Share of different sources in total public funding



Data source: data on public funding were provided by the Ministry of Education and Science upon request.

Figure 3.10: Total number of students in HEIs funded by the state scholarships and tuition fees



Data source: IAC 2017, p. 308

delivering wide-ranging curricula of poorly related subjects likely increases the number of programmes offered to attract more students rather than to exploit the economies of scope.

The tendency of HEIs towards specialisation (as opposed to curriculum diversity) within the centralised Soviet economy (Huisman et al. 2018), drastically changed with marketization. Toughening competition increased the diversity of curricula offered by a single institution, and probably the only constraining force is the existing licensing scheme - in order to launch a new programme, a university has to obtain a license from the MES, demonstrating eligibility in accord with certain criteria. According to Riesman 1956, lower-status universities deliberately mimic the higher status ones to gain status and recruit more students, which historically might lead to 'academic drift' or uniformity, and this is likely the case for Kazakhstan. On the other hand, empirical research by Rossi 2009 suggests that HEIs have two opposite incentives: to diversify curricula or exploit horizontal differentiation to "capture a wider range of student preferences and to match competition from other universities" but "at the same time they also face strong incentives to specialize in those disciplines that have attracted the most enrolments in recent years" (p. 409).

It is likely that in Kazakhstan, with its changing higher education landscape, both tendencies appear. The private universities traditionally specialise in less costly and more lucrative and attractive subjects; however, many of them refocused towards the subjects with higher probability of obtaining increased public funding via scholarships as soon as they got the opportunity to participate in the state funding scheme, or towards those becoming more popular due to perceived changes in the labour market. At the same time, the variety of programmes taught by relatively small institutions might raise doubts as to the quality of these programmes since increased curriculum diversity significantly increases costs and generates disutilities of scope instead (Brinkman 1981) unless these universities set very high tuition fees or attract funding from other sources, neither of which are the case. On contrary, it might be reasonable to expect the private 'elite' universities, or at least the most expensive among them, to maximise quality and prestige (in addition to quantity) as a factor in their attractiveness, as they set relatively high tuition fees and offer limited number of scholarships. This includes, among the other things (such as investing in better teaching, student services, etc.), higher selectivity, since in words of Winston "student demand is sensitive, too, to the quality of a school's students" (Winston 1999, p. 24). This might be the case for the national universities as well, though they offer much better funding opportunities to their applicants.

Table 3.2: Mean number of undergraduate programmes and full-time students per programme by university type

University type	Mean number of programmes per university	Mean number of students per programme	Curriculum diversity ratio
national	37	243	7.76
state	35	202	10.03
private 'elite'	14	203	7.10
private 'other'	21	120	24.81
Data source: Mean number of students computed from IAC 2015b; data on number of programmes offered by HEIs - from *AHEI RK* 2014.			

3.2 Data and basic estimations for the returns to higher education

In this and the following chapters of the thesis I use the administrative dataset for 90,329 individuals who entered higher education in 2010-2012 and graduated in 2014-2016 from four-year full-time Bachelor's academic programmes at 104 universities (nine national, 38 state and 57 private, among which 10 are 'elite' private, according to the classification given above). The data consists of the student characteristics (the subject they have studied, their entry UNT score, gender, language of instruction), monthly mandatory contributions to the state Unified Accumulative Pension Fund during each month after graduation up to January 2018, region ('*oblasts*'), type of economic activity, and size of employer's company (small, medium or large business).

In accordance with the *Pensions Act* 2013 first enacted in 1998, pension contributions are mandatory for all official working-age working individuals. They must be deducted by all employees and self-employed and comprise 10% of their income before tax. In the case of employees, the contributions are fully paid by the employee without an employer's contribution except those who are employed in hazardous jobs for whom an additional 5% is covered by the employers. There is no minimum income threshold for compulsory contributions, though there is a maximum threshold - the contributions cannot exceed an amount equal to fifty official minimum wages or around 3,000 USD in 2016 per corresponding exchange rate[11].

Summary statistics on selected variables follow in table 3.3. In accordance with the country-level statistics presented above, the four types of universities vary in their charac-

[11]The pension data is confidential. To secure confidentiality, it was merged with the university data by the Kazakhstani authorities to ensure the researcher did not gain access to personal data except for gender, university, subject, the language of instruction, test score, and company characteristics (industry, regional location and company size), and would thus not be able to identify individuals.

teristics. National and 'elite' private universities enrol the most able students as measured by their entry test scores. However, 'elite' private over-perform when comparing the mean test score for disaggregated subsamples of publicly and privately funded students - for both samples, they have best average student body. Along with that, the share of publicly funded students is massively larger at national rather than at other types of institutions, which is consistent with the higher education population statistics shown in table 3.1. Further, the least able students are served by the other private universities, and the share of scholarship-holders is smallest amongst them. The distribution of the log mean real wages across HEI types is consistent with the students' abilities as measured by their UNT scores.

Table 3.3: Summary statistics, N=90,329

Variable	**National, N=18,435**	**State, N=35,209**	**'Elite' private N=11,247**	**Other private, N=25,438**
Test score:				
mean	81.45	77.09	81.19	68.51
s.d.	15.06	15.99	17.51	17.27
Test score of the students granted scholarship:				
mean	83.68	81.07	96.70	80.27
s.d.	14.80	14.94	12.39	16.56
Test score of the privately-funded students:				
mean	76.58	73.19	77.55	67.48
s.d.	14.44	16.37	16.51	16.95
Log mean real wage (adjusted by CPI, base year – 2010):				
mean	8.3	8.18	8.65	8.06
s.d.	1.08	1.05	1.11	1.13
Number of observations:				
Gender:				
male	6,344	14,064	4,883	10,202
female	12,091	21,145	6,364	15,236
Scholarship holder:				
yes	12,628	17,195	2,139	2,056
no	5,807	16,546	9,107	23,370
NA		1,468	1	12

The initial dataset collected by the MES consists of 164,582 graduates from 109 universities: nine national (23,581 graduates), 38 state (59,884 graduates) and 62 private (81,116 graduates). To achieve accuracy in further estimations, I have applied several filters, dropping irrelevant observations or observations which were likely recorded with

errors and missing values:
1. 43,279 graduates with a duration of study of fewer than four years who are likely the distance-learning students obtaining their second degree or the short-time students who entered higher education after TVET institutions.
2. 27,656 graduates with no data on their test scores. Administrative data on the test score stored by the UNT administrator - the MES Testing Centre - was merged with the graduates' data; therefore if the score did not appear in the sample, then the person was likely not to be sitting the test or there were errors in the identification number recorded by the universities.
3. 3,318 graduates who either entered the university earlier than 2010 or graduated later than 2016.

The highest proportion of observations was dropped from the initial dataset due to missing entries for the test score. To test for randomness in the data loss, I show the graphs plotting an average share of missing values for the test score for each university-subject-cohort cell against the observed mean (figure 3.11), minimum (figure 3.12) and maximum (figure 3.13) test scores for each of these cells. Grey dots represent university-subject-cohort cells, and their size depends on the cell size, varying from 1 to 1,357. With the initial 109 universities, 12 subjects and five cohorts (which entered higher education in 2009-2013) there are 1,886 cells. Red dots represent their mean values for each corresponding test score. For all plots, the pattern in the variation of the mean proportion of missing values appeared to be reasonably non-systematic with respect to the test score observed, allowing to assume randomness in the missing observations.

Figure 3.11: Average share of missing values for test score and observed average test score for each university*subject*entry year cell

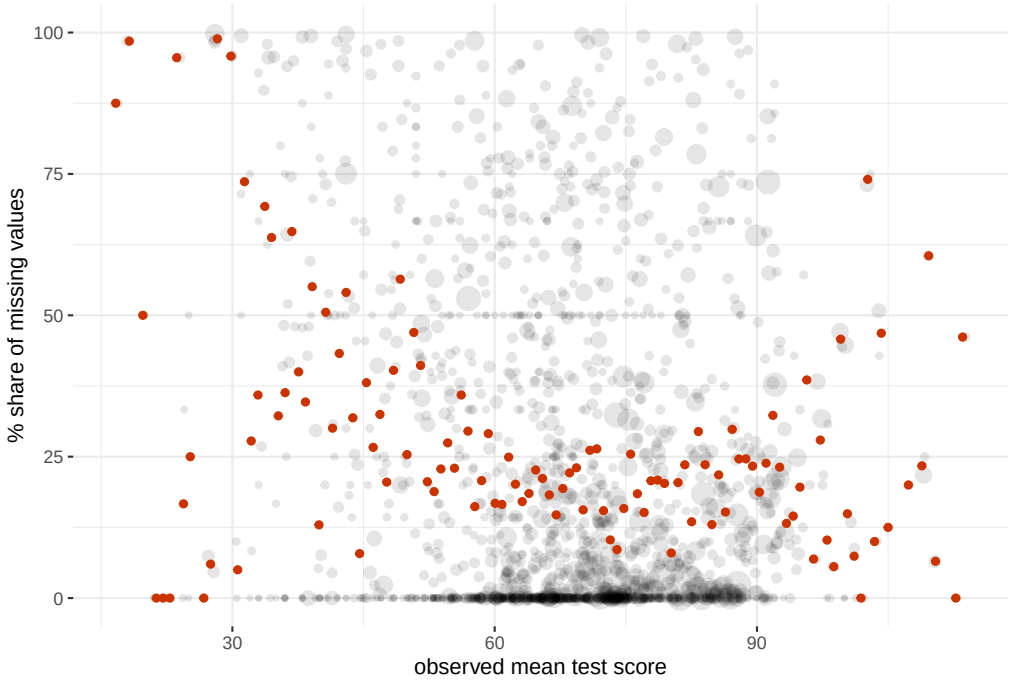


Figure 3.12: Average share of missing values for test score and observed minimum test score for each university*subject*entry year cell

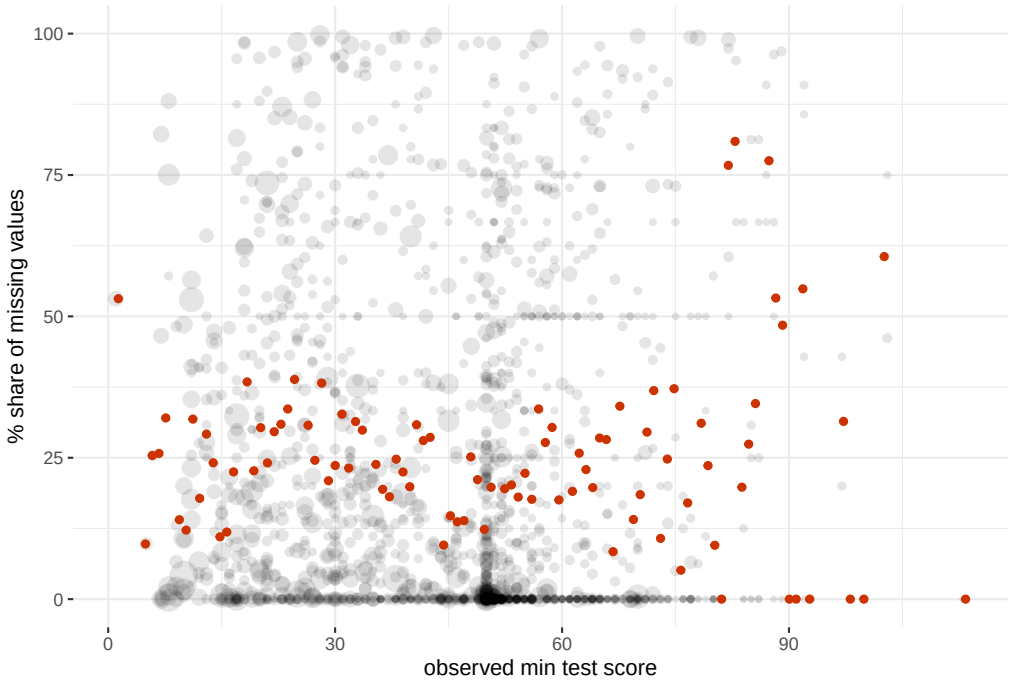
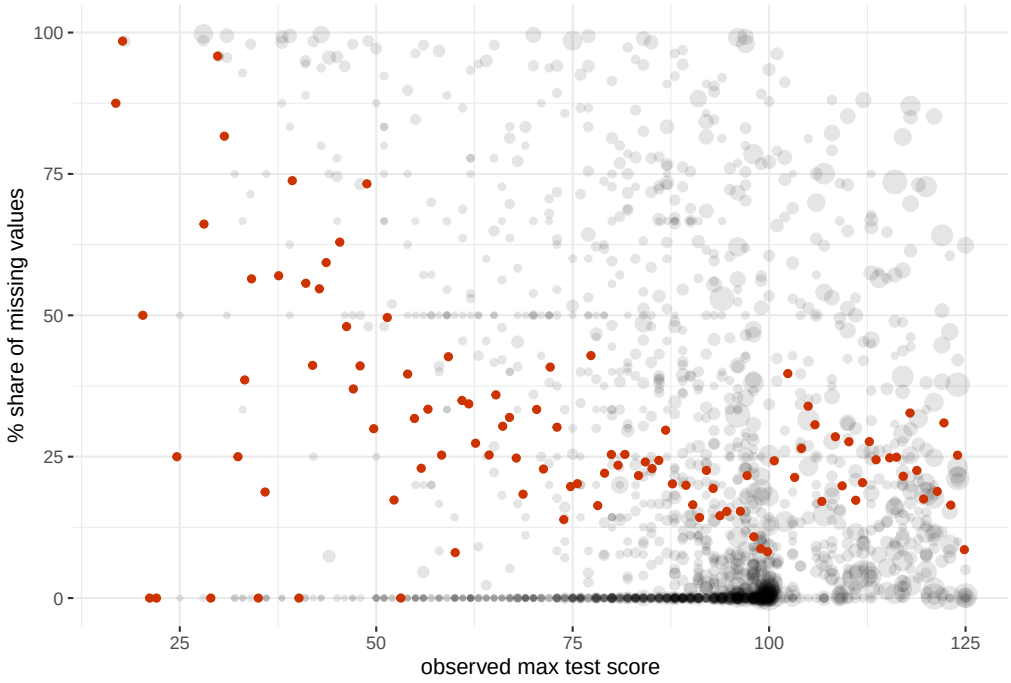


Figure 3.13: Average share of missing values for test score and observed maximum test score for each university*subject*entry year cell



The following sections report the estimates from the basic models assessing the variation in the returns to a degree depending on the university type, subject, gender, UNT score, scholarship holder status, and certain university characteristics. The returns are assessed in a form of a probability of being in official employment during at least one month after graduation and the graduates' mean real pension contributions over this period. Additionally, they provide a brief discussion of the results, relating them to the previous findings documented in the literature, where relevant.

3.2.1 Returns to degree: probability of employment

Table 3.4 reports the estimates computed with the probit model regressing the employment status, indicating whether a person has deducted the mandatory social contributions at least once during a calendar year from January following the year of graduation on their university type, gender, subject aggregated into five wider groups, test score, state-funded scholarship holder status, and cohort (university entry year) dummy. 1,532 individual observations were lost due to missing values regarding scholarship status (1,481 observations) and subject (51 observations). The same model are then recomputed separately for each university type subsample; these models additionally control for the university-fixed effects and log-transformed tuition fee. Average marginal effects are reported.

The probability of being employed is higher in the graduates of state (by around

Table 3.4: Returns to degree: likelihood of being employed, probit

	all	**national**	**state**	**private 'elite'**	**private other**
			Dep.var.: employment status		
university type: state	0.0189***				
	(0.0044)				
university type: private 'elite'	0.0450***				
	(0.0058)				
university type: private other	-0.0435***				
	(0.0052)				
gender: male	0.0211***	-0.0024	0.0549***	-0.0117	0.0197**
	(0.0033)	(0.0074)	(0.0052)	(0.0086)	(0.0065)
subject: Agriculture and Natural Sciences	-0.0284***	0.0011	0.0089	-0.0773*	-0.0439**
	(0.0069)	(0.0140)	(0.0110)	(0.0306)	(0.0159)
subject: Arts	-0.0098	-0.1097**	0.01053		-0.1266***
	(0.0116)	(0.0363)	(0.0240)		(0.0260)
subject: Education and Humanities	0.0129***	0.0041	0.0541***	-0.0326	0.0179
	(0.0043)	(0.0115)	(0.0099)	(0.0189)	(0.0099)
subject: Engineering and Technology	-0.0079*	0.0174	0.0039	-0.0175	0.0321***
	(0.0046)	(0.0118)	(0.0082)	(0.0140)	(0.0096)
test score	0.0010***	0.0001	0.0010***	0.0013***	0.0006**
	(0.0001)	(0.0003)	(0.0002)	(0.0003)	(0.0002)
scholarship holder	-0.0013	0.0251**	-0.0209***	-0.0369*	-0.0172
	(0.0040)	(0.0097)	(0.0061)	(0.0144)	(0.0131)
ln(tuition fee)		0.0814	0.0504	0.0925**	0.0747
		(0.0708)	(0.0324)	(0.0354)	(0.0415)
N	88797	18287	33737	11246	25289
Pseudo R2	0.0059	0.0063	0.0482	0.0223	0.0375
LR chi2	647.11***	142.15***	1970.11***	285.12***	1241.13***
university dummies	no	yes	yes	yes	yes
cohort dummes	yes	yes	yes	yes	yes

Notes: (1) Average marginal effects computed in R with 'mfx' package (Fernihough, 2019). White/robust standard errors are reported in parentheses.
(2) Reference category for employment status: not observed in official employment.
(3) Reference category for university type: national.
(4) Reference category for subject: Social Sciences, Business and Law.
* p<0.05, ** p<0.01, *** p<0.001

2 p.p.) and 'elite' private universities (by around 5 p.p.) compared to the national universities' graduates and lower in the graduates of other private universities (by around 4 p.p.). Among the various subject groups, only 'Education and Humanities' ensure an employment status that is significantly higher (though only by around 1 p.p.) than the baseline category - 'Social Sciences, Business and Law'. An increase in test performance of 10 UNT scores increases the probability of employment by around 1 p.p. for the whole sample, though the result is not significant for the national universities. Along with that, scholarship status results are somewhat unsystematic, while tuition fees is a predictor of employment status only for the 'elite' private university graduates: a one p.p. higher fee increases their probability of employment by around a nine p.p.

Table 3.5: Number of higher education graduates and those of them who entered postgraduate programmes in the same year

	2014	**2015**	**2016**
Number of higher education graduates	74,890	79,451	80,453
Number of higher education graduates enrolled into Master programmes during the same year	12,410	11,608	15,018
Share, %	16.57	14.61	18.67
Data source: *CSRK* 2019; *CSRK* 2019			

However, due to the data limitations, there is no knowledge about those graduates who have no pension contributions recorded, whether they are unemployed, self-employed, employed in the informal economy, in further education, or who are not in work due to personal circumstances. For instance, one might reasonably assume that a national university graduate would have better opportunities to continue their education at the graduate level since the national universities have more Master's programmes and more scholarship places to offer than other universities (and they might give preference to their graduates when allocating them or just better promote these opportunities among their undergraduates). Thus, practically, it is challenging to use this dataset to (1) estimate employability with sufficient accuracy; and (2) confidently control for non-random selection into employment, each of which represent the major limitations to this study.

Overall, around 30% of the graduates in the sample have no social records for the first calendar year after their graduation. According to the Committee on Statistics data reported in table 3.5, around 16% of graduates of the Bachelor's programmes in 2014-2016 continued their education at the Master's level. Though some of them might be employed during their graduate studies, considering those who continue their education abroad[12], this number seems to be a fair representation of those in further education. Thus, around 14-16% of graduates are neither employed by the formal sector nor in further education. To the best of my knowledge on the situation in the Kazakhstani labour market, it is reasonable to assume the majority of them are in informal self-employment or informal employment.

In Kazakhstan, the informality rate (proportion of individuals informally employed or self-employed in the labour force) for 2010-2017 was 25.7% on average, with a tendency to decline over the period. Among them, 56% were in informal self-employment and 44% in informal employment in the formal and informal sectors of the economy[13]. According to

[12]Outbound mobility ratio for tertiary education was 14.3% in 2015, UIS.Stat UNESCO data, http://uis.unesco.org/en/uis-student-flow. There is no data on those who study abroad on graduate-level programmes.

[13]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

the Ministry of Labour and Social Protection, the self-employed number about 2 million out 6.5 million employed in 2018 (*MLSP* 2018), however, not all of these are involved in informal activities.

Due to the centralised distribution of the labour force across regions, industries, and enterprises, the extensive nature of the production process and promotion of attitude toward work represent a duty rather than the right of a Soviet citizen, the unemployment and self-employment rates were close to zero even towards the end of the Soviet era (Verme 2000). In the early 1990s, unemployment emerged as a result of the state-owned enterprises' liquidation and employment reduction in the remainder. This redundant labour was not immediately absorbed by the private sector, which formed rather slowly. According to the Blanchard transition model (Blanchard 1997), the transition countries followed 'reduction in the public sector - growth in unemployment – extension in the private sector' path. However, as Verme (2000) argues, in many of them, including Kazakhstan, the lag in the second stage due to the slow accumulation of the private sector resulted in redistribution of a part of the workforce into self-employment which acted as a "buffer sector between wage employment, unemployment and economic inactivity" (ibid., p. 64). Verme (ibid.) have adopted the self-employment model developed by De Wit (1993). In this model, he suggests the concept of so-called 'self-employment profit of equilibrium', which is the value of the profit that the self-employment sector could offer to those workers downsized by the declining state sector during the adjustment stage, or in other words, "the reservation wage for self-employment". With the reduction in the state employment, it moves from the wage offered by the state sector to unemployment benefits, or to the amount "sufficient just to maintain the basic needs" (Verme 2000, p. 59). Unemployment benefits play a crucial role in this model: as soon as they are cancelled, self-employment expands, according to Verme, until it becomes "the largest employment sector in the economy" (ibid., p. 65).

In fact, in Kazakhstan, the year of the state-funded unemployment benefits' cancellation coincided with the beginning of the oil boom decade. As the private and public sectors grew due to the rapid oil boom, the gradual but rather slow outflow from self-employment came about, which is likely to correspond with the creation of the new jobs. Characterising the nature of self-employment in Kazakhstan, Mussurov and Arabsheibani (2015) note that it is "necessity-driven self-employment positively correlated with recession". They estimate the share of informal self-employment in the Kazakhstan Labour Force Survey data for 2006–2011 and document that around half of the self-employed operated informally (45% in 2011). At the same time, they observe a clear trend of decline in the informality of self-employment over the analysed period - it dropped by 12% and 16% for men and women, respectively. This is likely to be explained by the favourable macroeconomic conditions, structural change and "government... reforms designed to ease

the regulatory burden" (Mussurov and Arabsheibani 2015, p. 16). Notably, the share of informally self-employed is inversely related to their level of education. Additionally, the study reports that educational attainments have contributed to about 20% of the decline in the informally self-employed.

Furthermore, a higher level of education is likely to secure one from having to enter informal employment. Mussurov et al. (2019) adopting the "'legalistic' definition of informality that considers working without social security coverage" (ibid., p. 268) and using the Kazakhstan Labour Force Survey data for 2013, found that there was a relatively large share of the informally employed in the formal sector as a result of "the weak enforcement capacity of public institutions" (ibid., p. 268). Along with that, they found out that the extent of informality is higher for youths. With descriptive statistics, they report two trends observed in terms of being employed with 'verbal' or civil labour contracts[14] (versus written labour contracts) which usually assume working without social contributions deducted: on the one hand, younger workers are found to be more likely to work on 'verbal' or civil contracts, whilst on the other the overwhelming majority of people with higher education completed (97.8%) work with written labour contracts (ibid., p. 271-273).

These findings are in line with the Soros Foundation report, suggesting that younger people are mostly involved in informal employment in the formal sector in Kazakhstan - the share of 20-29 years olds comprises 32% of all those informally employed in the formal sector. There is no data on the types of jobs they occupy, but these are predominantly in small and medium enterprises and in accommodation and food service activities and the retail trade (Beisembayev et al. 2018). These jobs are not necessarily those requiring schooling below higher education level, but they are likely riskier in terms of labour protection, and are likely those more prone to reductions during the economic downturns. On the other hand, accommodation and food service activities are not among the main industries of employment for working graduates (as will be shown later), while wholesale and retail trade is the third-most important employment industry for the graduates of the state, private (other than 'elite') and national universities.

The outcomes of the two-stage earnings Heckit model developed by the study of Mussurov et al. (2019) elucidate the incentives mechanism of the choice between being engaged in formal versus the informal sector of the economy in Kazakhstan. In particular, it points to two trends that are potentially contradictory for this study. The returns to higher education[15] turned out to be higher in the formal sector versus the informal (50% versus 43%, respectively). At the same time, tenure of less than a year results in a higher earning

[14]Civil contract implies temporary employment and does not require an employer to provide social protection to the worker under contract. As Mussurov et al. (2019) note, they are usually renewed every 12 months "in order to avoid the financial overhead of a full-time employee" (p.273) since they automatically turn into permanent contracts if not renewed or terminated after 12 months.

[15]Baseline category is the respondents with primary or basic secondary education - a compulsory level of education.

penalty in the formal than in the informal sector (16% versus 9%, respectively). Thus, for a young person with a degree and no tenure (or experience), there are both the incentives to enter the formal sector considering the returns to a degree, and the incentives to refrain from such considering the returns to tenure. As the authors conclude, "informal employment may be a voluntary choice: workers choose to work informally because it is equally attractive to work in that sector, especially for degree holders" (Mussurov et al. 2019, p. 278). Moreover, they argue that employees with tenure of less than a year are "likely to enter the workforce for short-term earnings opportunities and that job separation rates are higher in the informal sector" (ibid., p. 278), This is generally consistent with a rather significant proportion of the potentially informally employed or self-employed observed in the administrative data I used. Thus, the computations on the likelihood of being observed in formal employment should be interpreted with a degree of caution.

3.2.2 Returns to degree: mean real wages

The OLS model reported by table 3.6 regresses the log transformed mean real pension contributions (referred to as a 'wage' for simplicity) adjusted by CPI, with 2010 as the base year on the same set of explanatory variables. With the data at hand, I have no clear understanding of the reasons for an individual not to be observed in official employment, as per the discussion presented above. Therefore, the mean of the pension contributions is computed only for those months when a graduate was in official employment, with the months when they are not being dropped. With that, the sample size decreases to 61,030 working graduates.

Dropping missing values when computing mean wage generates a sample selection problem since wage returns are estimated for the sample conditional on being observed in the formal sector official employment. As found in the previous section, the probability of being employed in the formal sector differs for different university types: it is the highest amongst the graduates of the 'elite' private and the lowest amongst the graduates of the remainder of the private universities. It is also lower for the national versus state universities. The latter possibly reflects a higher propensity to enter post-graduate studies amongst national university graduates. If graduates self-selecting for further studies are relatively more able, then employment and returns to education estimates for the national university graduates underestimate their actual employment opportunities and returns. However, there is some anecdotal evidence that a master's degree does not provide significant returns in Kazakhstan (at least compared to the undergraduate degree), thus graduates choosing such courses might be relatively less able and those who could not enter the labour market immediately. Then the returns are overestimated instead. Thus, it is difficult to predict the direction of the bias.

The bias for the other private universities' graduates is probably less vague. They likely

have a higher propensity to select informal employment and self-employment because better (in terms of salary and social security) jobs are less available for them due to the perceived lower quality of the education they obtained. Therefore, the estimated coefficients likely overestimate the returns and employment opportunities if only relatively better graduates are observed.

Overall, since we only observe wages for those in employment, to the extent that these are a positively selected sample: (a) the returns estimates might not be generalisable; and, more importantly, (b) those who select in who have lower levels of observed human capital (and enter lower HEI types) will disproportionately be those with higher unobservable skills that are rewarded in the labour market, hence the results underestimate the return to the better HEIs.

The wage returns to the graduate from 'elite' private universities is nearly 50 p.p. higher than the returns for the national university. In turn, the state and other private university graduates earn around 9 p.p. and 14 p.p. lower than national university graduates, respectively. However, it should be noted that their graduates are mostly employed in the provinces, unlike the graduates of the national and 'elite' private universities, the majority of whom are employed by the two most economically successful cities. State-funded scholarship holder status is only significant for the whole sample, while better test scores are positive and significant for all graduates except other private universities: each 10 UNT score points increase wages by around 3 p.p. for national and state and by around 5 p.p. for 'elite' private universities. The three largest subject groups – 'Education and Humanities', 'Social Sciences, Business and Law' and 'Engineering and Technology' - provide approximately similar returns to a degree; however, it is significantly lower for those graduating from 'Agriculture and Natural Sciences' (by about 15 p.p.) and higher for graduates of 'Arts' degrees (by about 27 p.p.)[16]. Finally, tuition fees, as can be surmised, are a relatively more important determinant of the graduates' labour market outcomes at the 'elite' private and national universities where they are much more scattered: a one p.p. higher fee is associated with around a 58 p.p. higher salary at the 'elite' private and a 52 p.p. higher salary at the national universities.

Figure in appendix B.2 shows the density plots of the mean of real wages[17] of the graduates during a year in employment, by cohort, and by university type. Dashed lines indicate mean wages for pooled cohorts. The descriptive picture confirms that private 'elite' universities' graduates get higher salaries in each year. This could be at least partially explained by differences in the industry of employment (type of economic activity)

[16]It could be that Arts graduates have higher but not systematic earnings (or piece-rate vs. time-rate earnings), adopted methodology for computing average wages based on only those months when a person has deducted social contributions ignores this possibility.

[17]'Wages' here are computed as the mean of the pension contributions for the months when a person is observed in official employment (excluding those that are unobserved) multiplied by 10, and averaged across academic programmes and universities.

Table 3.6: Returns to degree: mean real wages, OLS

	all	**national**	**state**	**private 'elite'**	**private other**
	Dep.var.: log mean real wage				
university type: state	-0.092***				
	(0.0122)				
university type: private 'elite'	0.3968***				
	(0.0169)				
university type: private other	-0.1520***				
	(0.0147)				
gender: male	-0.0389***	-0.0128	0.0127	-0.1138***	-0.0599**
	(0.0096)	(0.0214)	(0.0153)	(0.0251)	(0.0195)
subject: Agriculture and Natural Sciences	-0.1618***	0.0007	-0.0756*	-0.1038	-0.2075***
	(0.0194)	(0.0398)	(0.0322)	(0.0815)	(0.0494)
subject: Arts	0.2427***	-0.0129	0.1752*		-0.0122
	(0.0339)	(0.1189)	(0.0687)		(0.079)
subject: Education and Humanities	0.0236	-0.0063	0.1822***	-0.0326	0.0563
	(0.0122)	(0.0325)	(0.0274)	(0.0509)	(0.0293)
subject: Engineering and Technology	0.0637***	0.0103	0.1273***	-0.0456	0.0897**
	(0.0134)	(0.0344)	(0.0251)	(0.0406)	(0.0293)
test score	0.0025***	0.0025**	0.0022***	0.0046***	-0.0003
	(0.0003)	(0.0009)	(0.0005)	(0.0009)	(0.0006)
scholarship holder	0.0749***	0.0361	0.0176	-0.0035	0.0375
	(0.0111)	(0.0269)	(0.0165)	(0.0398)	(0.0348)
log (tuition fee)		0.5195*	-0.1916*	0.5793***	-0.1345
		(0.2022)	(0.0839)	(0.0995)	(0.1214)
constant	8.0781	1.1485	10.7439***	0.4399	9.76***
	(0.0284)	(2.7146)	(1.0855)	(1.3629)	(1.5539)
N	61030	12593	23826	8287	16177
Adj. R2	0.0340	0.0155	0.0379	0.0834	0.0433
F Statistic	171***	13.74***	24.17***	43.45***	15.76***
university dummies	no	yes	yes	yes	yes
cohort dummies	yes	yes	yes	yes	yes

Notes: (1) Computations are done in R. HC1 robust standard errors computed with 'estimatr' package (Blair et al, 2019) in parentheses.
(2) Reference category for university type: national.
(3) Reference category for subject: Social Sciences, Business and Law.
* p<0.05, ** p<0.01, *** p<0.001

shown in appendix B.3. The majority of graduates are absorbed by only a relatively few sectors; for the national, state and other private universities, these are 'Public administration and defence; compulsory social security' and 'Education'; and for 'elite' private these are 'Financial and insurance activities', 'Public administration and defence; compulsory social security', 'Professional, scientific and technical activities' and 'Wholesale and retail trade'. The lower segment of the figure in appendix B.3 displays the mean nominal entry wages of those graduates along with the country-level mean wages for all employees (independent of their level of education) for those industries in 2014-2016. As can be seen from the country-level data, the best-paid industries include 'Professional, scientific and technical activities' and 'Financial and insurance activities', while 'Education' and

'Public administration and defence; compulsory social security' appear to be among the worst paid. The latter is the case for the entry wages computed from the data, which are generally lower than the average country-level industry wages. The country-level wages and entry wages gap vary from 0.18 log points to 1.09 log points (or from about 17,000 KZT to 183,000 KZT, in absolute values) with the larger gap in the best-paid industries (which possibly also employ better-educated workers). However, this also varies for different types of universities, with the lowest gap for the 'elite' private universities' graduates for nearly all industries - see figure in appendix B.4. Additionally, 'elite' private universities have the largest share of graduates employed by large businesses, with more than 251 employees (37% versus 31%, on average, in others) and the smallest share of those employed by small enterprises with less than 100 employees (32% versus 45% in others) which are also likely to contribute to the observed wage gap across the different types of universities[18], since wages paid by small businesses tend to be lower than those paid by large businesses in Kazakhstan[19]. However, there is anecdotal evidence that small businesses tend to be more involved in informal employment, for example, by paying, among other things, hidden wages when a wage, or a part of it, is paid informally to evade taxes. Therefore, the actual wages of those employed by small enterprises might be higher, which requires additional caution when interpreting the results.

In addition to the brief discussion on bias caused by conditioning on employment status presented at the beginning of this section, there are several possible omitted variables not observed in the data but that might affect the selection into the different types of HEI (even conditional on test score) and different subjects. Potentially the most important among them is the students' socio-economic backgrounds. It is reasonable to expect students from richer families to enter 'elite' private and to some extent national universities much more often than the remaining private and state universities and to choose relatively more lucrative and expensive subjects, such as Business Administration, IT, and Oil and Gas Engineering. Therefore, including graduates' socio-economic status should decrease the estimates for employability and returns to a degree for these universities and subjects.

3.3 Summary and conclusions

In this chapter, I described the current higher education institutional setting in Kazakhstan and the relevant reforms the country had gone through over the transition period. Additionally, I presented a preliminary analysis of the returns to higher education for the recent graduates. The same dataset is used in the subsequent chapters that scrutinise the underlying mechanisms and evaluate some of the reforms in detail.

[18] According to the Committee on Statistics' company classification, www.stat.gov.kz.
[19] The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

I found a clear heterogeneity in the Kazakhstani market of higher education. I distinguish between four types of HEIs differing in their location, tuition costs, public funding and support, financial aids available to their students, subject composition, and student body. Unsurprisingly, the most expensive among them provide the highest returns premia in the form of higher salaries and, possibly, better employment opportunities. However, my estimates with regards to the probability of being observed in formal employment must be treated with a degree of caution as they are likely contaminated by unobserved effects. Additionally, the subject studied at the university turned out to be a less important determinant of further labour market returns than university type.

Chapter 4

University selectivity and returns premium: evidence from Kazakhstan

4.1 Introduction and motivation

In line with the transition reforms, Kazakhstan has experienced, and is currently experiencing, dramatic changes in higher education: a sharp increase in the number of HEIs and students, privatization, marketization, changes to academic content and the design of new frameworks and institutional structure. In 2001, nine public universities were granted the status of *'national university'*, allowing them to benefit from relatively better public funding, administrative support and the privilege to raise their tuition fees. In return for better input, they are expected to "guarantee consistently high world-class standards of education" (*Decree* 2001) and "integrate teaching, learning and research at all levels of study" (OECD 2017, p. 56). In accordance with these expectations, in 2012, national universities were forced to become more selective in their admissions, increasing minimum admission requirements compared to other institutions in order to improve the quality of their student intake. This would normally be reflected in better labour market outcomes for these graduates compared to those from other HEIs – the so-called returns premia.

The possible relationship between higher education selectivity and improved labour market outcomes of such graduates is a trending though well-studied topic. Starting with the pioneering works of Solmon (1975) and Wise (1975), higher education selectivity is commonly defined as an average quality of student intake across institutions measured by the mean entry examination score, such as the SATs (Standard Aptitude Tests) in the United States or A-Levels in the United Kingdom. As a matter of course, more selective institutions, with their superior students and staff and advanced resources, are

presumably better in academic quality (apparently with two-way causality between quality and selectivity) which should normally add relatively more value to the human capital productivity and lead to higher employability and salaries, as implied by the human capital theory introduced by Becker (1975), Mincer (1974) and Schultz (1960, 1961).

Another path from institutional selectivity to future earnings is the so-called peer effect – being in a class with more able peers creates value by itself, inspiring students to become more (economically) successful in their future lives (Sacerdote 2011, Carrell et al. 2009, Brunello et al. 2010, Winston and Zimmerman 2004, Stinebrickner and Stinebrickner 2006, Garlick 2018). The perspective of the peer-effects literature allows one to understand the nature of the institutional selectivity and two-way causality between peer-effects and selectivity. Winston (1999) emphasizes that peer effects constitute a specific feature of the technological process in (higher) education, or so-called "customer-input technology". "High quality colleges are selective because that is the way they assure an ample input of student quality" (ibid., p. 23), and, therefore, "student and institutional quality go hand in hand" (ibid., p. 18).

The other possible scenario, however, assumes a negative relation between peers' higher ability and an individual's own achievements referred as 'Big Fish Little Pond Effect' - comparison with more able peers might demotivate and decrease future outcomes (Marsh et al. 1995, Hau and Marsh 2003, Bui et al. 2014). In either event, empirical evidence often suggests peer effects to be more significant for students either on the bottom of the test score distribution (Winston and Zimmerman 2004, Stinebrickner and Stinebrickner 2006, Garlick 2018) or those from disadvantaged backgrounds who "might benefit the most from having good peers" (Stinebrickner and Stinebrickner 2006, p. 7). Equivalently, at the secondary school level achievements driven by interactions with peers are usually observed among the low-achievers, students from poor families and minorities (Abdulkadiroğlu et al. 2014, Abdulkadiroğlu et al. 2011, Dobbie and Fryer Jr 2011). A similar conclusion arises from the literature focused on the impact of student heterogeneity on their outcomes, commonly capturing the effects of weaker students benefiting from their high achieving peers (Lyle 2009, Booij et al. 2017, Braakmann and McDonald 2018). On the other hand, some studies have found the best-achieving students being also advantaged by interacting with equal peers (Sacerdote 2001).

There is another path from peer effect to higher returns - so-called, network externalities - 'ties formed between college peers' which lead to referral-based 'good' jobs allocation (Zimmerman 2013, p. 1). However, conclusions from this literature hardly apply to the graduates of the public institutions, as the cause of these effects probably comes from family wealth, and children from wealthier families tend to study at elite private institutions, which is also the case in Kazakhstan.

Finally, it could be the case that attending more selective institution is a signal of stu-

dent's greater abilities, as it is perceived by employers, and this sorts more able and productive workers from less able and productive, which is naturally implied by the signalling and sorting theory developed by Spence (1973), Stiglitz (1975), Arrow (1973). Education could be classified as an experience good (as opposed to inspection good) whose quality can only be determined after purchase (Nelson 1970), and reputation of the producer matters a lot for experience goods (MacLeod et al. 2017). Notably, in this case, the selective university need not necessarily be better in quality, but could rather create reputation effects.

Practically, these effects often coexist and can only rarely be disentangled and decomposed effectively. Using the natural experiment of the reform reducing the amount of coursework at the top university in Colombia, Arteaga (2018) found it to negatively affect the graduates' wages which "reject a pure signaling model" (ibid., p. 212). She assumes that since the reform has not affected the university's international and national rankings, according to the signalling model the affected graduates' wages should not change while the human capital model predicts their decline, where the latter was indeed the case.

At the same time, many empirical observations simply assume the existence of these effects which are expected to contribute in a positive relation between university selectivity and its graduates' outcomes. However, evidence from the empirical literature often - though not always - argues in favour of the significant role of selectivity policies contributing to better labour market outcomes of elite institutions' graduates rather than productivity, peer or reputation effects; and these studies are probably of particular interest due to their non-trivial results.

Studies of Solmon (1975), Loury and Garman (1995), Brewer et al. (1999) and Hoekstra (2009), based on U.S. data as well as the earliest U.K. study by Chevalier and Conlon (2003) found certain significant estimates associated with selectivity. Solmon names the average SAT scores among "the most important of the measurable institutional traits in the earnings functions of former students" (Solmon 1975, p. 583). Loury and Garman (1995) concludes that every 100 points added to the median SAT could increase earnings by 2.4-5% for white and black men, respectively. Hoekstra modelled a regression discontinuity design based on a rather complicated admission rule to enter flagship public university accounting for both SAT score and the high school GPA. With the data on the earnings of 28- to 33-year-olds, he identified considerable returns to "enrolling at the flagship state university - approximately 20% higher earnings" (Hoekstra 2009, p. 718). Chevalier and Conlon (2003), with the use of propensity score-matching techniques, found the returns to attending elite research-intensive and more selective Russell Group universities to be up to 6% higher as compared with other institutions in the UK.

At the same time, Dale and Krueger, using various approaches to control for the student admission by elite colleges - the so-called "'self-revelation' model because individuals reveal

their unobserved quality by their college application behaviour" (Dale and Krueger 2002, p. 12-13) - concluded that among the school characteristics considered, average tuition costs are more important than average SAT score though the returns to both are "greatest for students from more disadvantaged backgrounds" (ibid., p. 31). In their second paper, they used extended indicators of college quality (rather than just selectivity as measured by the test score) and discovered significant returns from attending more selective colleges: a "100-point higher SAT score led to students receiving about 6 percent higher earnings"; however, this disappeared in the model adjusted by selectivity (Dale and Krueger 2014, p. 29).

Similarly, the study by Walker and Zhu (2017), employing U.K. data, controls for university selectivity by constructing two residual wages measures – selectivity-unadjusted from the wage regression that omits subject and institution, and selectivity-adjusted from the same regression that included the mean standardized A-Level score for each subject-institution cohort, defining the difference as the wage premium attributed to selectivity. The latter turned out to be substantial, though varying widely across universities. According to this study, so-called New Universities (former polytechnics which were granted university status in 1992) perform better in terms of returns premium when adjusted for selectivity, while the opposite is true for Russell Group universities.

Finally, the research report on relative labour market returns (Belfield et al. 2018) again provides evidence of a clear though not homogeneous hierarchy of U.K. universities in earnings premia, which is dominated by the Russell Group. The authors then used Inverse Probability Weighted Regression Adjustment, and found these differences in earnings dropped noticeably: "high-status, high-earnings institutions typically take high-ability individuals who would likely have had high earnings regardless of the institution they attended, whereas low-status universities typically take lower-ability individuals" (ibid., p. 46).

Very few attempts have been made to address the relation between institutional quality/selectivity and their graduates' outcomes in developing economies, and to the best of found knowledge, the majority are concerned with the secondary education level. Ajayi (2011) measures "academic outcomes for students who attend [secondary] schools of differing quality" in Ghana and find "that the effects of school quality are meaningful" (ibid., p. 71). Hanushek (1995) comprehensively summarises a number of studies based on developing countries' data, comparing them with the similar U.S. data studies, referring to "a possible differentiation by stage of development and general level of resources available" (ibid., p. 231) between the two. He concludes that school quality is a crucial factor in students' achievements, in particular, that "low school quality may frequently be an important explanation for the widespread failure to take advantage of the apparently high returns available from education" in developing countries (ibid., p. 236), though it is poorly

possible to identify which exact measurable school characteristics are the most significant determinants of quality.

Finally, there are few empirical examinations analysing the effect of school quality on economic rather than academic outcomes in the developing world. The first paper stressing the importance of school quality was undertaken by Behrman and Birdsall (1983). They show that ignoring quality measurement while estimating the returns to schooling might generate upward bias in estimates and, using Brazilian data, show the importance of schooling quality for labour market outcomes. They conclude that "'deepening' schooling by increasing quality" rather than "'broadening' schooling by increasing quantity" could be a more rewarding policy in the context of the developing countries (ibid., p. 929). Psacharopoulos and Velez (1993), exercising the data for higher education quality measured with a number of indicators and individual earnings in Colombia, find that "the score on the university entrance examination and the university's prestige rating have a significant positive impact on the earnings and occupational status of adults" (ibid., p. 130).

This was recently reconfirmed by MacLeod et al. (2017) who empirically test the effects of college reputation on graduates labour market outcomes using the introduction of the national exit exam as a natural experiment. They assume that bringing in a new signal of individual ability in a form of exit exam should reduce the returns to college reputation given that employers offer wages in accordance with it, and indeed the Colombian data appear to confirm this. Lastly, the study using data from Honduras states that "men educated in counties with better quality schooling earned significantly higher incomes than those men educated in counties with low-quality schools" (Bedi and Edwards 2002, p. 182).

Thus, methodologically, international literature agrees on the importance of institutional quality and selectivity as the major factors influencing their graduates' further earnings' variation; however, evidence about the relationship between selectivity and further earnings does not have such a straightforward interpretation. It is worth noting that the empirical studies on the developing countries often suffer from a lack of data and, therefore, use more aggregated indicators of quality (such as average schooling of teachers at a district level, as in Behrman and Birdsall (1983)) which could inflate estimates of quality. However, accounting for this possible bias, it seems that institutional quality has a more clear and systematic impact on individual outcomes in developing than in developed countries.

To the best of my knowledge, the current study represents the first attempt to estimate the returns to attending more selective institutions in the former Soviet bloc countries. The motivation behind this study can be comprehensively summarised in the words of Dale and Krueger (2014, p. 2): "understanding why students who attend higher quality

colleges have greater earnings is crucial for parents deciding where to send their children to college, for colleges selecting students, and for policy-makers deciding whether to invest additional resources in higher quality institutions". Although it is difficult to judge the quality of HEIs in Kazakhstan due to a lack of reliable evidence, I might at least assume a better than average quality of the national universities based on their higher selectivity and relatively better public funding. Therefore, as a practical point, it is critical to understand whether this anticipated better quality is actually reflected in graduates gaining higher wages.

In 2004, Kazakhstan introduced its centralised multiple-choice question examination for all secondary school leavers, limiting their entry into higher education based upon their reaching appropriate minimum test scores. In 2012, national universities, as flagship institutions, were required to enrol students with higher minimum test scores, unlike other institutions. This natural experiment allows to address the following research question: do more selective national universities provide higher returns to undergraduate degrees than other HEIs? I use administrative data on the entry salaries of a sample of higher education graduates and the fuzzy regression discontinuity design, which can be applied due to changes in the enrolment policy affecting national universities, to control for non-random selection. I should note that the intervening policy which made the entry test harder for all applicants in the same year limits the possibility of testing other quasi-experimental research techniques, such as difference-in-differences. The FRDD results reveal no significant effect of attending a national university in Kazakhstan, despite their higher selectivity and better funding, at least for the first affected cohort and during their first year in employment.

The remainder of this chapter is divided into the following sections. The following section explains the institutional framework in Kazakhstan, the regulations and procedures guiding the centralised entry examination, and describes the dataset used for analysis. In addition, it briefly explains public funding of higher education which is effectively achieved through the central exam and scholarship allocation scheme, allowing one to understand the differences in the distribution of the test scores across different types of HEIs. Section 3 presents the methodology, Section 4 documents the findings, while the final section discusses possible interpretations fitting the country context and the concluding remarks to the study.

4.2 Institutional background, regulations, public funding and data

Higher education in Kazakhstan experienced major reforms with the transition. The number of HEIs increased dramatically from 55 public institutions in 1990/91 to 122 public

and private institutions in 2017/18[1], where the corresponding number of students grew from 287,367 to 496,209[2]. The structural reforms towards achieving internationally recognised frameworks in accordance with the Bologna Principles and European Credit Transfer and Accumulation system, such as the introduction of three levels of higher education (Bachelor, Master and PhD), a cumulative credit-based system and a gradual transition to greater educational decentralization and autonomy, have been adopted. However, the current system is still highly centralised and regulated by the Ministry of Education and Science.

The current higher education hierarchy includes public - national and state - and private universities[3]. 47 out of 122 HEIs are public, including 10 national universities. In 2001, *'national university'* status was granted to nine large public "HEIs considered as having the best potential for training and research" (OECD 2007, p. 169):

1. Al-Farabi Kazakh National University
2. Gumilyov Eurasian National University
3. Kazakh National Agrarian University
4. Satpayev Kazakh National Research Technical University
5. Asfendiyarov Kazakh National Medical University
6. Abai Kazakh National Pedagogical University
7. Zhurgenev Kazakh National Academy of Arts
8. Kurmangazy Kazakh National Conservatory
9. Kazakh National University of Arts.

In 2015, the newly established Kazakh National Academy of Choreography was also given this status. As opposed to the 'national' epithet, other public universities are called 'state HEIs'[4]. Table 4.1 documents the number of students and share of state-funded scholarship holders in national universities in 2014.

All national universities are situated in Kazakhstan's two biggest cities: the previous capital, Almaty, which remains the main financial and business centre, and the current capital, Astana. Two of these universities (Al-Farabi Kazakh National University and Gumilyov Eurasian National University) are multidisciplinary, whereas the others specialise in selected subjects. Four out of ten national universities recently appeared in the QS World University Ranking (Al-Farabi Kazakh National University – 220 in 2019, Gumilyov Eurasian National University – 394 in 2019, Satpaev Kazakh National Research Technical University – 464 in 2019, Abai Kazakh National Pedagogical University – 481 in

[1]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

[2]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

[3]The Nazarbayev University - an independent internationalised public university established in 2010 - excluded from this analysis due to data unavailability and different regulations.

[4]There are different types of HEIs, depending mostly on the number of subjects offered: university, academy and institute; for simplicity they are interchangeably referred to as 'university' or 'HEI' in this study.

Table 4.1: National universities, selected statistics, 2014

University	**City**	**Number of students in 2014**	**Share of students with state funded scholarship in 2014**
Abai Kazakh National Pedagogical University	Almaty	6,534	40%
Al-Farabi Kazakh National University	Almaty	14,091	75%
Asfendiyarov Kazakh National Medical University	Almaty	8,853	76%
Gumilyov Eurasian National University	Astana	13,860	81%
Kazakh National Academy of Choreography	Astana	NA	NA
Kazakh National Agrarian University	Almaty	4,782	29%
Kazakh National University of Arts	Astana	1,283	79%
Kurmangazy Kazakh National Conservatory	Almaty	856	94%
Satpaev Kazakh National Research Technical University	Almaty	10,222	83%
Zhurgenev Kazakh National Academy of Arts	Almaty	1,447	74%
Source: IAC 2015b			

2019, Kazakh National Agrarian University – within 651-700 in 2019). In addition, they conventionally occupy the top positions in two national rankings[5].

While the state universities - mostly being former Soviet institutions - are relatively homogeneous, private universities are more diverse. Some of these appeared in the 1990s with the privatization of the state institutions or upgrade of the post-secondary vocational schools, whilst others have been established more recently. Ownership is also diverse: while the majority are private, 16 operate as joint-stock companies, including some with state participation. Private HEIs significantly deviate from each other (and from public universities) in terms of teaching and research quality, selectivity policies, and student intake, internationalisation, tuition fees and perceived returns to education, varying from very poor 'money-makers' to the most prestigious and expensive 'elite' institutions, whilst at the same time being more marketised than public universities. For instance, the range in tuition fees among private universities is three times as high as the range among state

[5]Independent Agency for Quality Assurance in Education, https://iqaa.kz; Independent Agency for Accreditation and Rating, http://www.iaar.kz.

universities and six times as high as the range among national universities[6]. They are more likely to deliver market-oriented academic programmes, such as 'Business Studies' and 'Law', and be more specialised and smaller than the national and the majority of the state HEIs. Finally, private universities receive considerably fewer public transfers, for example, in 2012, a private university received nine times less than a state and twelve times less than a national university on average[7].

The rules regulating entrance into higher education are centralised and must be followed by all HEIs, regardless of ownership. In 2004, the centralised examination, serving both as an entry exam and as a framework for the merit-based system of funding, was introduced. The Unified National Test (UNT) – an examination given to secondary school leavers - permits entry into higher education as dependent upon gaining the required score and eligibility to apply for the state-funded scholarship on a competitive basis at any university, regardless of ownership. It attempted to reduce corruption associated with higher education enrolment and allocation of the state-funded scholarships and to unify minimum requirements as based on the 'quality' of student intake. The UNT exam is taken over several days across the country and is meticulously monitored and controlled by the authorities, including by officials of the National Security Committee. Measures to prevent cheating are taken seriously, which assume that students are unlikely to manipulate their scores in general. The UNT is a multiple-choice test, and is assessed by a computer algorithm in which no personal intervention is allowed. Though the test content is often criticised for being oriented towards memorisation of facts and figures instead of testing thinking ability and skills, it is, however, believed to increase transparency and unification of the enrolment criteria and procedures, as well as decreasing corruption.

At the year under examination, UNT included 125 questions on five subjects: mathematics, the history of Kazakhstan, first language (Kazakh or Russian), second language (Kazakh or Russian) and an elective subject depending on the career choice.

Before 2012, secondary school leavers were required to attain 50 out of 125 UNT attainment scores to be eligible for entry into any university; most HEIs did not set additional selection criteria (which is still the case). However, selected degree subjects (specialities) have the right to ignore the test score for subjects other than history and language upon the applicant taking an additional subject-specific examination, as independently set by the university itself (*Decree* 2012). The list of these subjects can be seen in appendix C.1.

New regulations were adopted in 2012 (*Decree* 2012). The minimum required test score to enter national universities was increased to 70, while for other HEIs the minimum score remained unchanged. In addition, in 2012, the test content partly changed with new

[6]Minimum tuition fee for national universities is 600,000 KZT, maximum – 916,718 KZT; minimum tuition fee for state universities is 258,857 KZT, maximum – 804,000 KZT; minimum tuition fee for private universities is 228,095 KZT, maximum – 2,157,000 KZT (the MES data for 2018).

[7]Data on public funding is provided by the authorities on request.

questions oriented towards the evaluation of logical and reasoning skills being introduced (MES 2012), and the measures taken to prevent corruption and cheating during the test were enhanced (*Decree* 2011, Irsaliyev 2011). The measures contributed to a drop in the number of examinees who successfully passed the test and a corresponding decrease in the country-level average score in 2012, as can be seen in figure 3.4.

The study uses administrative data on 6,791 full-time Bachelor's (undergraduate) students who entered seven national (N=2,723) and 24 state (N=4,068) universities in 2012, as recorded by the MES. The data excludes 2,526 graduates recorded at the initial dataset who were not observed to be in official employment for 1.5 years after graduation. Additionally, private university graduates were dropped from this analysis considering their heterogeneity, resulting in a clearer control group of the state universities only. This was also undertaken to eliminate the possible effects of selection policies beyond the official UNT score practised by some private universities[8]. Finally, the sample excluded graduates of the subjects listed in appendix C.1 due to different entry requirements concerning their admissions. The diagram at appendix C.1.1 depicts the data processing steps. For illustrative purposes, some descriptive plots presented in this section include the wider sample of students who entered national and state universities in 2010-2012 (N=27,218).

The data consists of student demographics (gender, university, subject of study, language of instruction and characteristics of the companies for which they work), their test score and their monthly compulsory pension contributions to the Unified Accumulative Pension Fund (UAPF) which mandates each employee to deduct 10% of the salary before tax in accordance with *Pensions Act* 2013 during each month after graduation up to January 2018 (1.5 years). For summary statistics, see appendix C.2.

The dependent variable is the mean of the pension contributions for those months when a person is observed in official employment, excluding the months when they are not, as I have no clear understanding of the reasons for not being in formal employment during those periods. As this proxy for wages is log transformed, the sample used for main estimations includes only employee-graduates deducting pension contributions to the UAPF at least once during the observed period; and I have no knowledge of those graduates who have no social records, whether they are unemployed, self-employed, employed in the informal economy, in further education or are not in work due to personal circumstances. 27% of 2012 cohort's graduates have zero pension contributions for each month for 1.5 years after graduation; for comparison, the share of those for two previous cohorts is essentially the same: 28% for both the 2010 and 2011 cohorts. Table 4.2 shows the distribution of these graduates by university type, gender and subject. For the majority of subjects, the share of graduates not observed in formal employment is higher at the national than at the state

[8]Few 'elite' private universities run their programmes entirely in English and admit international examinations in addition to the UNT.

universities, which is possibly explained by better further education opportunities which the national universities might offer to their graduates. Around 18% of the graduates of the Bachelor's programmes in 2016 in Kazakhstan continued their education at the Master's level (computed on data from *CSRK* 2019, *CSRK* 2019), though some of them might be formally employed during their graduate studies. Along with those continuing their education abroad[9], this number forms a somewhat reliable approximation of graduates in further education. To the best of my knowledge on the Kazakhstani labour market, the majority of the remainder being likely to be informally employed or self-employed, which could be a voluntary choice at least for some of them. The study by Mussurov et al. 2019 implies that for a higher education graduate in Kazakhstan it might be equally attractive to work in the informal vs. formal employment, accounting for the higher returns to degree and a higher earning penalty for those with tenure of less than a year in the formal sector.

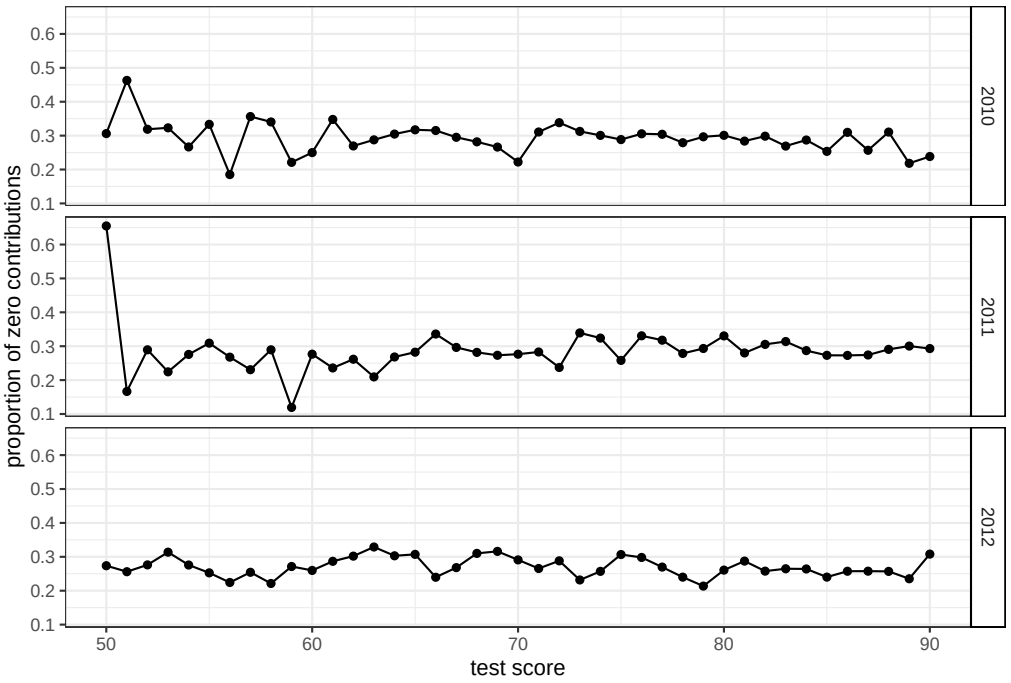
Table 4.2: Share of the graduates with zero mean pension contributions by university status, gender and subject, cohort-2012

	National	State
Male	0.26	0.29
Female	0.28	0.25
Agricultural Sciences	0.31	0.23
Arts	0.40	-
Engineering and Technology	0.24	0.29
Healthcare and Medicine	-	0.11
Humanities	0.36	0.26
Law	0.32	0.30
Natural Sciences	0.28	0.25
Safety	-	0.17
Services	0.28	0.26
Social Sciences and Business	0.22	0.22

Additionally, to test whether the estimates are uncontaminated by possible non-random selection into employment, I visualise the plot showing the proportion of graduates with zero mean pension contributions against their test score for each cohort - figure 4.1. For the cohort enrolled in 2012, the share of those unobserved in formal employment looks fairly unsystematic relative to the test score and somewhat similar to previous cohorts and - more importantly - does not jump at the threshold. Furthermore, I run two robustness exercises. First, I re-estimate the models with the log of mean pension contributions computed with all observed months including those with zero deductions. Second, I re-estimate them with the sample of working and non-working graduates (N=9,317) with an

[9]Outbound mobility ratio for tertiary education was 14.3% in 2015, UIS.Stat UNESCO data, http://uis.unesco.org/en/uis-student-flow. Detailed data is unavailable.

Figure 4.1: Proportion of graduates with no pension contributions observed in each month during 1.5 year after graduation for 2010-2012 cohorts



inverse hyperbolic sine transformation of the mean of pension contributions approximating log transformation but allowing the retention of zero values (Burbidge et al. 1988).

However, it should be emphasised that in a similar manner to the previous chapter, there is a sample selection problem since I compute the returns to university selectivity conditional on being observed in official employment. As discussed above, if this sample is positively selected (abler students are observed), the returns to graduating from the better-quality institutions are underestimated. Along with this, if one assumes that the national universities provide their graduates with better opportunities for postgraduate studies (such as the Master's programme abroad), then the downward bias is aggravated further. Though I conduct computations for the wider sample of all graduates, this possibility cannot be fully ruled out, since I do not have data on the real labour market status of the unobserved individuals.

Additionally, restricting the sample to public university graduates only might cause another selection issue if the policy redistributes the enrolees or a part of them from national to 'elite' private rather than state universities. This affects the identification and external validity since discontinuity affects the probability of going to national university but also of being in the sample of public university graduates. This should not affect those enrolees whose decisions depend on scholarship availability since private universities had much fewer funding opportunities for their applicants during the time under consideration.

However, this likely affects applicants who choose to pay for themselves, as the tuition fee is comparable at the national and the majority of 'elite' private universities (with the exception of the most expensive among them). This will mean a relatively adverse selection in the state as opposed to national universities and bias returns to national up. Thus, the results should be interpreted with all these possible biases in mind.

The subject is defined in accordance with the MES classification based on the *Classifier of Specialities for Higher and Postgraduate Education* (*Decree* 2009) which is partly inherited from Kazakhstan's Soviet past and, therefore, has little compatibility with international classifications; the list of majors attributable to each broadly defined area (referred to as a subject) is given in appendix C.3.

To gauge higher education selectivity, following Walker and Zhu (2017), I compute the mean standardized test score by university type for each subject (figure 4.2). 'Veterinary Science', 'Military and Security' and 'Healthcare and Medicine' for 2012 are dropped from the plot due to the absence of students studying these subjects at the national universities. As documented by the plot, almost every subject in each year in the national universities are more selective than in the state universities, and this gap expanded in 2012. This suggests that, at any rate, national university education is associated with "exposure to high achieving peers" (Abdulkadiroğlu et al. 2014). Density plots across cohorts depicted by figure 4.3 show that in 2012, the number of students with a test score lower than 70 dropped among national universities, though very few such individuals were still enrolled.

The centralised test serves as a tool for public funding of HEIs through the *State Order for Training the Specialists* which comprises up to 94% of all public funding (*MES* 2014). Starting from 2004, Kazakhstan gradually began switching to the voucher system of higher education funding. However, it is currently confined by the relatively limited number of best-achieving students awarded academic merit-based scholarships and students from deprived backgrounds who are granted scholarships independent of their academic achievements (in total, they comprised 137,841 out of 496,209 students or 28% in 2017/18[10]). Along with this, the system is, practically speaking, not fully based on the student's choice of a university and, therefore, does not increase competition among universities in terms of student intake, as it was initially supposed to.

After the severe economic crisis in the 1990s, Kazakhstan witnessed an oil boom in the 2000s during which both public and private spending on higher education increased. Public spending on higher education grew from 9,344 million KZT in 2001 to 187,986 million KZT in 2016 (or from approx. 62,344.9 thousand USD in 2001 to approx. 564,031.3 thousand USD in 2016 as per the corresponding exchange rates) (IAC 2017, p. 342). However, in terms of the share of GDP, public spending on higher education comprised only around 0.3% of GDP and "accounts for 8.6% of the total state budget for education" (OECD

[10]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

Figure 4.2: Mean standardised test score by subject across universities for 2010-2012 cohorts

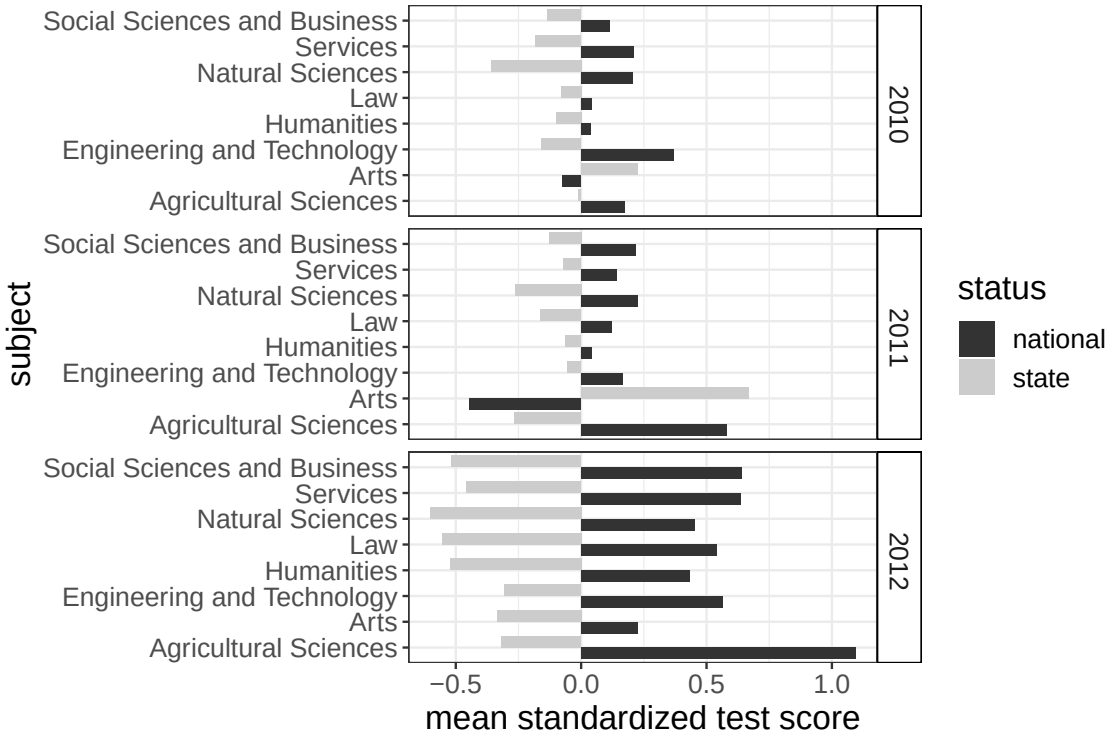
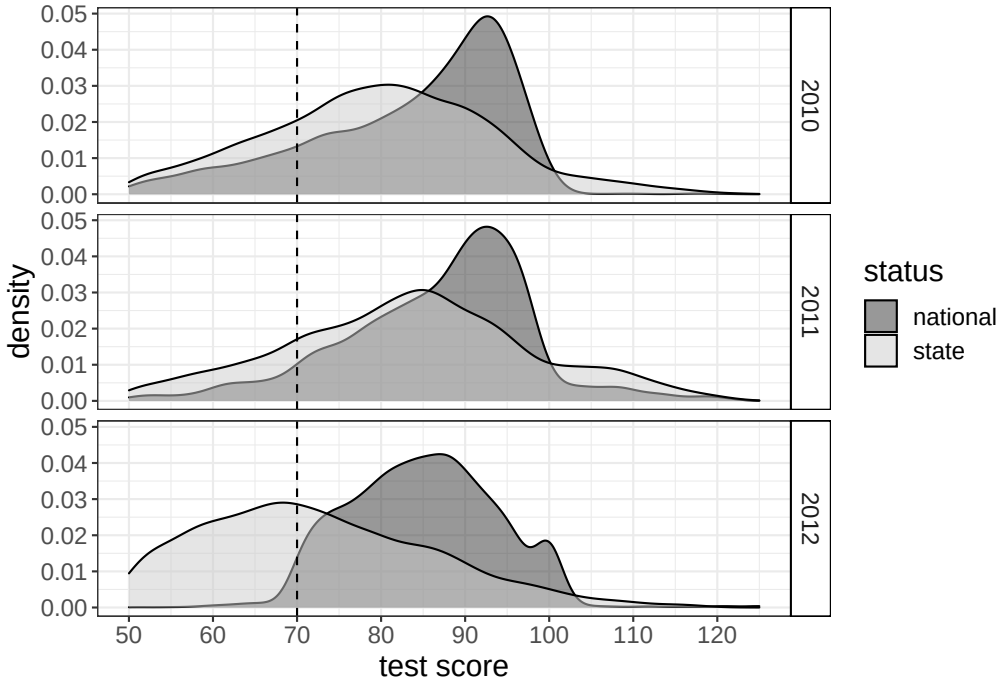


Figure 4.3: Test score density plot for 2010-2012 cohorts



2017, p. 53).

Due to limited public funding, all HEIs in Kazakhstan rely heavily on private funding through tuition fees: according to the Ministry of the National Economy data, "in 2014, approximately 70% of Kazakhstan's total expenditure on higher education came from private rather than public sources... - primarily from tuition fees" (OECD (2017, p. 53)). The share of privately funded students increased respectively – in 2016, they made up 73.3% of the total student body in higher education (as compared to 47.1% in 1998) (IAC 2017). At the same time, this is not the case for national universities where the average share of state-funded scholarship holders is around 70% of all students (table 4.3). As the MES argues, public funding is essentially the main source of their funding (*MES* 2014), although they are additionally allowed to enrol students on the tuition fee basis and, moreover, set higher tuition fees than the state and majority of private universities (table 4.3).

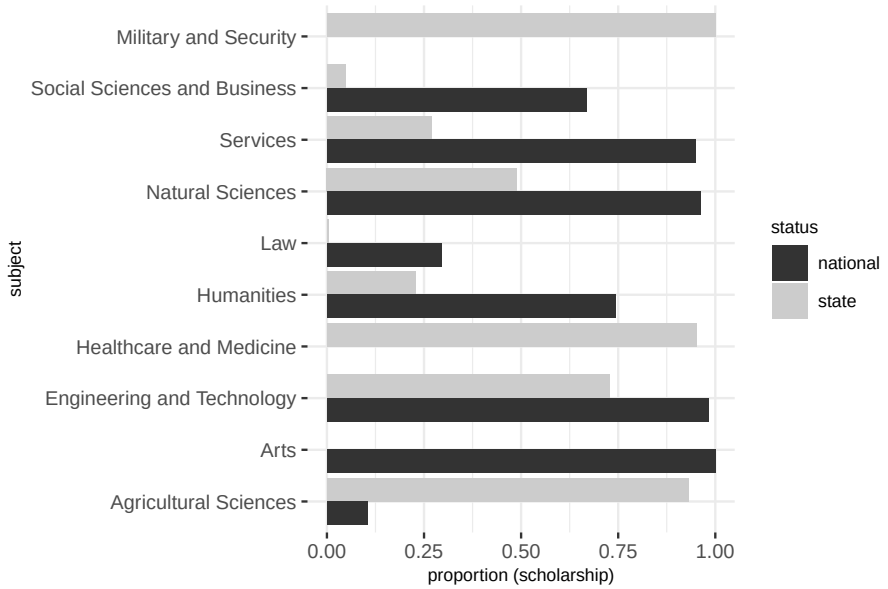
Table 4.3: Average number of students, state-funded students and tuition fees by university status

	National universities	State universities	Private universities
Average number of students in 2014	6,881	4,880	3,206
Average share of students with state funded scholarship in 2014	70%	45%	8%
Average tuition fees in 2018, KZT	697,802	414,235	494,883
Data source: Average number of students and share of students with scholarships computed from IAC 2015b; data on average tuition fees provided by the MES.			

In accord with the MES aggregated data, the national universities in the sample have a larger number of publicly funded students (appendix C.2) than the state universities, though this is to some degree dependent on the subject area (figure 4.4). This can be explained by the process of placement of the annual *State Order for Training the Specialists*. First, the Ministry allocates the appropriate scholarship placements across universities based on their assessment: their facilities, research activity, staff, budget, reputation, relevant collaborations, number of students and graduates' employability, all of which essentially favours national universities. Second, the amount given for the state-funded scholarship differs depending on the university status: for state and private HEIs it comprises only about 50-80% of the scholarship allocated to national universities for the same subject (*Decree* 2010; *Decree* 2011; *Decree* 2012; *Decree* 2013; *Decree* 2014). Third, the scholarship allocation across subjects is also made centrally by the government with consideration for the country's economic agenda and social priorities[11] and the labour market demand, though, to the best of my knowledge, there are no estimations of the labour de-

[11]Such as the State Programme for Industrialization.

Figure 4.4: Distribution of state-funded scholarships by university status and subject area (2012, n = 6,791)



mand and supply trends providing clear evidence for the policy. As can be seen from table 4.4, which shows the total number of scholarships offered to study at the undergraduate level by subject, there is a bias towards those subjects that are comparatively more expensive to run and/or those that are believed to be less lucrative, such as engineering and technology, medicine, science and education (teacher training), which are more likely to be taught by large multidisciplinary public universities.

This suggests that national universities receive better public funding through the State Order than other institutions, which is additionally confirmed by the official data provided by the MES. Figure 4.5 documents average per university public funding according to university status: in 2012, nine national universities together acquired around 11 billion KZT (approx. 74 million USD), while 44 state universities together acquired around 42 billion KZT (approx. 280 million USD); and the gap keeps growing over time. They additionally earn more from privately funded students. According to *State Companies' Financial Statements Depository* of the Ministry of Finance[12], in 2016, incomes from teaching funded privately for three national universities altogether comprised 9,280,318.6 KZT (approx. 27,844.6 USD) and for 26 state universities - 32,052,841.3 KZT (approx. 96,171.0 USD); based on this, private funding was about 2.5 times higher at national universities than at state ones, on average[13]. Finally, they "enjoy access to enhanced funding for research" (OECD 2017, p. 56) and are required to pay higher salaries to their

[12]The Depository of Financial Statements of the Public Interest Entities, https://opi.dfo.kz/p/.
[13]Aggregated data on private funding is unavailable.

Table 4.4: Total number of scholarships offered in 2010-2014

Broad subject area as defined by the MES	Academic year				
	2010/11	2011/12	2012/13	2013/2014	2014/15
Agricultural Sciences	1,730	1,911	2,000	2,000	2,020
Arts	950	957	820	905	1,025
Education	9,375	8,375	6,764	6,794	5,864
Engineering and Technology	11,465	11,802	11,957	12,432	12,600
Healthcare and Medicine	5,000	5,000	5,000	4,500	4,000
Humanities	720	820	700	770	790
Law	220	220	170	130	140
Natural Sciences	1,000	1,323	1,350	1,470	1,470
Military and Security	60	60	60	60	60
Services	900	895	900	900	950
Social Sciences and Business	730	744	750	770	844
Veterinary Science	550	623	630	650	650
Total:	32,700	32,730	31,101	31,381	30,413
Source: *Decree* 2010; *Decree* 2011; *Decree* 2012; *Decree* 2013; *Decree* 2014					

academic and administrative staff - 1.75 times higher than salaries in identical jobs at the state universities - in accordance with the *Model Provisions on the Universities with the Special Status* (*Decree* 2001).

Table 4.5 displays selected statistics of the pension contributions deducted by the public universities' graduates. Mean pension contributions for these are 8,934 KZT, suggesting the average monthly entry salary for public university graduates of 2012 cohort is around 90,000 KZT (for comparison, average country-level monthly salary was 149,195.9 KZT for the same period[14] and the average salary of private university graduates in the sample is about 110,000 KZT). State university graduates earned lower salaries (around 83,000 KZT) than students who had graduated from national universities (99,000 KZT), and this is the case for all subjects. There are somewhat more female graduates than male graduates in the sample, whilst the share of students granted a state-funded scholarship is 65%. Recorded contributions are higher for both male and scholarship-holder graduates.

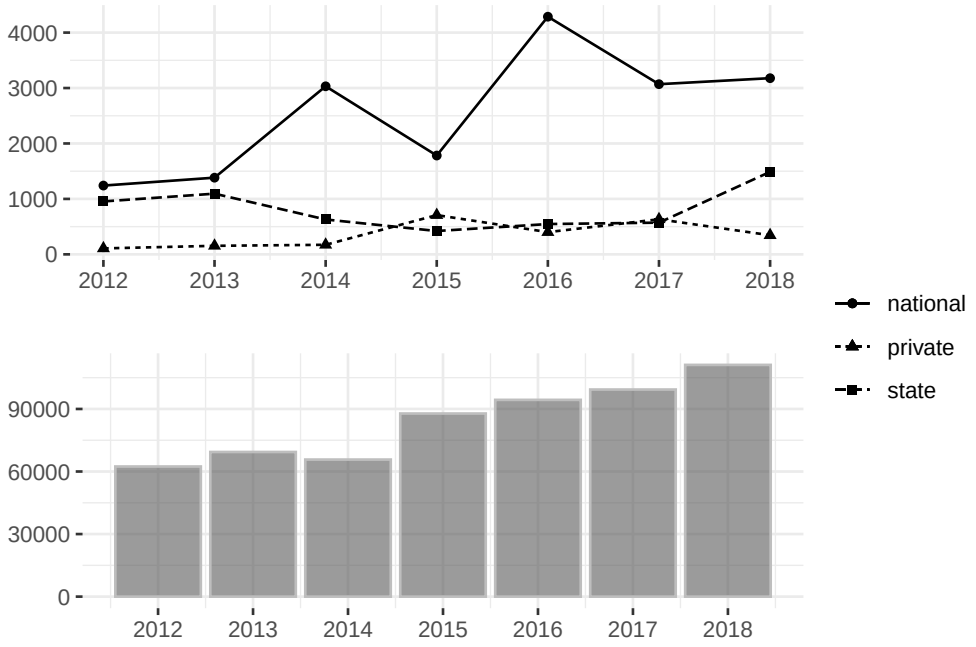
4.3 Methodology and identification strategy

4.3.1 Weighted least square

One way to compute the effect of treatment on the labour market outcome - where the *treatment* is attending national university and the *outcome* is the entry wage - is the simple OLS model, with which I start. Since the number of observations per university

[14]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

Figure 4.5: Public funding by the university status



Data source: data on public funding (bar chart) and public funding by HEIs status were provided by the MES upon request; number of HEIs by status - the Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

Table 4.5: Mean pension contributions by gender and scholarship (n = 6,791)

Mean pension contributions for the months when a person worked	Gender		State scholarship holder	
	male	female	yes	no
mean	9361.31	8560.60	9173.27	8408.50
median	7998.77	7173.06	7809.02	7032.44

varies substantially from one university to another, to ensure more information comes from those with a larger number of students in the sample, the regression is weighted by $\sqrt{N}$ per university[15]. To capture possible differences across genders, all computations are performed for two gender subsamples separately, and I control for the graduate's individual test score:

$$\ln Y_i = b_0 + b_1 D_i + b_2 x_i + e \tag{3.1}$$

[15]With *aweight* option in Stata.

where
Y_i – mean pension contributions for the months when graduate i worked, as a proxy for their wage - *outcome*
D_i – dummy variable for the university status (national vs. state), from which i has graduated - *treatment*
x_i – graduate i's test score
e – composite error term.

The problem with equation (4.3.1) is a possible bias caused by the non-random nature of the treatment assignment and, therefore, the bias in estimations and a lack of causality in interpreting the results. This is essentially the measurement error induced by the omitted variable bias, since there might be unobserved factors influencing both the probability of being treated and the outcome. To address this bias, I make use of a fuzzy regression discontinuity design, which is possible due to regulation imposing different minimum entry scores for national vs. state universities in 2012.

4.3.2 Fuzzy regression discontinuity design

As put forward by Thistlethwaite and Campbell (1960), RDD is widely used in many applications in Labour Economics and has been summarised by Angrist and Pischke (2009). With fuzzy RDD, one observes both treated and untreated observations on both sides of the threshold, though the probability of being treated discontinuously jumps at the threshold - the score of 70, in this case:

$$P(D_i) = 1|x_i = \begin{cases} g_i(x_i), & \text{if } x_i \geq 70 \\ g_0(x_i), & \text{if } x_i < 70 \end{cases}, where\ g_i(x_i) \neq g_0(x_i)$$

where
D_i – dummy variable for the university status (national vs. state) which graduate i has graduated from - *treatment*
x_i – graduate i's test score.

The crucial assumption is that people near the threshold are comparatively similar, to believe the treatment is being assigned randomly. The treatment effect then is the *LATE* (local average treatment effect) and is found in some sensible interval around the threshold as:

$$\tau = \frac{\mathbb{E}[\ln Y_i|x_i \geq 70] - \mathbb{E}[\ln Y_i|x_i < 70]}{\mathbb{E}[D_i|x_i \geq 70] - \mathbb{E}[D_i|x_i < 70]}$$

where
Y_i – mean pension contributions for the months when graduate i worked, as a proxy for their wage - *outcome*.

The sample used for FRDD computations includes persons who entered higher education in 2012 with the test score $[70 \pm 20]$, i.e. $x_i \in [50; 90]$, comprising 5,605 graduates from seven national ($N = 1{,}979$) and 24 state ($N = 3{,}626$) universities. To ensure comparability, WLS with model 4.3.1 is estimated on the same sample.

I employ fuzzy design because there are both treated and untreated observations on both sides of the threshold: obviously, not everyone with a test score above the threshold will choose to study at a national university, and - despite regulations imposing the minimum score for national universities - there were 28 individuals who entered them in 2012 with a test score below 70, as can be seen from the first stage plot - the binned scatter plot showing D_i for each $x_i \in [50; 90]$ for each year's sample - figure 4.6.

The share of treated observations plotted against each test score within the interval (figure 4.6) discontinuously jumps at the threshold only in 2012. Unlike the plot for the treatment, similar graphs for other observed characteristics - the graduates' gender, year of birth and share of scholarship holders among them and mean wages (figures 4.7, 4.8, 4.9, 4.10), plotted as a falsification exercise - do not show a discontinuous jump at or around the threshold.

Technically, fuzzy RDD is a "design where the discontinuity becomes an instrumental variable for treatment status...[which]... leads naturally to a simple 2SLS estimation strategy" (Angrist and Pischke 2009, p. 260). At the first stage, regressing D_i on the instrument (forcing variable) and covariates allows one to estimate the part of it that is uncorrelated with ϵ; at the second stage, the predicted values of D_i are used to gain an unbiased estimator for β_1 by regressing Y_i on $\hat{D}_i$ and covariates:

$1^{st} stage$:

$$D_i = w_0 + w_1 x_i + w_2 (x_i \times z_i) + w_3 z_i + u \tag{3.2}$$

$2^{nd} stage$:

$$\ln Y_i = a + b x_i + d (x_i \times z_i) + t \hat{D}_i + e \tag{3.3}$$

where

$z_i = \begin{cases} 1, & \text{if } x_i \geq 70 \\ 0, & \text{if } x_i < 70 \end{cases}$, *is the forcing variable (instrument)*

u and e are the error terms, and

t is the LATE.

RDD has both strengths and weaknesses; generally, in solving the endogeneity problem it can, however, produce biased estimates if people around the score threshold are not 'sufficiently similar'. Moreover, considering its local nature, RDD estimates effects only around the threshold and might not be generalisable towards the graduates with the UNT

Figure 4.6: Binned scatter plot for 'national'; dots are the means for 'national' for each test score

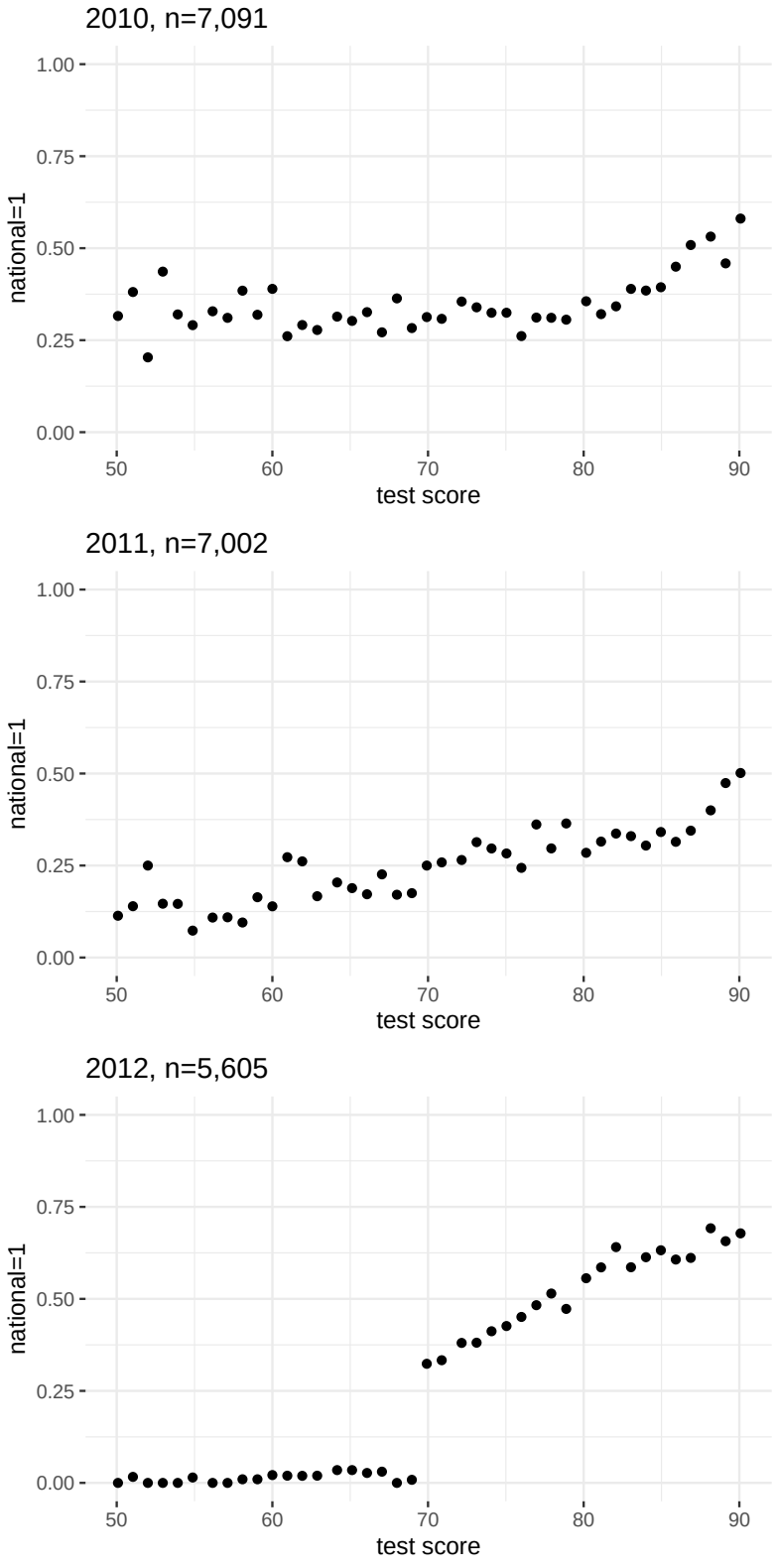


Figure 4.7: Binned scatter plot for 'gender' (2012 cohort; national and state universities; N = 5,605; dots are the means for 'gender' for each test score)

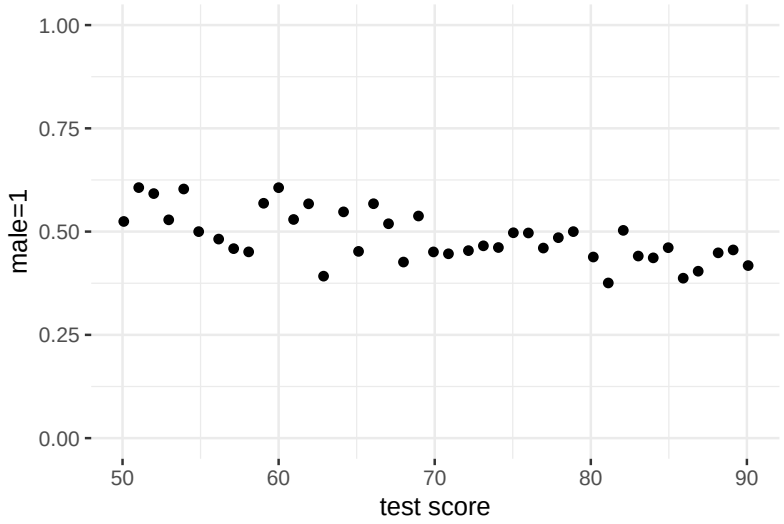
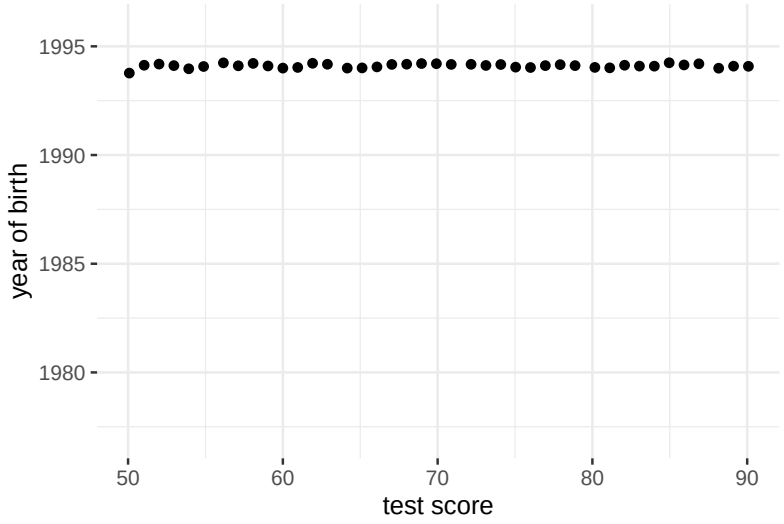


Figure 4.8: Binned scatter plot for 'year of birth' (2012 cohort; national and state universities; N = 5,605; dots are the means for 'year of birth' for each test score)



scores higher than 90.

4.4 Outcomes

Tables 4.6 and 4.7 document the results of the estimated models separately for gender subsamples. For FRDD estimations, the narrower bandwidth - $x_i \in [60; 80]$ - is additionally used to test robustness of the results.

Figure 4.9: Binned scatter plot for 'scholarship' (2012 cohort; national and state universities; N = 5,605; dots are the means for 'scholarship' for each test score)

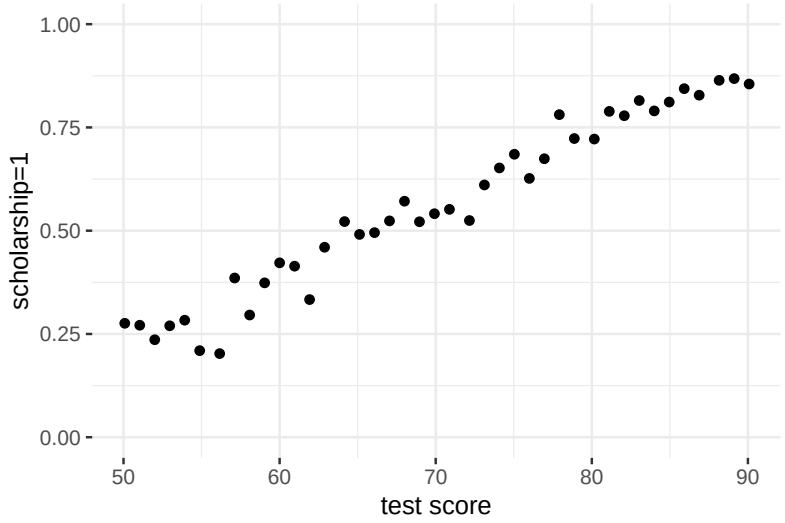


Figure 4.10: Binned scatter plot for 'log mean wage' (2012 cohort; national and state universities; N = 5,605)

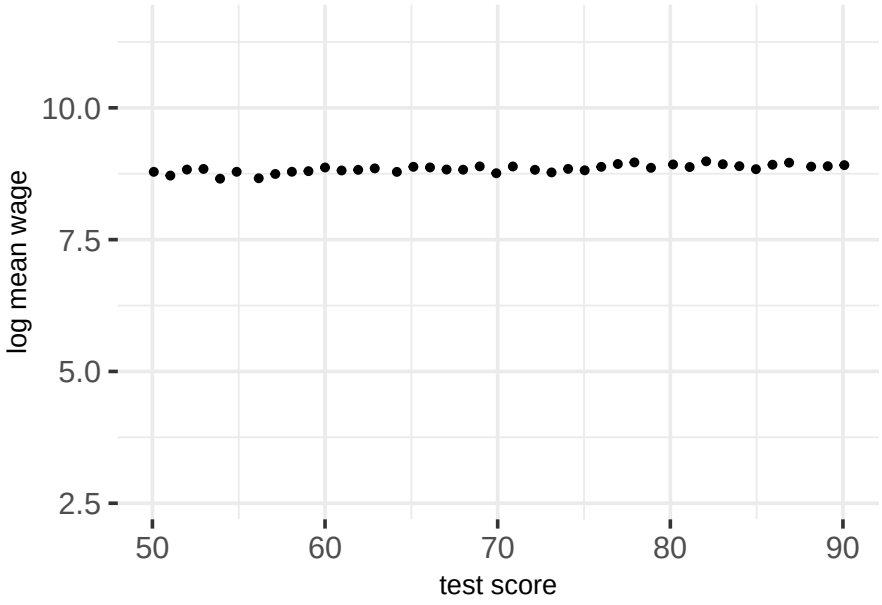


Table 4.6: WLS and FRDD estimates of the returns to attending national university vs. state university, men

	WLS	FRDD		FRDD	
		1 st	2 st	1 st	2 st
		Dep.var.: ln Y			
national	0.101*		-0.358		-0.508
	(0.045)		(0.235)		(0.366)
score	0.002				
	(0.002)				
instrument, z		0.275***		0.249***	
		(0.023)		(0.031)	
N	2657	2657		1483	
Bandwidth		[50; 90]		[60; 80]	
Adj./Centred R2	0.0064		-0.0496		-0.0907
F Statistic	5.14**		4.17**		1.18
F test for excluded instruments		138.60***		64.99***	
FRDD computations are done in Stata with ivreg2 command.					
Robust standard errors in parentheses.					
* p<0.05, ** p<0.01, *** p<0.001					

Table 4.7: WLS and FRDD estimates of the returns to attending national university vs. state university, women

	WLS	FRDD		FRDD	
		1 st	2 st	1 st	2 st
		Dep.var.: ln Y			
national	0.176***		0.075		-0.027
	(0.034)		(0.124)		(0.166)
score	-0.001				
	(0.002)				
instrument, z		0.354***		0.358***	
		(0.023)		(0.030)	
N	2948	2948		1577	
Bandwidth		[50; 90]		[60; 80]	
Adj./Centred R2	0.0139		0.0155		-0.0018
F Statistic	17.70***		6.71***		1.73
F test for excluded instruments		239.24***		139.99***	
FRDD computations are done in Stata with ivreg2 command.					
Robust standard errors in parentheses.					
* p<0.05, ** p<0.01, *** p<0.001					

With the weighted least square model, national universities turned out to provide a returns premium of about 11 p.p. and 19 p.p. for men and women, respectively, and the result is statistically significant. The models are significant as well, though they explain only about 1% of the variation in female graduates' entry salaries and even less in male graduates. However, significance fully vanishes with FRDD, demonstrating no difference between national and state universities as soon as university selectivity is explicitly controlled for. Narrowing the test score bandwidth for FRDD essentially does not change the results, yet produces higher variance due to the smaller sample size.

The instrument is highly statistically significant and supports the idea that the probability of entering national university is about 28 p.p. and 36 p.p. higher for applicants with a test score above or equal to 70 UNT scores, respectively, for males and females choosing to study in the public higher education system. The comparison between WLS and FRDD clearly shows a selectivity effect and selection on unobservables into the national (more selective) university. Moreover, the second stage of the FRDD for the male sample suggests that national university graduates, in fact, earn about 43 p.p. less than the state university graduates once the selectivity policy is explicitly accounted for, though the coefficient is not statistically significant. This should be interpreted as follows: the value added to human capital by the national universities is smaller than the value added by state university. This is not the case for female graduates, amongst whom national university graduates still earn more albeit the coefficient drops from a 19 p.p. premium to about 8 p.p. and loses statistical significance.

To test the robustness and to capture possible interfering effects, the same models are recalculated on different samples. First, it is likely to expect significant geographical differences in Kazakhstan, therefore WLS and FRDD are recomputed for the sample consisting of two cities only - Almaty and Astana - where all the national universities are situated. Second, there could be a trade-off between wages and better employment opportunities when comparing national universities with other public institutions. In an attempt to capture the possibility of better employment perspectives of the national universities' graduates, I use all available months after graduation while computing the mean of their pension contributions, including those with zero contributions, assuming that this should produce 'better' estimates for the national universities. Finally, I compute the same models on the sample of all graduates including those with no social contributions recorded in each or some months after graduation using IHS instead of logarithmic transformation to keep zero values. The results are presented at the tables 4.8, 4.9 and 4.10.

Table 4.8: WLS and FRDD estimates of the returns to attending national university vs. state university, cities of Almaty and Astana

	Men			*Women*		
	WLS	FRDD		WLS	FRDD	
		1 st	2 st		1 st	2 st
	Dep.var.: ln Y					
national	-0.216		0.008	-0.005		-0.229
	(0.123)		(0.397)	(0.092)		(0.434)
score	0.003			-0.001		
	(0.005)			(0.004)		
instrument, z		0.523***			0.378**	
		(0.136)			(0.130)	
N	862	862		1250	1250	
Adj./Centred R2	0.0015		0.0015	0.0000		-0.0077
F Statistic	1.76		0.49	0.04		0.50
F test for excluded instruments		14.83***			8.43**	

FRDD computations are done in Stata with ivreg2 command.
Robust standard errors in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Table 4.9: WLS and FRDD estimates of the returns to attending national university vs. state university, mean pension contributions computed with zero contributions

	Men			*Women*		
	WLS	FRDD		WLS	FRDD	
		1 st	2 st		1 st	2 st
	Dep.var.: ln Y					
national	0.067		-0.658	0.105		-0.073
	(0.067)		(0.347)	(0.059)		(0.225)
score	0.005			0.003		
	(0.003)			(0.003)		
instrument, z		0.275***			0.354***	
		(0.023)			(0.023)	
N	2657	2657		2948	2948	
Adj./Centred R2	0.0035		-0.0570	0.0042		-0.0003
F Statistic	3.53*		2.84*	5.40**		1.76
F test for excluded instruments		138.60***			239.24***	

FRDD computations are done in Stata with ivreg2 command.
Robust standard errors in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Table 4.10: WLS and FRDD estimates of the returns to attending national university vs. state university for all graduates including those unobserved in formal employment and with mean pension contributions computed with zero contributions

	Men			*Women*		
	WLS	FRDD		WLS	FRDD	
		1 st	2 st		1 st	2 st
	Dep.var.: IHS Y					
national	0.155		-0.281	0.959***		1.148
	(0.198)		(0.924)	(0.185)		(0.733)
score	0.026**					
	(0.009)					
instrument, z		0.293***			0.361***	
		(0.021)			(0.019)	
N	3577	3577		4100	4100	
Adj./Centred R2	0.0062		0.0019	0.0122		-0.0077
F Statistic	8.02***		1.93	19.12***		1.16
F test for excluded instruments		202.25***			355.58***	
FRDD computations are done in Stata with ivreg2 command.						
Robust standard errors in parentheses.						
* p<0.05, ** p<0.01, *** p<0.001						

There are very few people in the sample who have graduated from the state universities in Almaty and Astana - 63 and 70 against 799 and 1,180 national universities' graduates, for men and women respectively. Possibly due to small sample size, the estimations run on them identify no statistically significant difference between national and state university, even with the weighted least squares. This is also the case for both models with zero social records accounted for, except for WLS estimations for the female subsample including graduates not observed to be in employment. It seems that graduating from a national university does not improve social security with regard to the labour market, at least to the extent to which zero contributions could serve as a proxy for unemployment or informal (self-)employment.

Finally, to capture possible variation across subjects the models are estimated separately for three subject subsamples: (1) Agriculture and Natural Sciences; (2) Engineering and Technology (additionally includes 36 graduates of Healthcare and Medicine programmes); (3) Social Sciences, Humanities, Business, Services and Law. Tables 4.11 and 4.12 document results for WLS and FRDD estimations, which are robust across all subjects.

Table 4.11: WLS estimates of the returns to attending national university vs. state university for disaggregated subject groups

	Agriculture and Natural Sciences	Engineering and Technology	Social Sciences, Humanities, Business and Law
	Dep.var.: ln Y		
national	0.272***	0.059	0.164**
	(0.063)	(0.041)	(0.048)
score	-0.002	-0.000	0.003
	(0.004)	(0.002)	(0.003)
N	1014	2856	1720
Asj. R2	0.0302	0.0014	0.0182
F Statistic	14.09***	1.23	11.63***
WLS computations are done in Stata with aweight command.			
Robust standard errors in parentheses.			
* p<0.05, ** p<0.01, *** p<0.001			

Table 4.12: FRDD estimates of the returns to attending national university vs. state university for disaggregated subject groups

	Agriculture and Natural Sciences		Engineering and Technology		Social Sciences, Humanities, Business and Law	
	1 st	2 st	1 st	2 st	1 st	2 st
	Dep.var.: ln Y					
national		-0.000		-0.334		0.0181
		(0.191)		(0.275)		(0.147)
instrument, z	0.416***		0.223***		0.396***	
	(0.040)		(0.021)		(0.032)	
N	1014		2856		1720	
Centred R2		0.004		-0.049		0.0160
F Statistic		1.33		2.37		7.65***
F test for excluded instruments	110.56***		113.02***		157.47***	
FRDD computations are done in Stata with ivreg2 command.						
Robust standard errors in parentheses.						
* p<0.05, ** p<0.01, *** p<0.001						

4.5 Summary and conclusions

There might be several alternative explanations for the results obtained. The first is driven by locality of RDD: it could be that the students with test scores varying around the threshold are not those benefiting the most. Main FRDD model captures observations up to the 81st percentile of the total test score distribution in 2012 (70th for national and 89th for state university graduates), leaving 20% of the top performers beyond. Although empirical examinations worldwide usually find the students on the bottom of the distribution to gain more from advanced quality education than the top achievers likely having good labour market outcomes regardless of the type of a university they attend, there is still a possibility for the latter to benefit the most. After all, they are the ablest students who can best follow more advanced and research-intensive curricula, enjoy better library resources and labs, learn from more qualified academic staff and high achieving peers, if there are any of the listed.

The second possible explanation arises from the data constrains. The data at hand only provides entry salaries immediately after graduation and for a short time thereafter, which are believed to be noisy and not the best indicator of the life-long earnings (Walker and Zhu 2017). Furthermore, as Solmon states, an institution's quality "does affect later incomes more than it influences incomes immediately on entering the labor force" (Solmon 1975, p. 537), which is confirmed by some empirical observations (MacLeod et al. (2017) that found a certain correlation between earnings and college reputation increasing with experience) but rejected by others (Lemieux (2006) who found the returns to education to be constant over time). However, this might be reconciled by Arcidiacono et al. (2010) who discovered the differences in the returns to ability for American college graduates vs. high school graduates: for the first ones, the returns to ability are high from the beginning of their career and essentially do not change thereafter. In turn, MacLeod et al. (2017) tend to explain this evidence by the fact that (American) colleges thoroughly sort students in the first place according to their abilities, unlike colleges in Colombia and, possibly, other less developed countries with less established institutions. Therefore, it is still quite possible that graduates' later-life earnings diverge, reflecting the presumed better quality of more selective HEIs, and it could be advantageous to rerun the same computations for the future earnings of the same graduates to test this hypothesis. Additionally, there could be advantages other than wage returns to graduating from a better university, for instance, higher employability (which still could not be estimated accurately enough due to data limitations) or non-economic returns (like access to geographically more advantageous labour markets and more prestigious jobs).

Third, I have no other reliable indicators of university quality and selectivity at my disposal, such as the subjective indexes used by international studies (Solmon 1975, Brewer

et al. 1999, Dale and Krueger 2014) or even a set of measurable indicators comparable across institutions, and can therefore only depend on the average test score which might not be the best measurement to sort students according to the qualities valued by employers. The previous research on developed economies' data suggest that "more selective schools tend to accept students with higher earnings capacity" (Dale and Krueger 2002, p. 29). This might not be the case for Kazakhstan, if the UNT only evaluates the ability to remember a large amount of information and to some extent to work hard. These qualities still might not be enough to be competitive in the labour market. Overall, any test score serving as an indicator of individual ability might not be a good measure for labour market performance - in the words of Griliches: "'ability', in the sense of being able to earn higher wages, other things equal, has little to do with IQ" (Griliches 1977, p. 7). Moreover, the study by Heckman and Kautz 2012 revealed that the standardised entry tests fail to assess students' soft skills or noncognitive abilities, which are an important determinant of their further labour market returns. Thus, had I access to other reliable indicators of institutional quality, I might end up with a completely different hierarchy in Kazakhstani higher education setting, which might appear more consistent with the results observed.

Fourth, I observe only the first cohort affected by the selectivity-forcing policy. It might well be the case that the effect of the policy appears later, with later cohorts, if one assumes the quality of teaching improves gradually with the improved student body. Furthermore, as shown by figure 4.5, though the national universities get an advantage of relatively better public funding in all depicted years, the difference in funding is not that substantial during the year under examination, as it becomes later on. A soaring gap in funding, as observed from 2014 onwards, could additionally contribute to possible increased returns to graduating from a national university for these later cohorts.

However, it could be in fact the case that a national university diploma in and of itself does not create value or lead to any reputational effect that is clearly distinguishable from a state university diploma, as is signalled and perceived by the labour market, at least for entry wages and during the period under consideration. It is worth noting that this result appears regardless, even, of the national universities' locations in the cities with the highest wages, in contrast to the provincial state universities. The question which arises then is why do better students (as measured by their UNT score) choose to study at national universities? The answer seems to be hidden in the existing funding scheme, which forces them to do so by increasing their chances of gaining a publicly-funded scholarship. Furthermore, this stipend scheme might distort HEIs' incentives to invest in their quality since they end up getting the best students anyway.

Thus, accounting for possible inaccuracies caused by data shortcomings or methodology limitations, the current study provides a revealing snapshot analysis which might be helpful in terms of relevant policy reconsideration. This is particularly important for the policies

aimed at evaluating and ranking universities based on raw averaged data about the salaries of their graduates. It is important to stress that, firstly, entry wages might depend on many factors, of which selectivity is one of the more crucial and, secondly, simple comparison across universities likely leads to biased conclusions when selectivity (and other factors) are not accounted for. Specifically, for Kazakhstan, this sort of comparisons was one of the rationales for the current policy of privatisation and – consequently – restricting access to public funding of state universities. The results from this study might question the long-term efficiency of this policy as it might lead to an ineffective redistribution of public resources.

Chapter 5

Effects of raising higher education entrance requirements on enrolment, student quality, and their labour market returns: a country-level experiment

5.1 Introduction and motivation

In Kazakhstan, the depreciating overall quality of higher education, along with its perceived overproduction, is one of the most frequently expressed public concerns. It systematically appears in policy documents and policy makers' agendas, and a number of efforts have urged addressing the issue (*Programme* 2004, *Programme* 2010, *Programme* 2016, Nazarbayev 2012). This study empirically examines one of the attempts to improve higher education quality through improving student quality - toughening a centralised entry examination undertaken in 2012 - and its effects on programme-level higher education enrolment, student composition, and the affected graduates' labour market outcomes. Although the entry requirements are centralised and uniform, I consider the possibility of heterogeneous effects of the policy on academic programmes run by HEIs depending on their pre-policy quality. I rely on the fact that the effect of this policy change was mostly concentrated at the lower tail of the test score distribution, drastically increasing the number of fails. Thus, I generally expect an associated decrease in the number of students for those programmes that usually enrol relatively more students with test scores closer to the cut-off point, if neither enrollees nor universities change their strategies ex-post. However, the 2012 test shock could necessitate both the higher education enrollees and the

universities to adapt their strategies. For example, it could push the applicants to reconsider their choices in favour of less prestigious and selective universities or programmes if their test score turns out to be lower than expected. On the other hand, the universities, being threatened by decreasing student inflow in an otherwise highly competitive Kazakhstani higher education market, could also change their enrolment policies, for example, by decreasing admission criteria or reinforcing their recruiting campaigns. Therefore, the expectations about programme-level enrolment numbers and students' quality are ambiguous.

I am unaware of any previous research that has exploited data on the toughening higher education centralised entry examination on the HEIs' programme-level outcomes. However, there are a few studies examining the effects of introducing similar initiatives on the affected students' later labour market returns, high school drop-out rates and overall college enrolment. In particular, the study by Dee and Jacob 2007 has analysed the heterogeneity of the effects that the U.S. standardised high school exit test, as introduced in the 1970s, had on educational attainments and early labour market returns. It found small negative and heterogeneous effects on high school completion rates, and no effect on college enrolment and labour market outcomes. Clark and See 2011 explored a toughening of Florida high school graduation standards and found very similar results. However, in the U.S. the high school completion examination is not directly associated with higher education entry requirements, unlike in the case considered with this study; therefore, finding no effect on U.S. college enrolment is not necessarily surprising.

I consider different effects of the policy on four different types of higher education providers as principally determined by study costs and the associated financial aid availability and, consequently, the differences in their students' socio-economic backgrounds. This hierarchy seems to comprehensively capture the heterogeneity in Kazakhstan's higher education setting. Besides that, the differentiation across the various types of HEI allows to partially separate the effects of another simultaneous policy shock that concerns only a group of most prestigious public institutions - national universities. In the same year, based on their status as leading research-intensive institutions, the government increased their test threshold. Considering them as being distinct from other HEIs allows to assess the effects of the test-tightening policy I am primarily interested in for the remaining institutions, but not to disentangle the two policies for the national universities. The latter is hardly feasible, as both likely affected the worst-quality programmes among them.

The consequences of heterogeneity across public- and private-type higher education providers for policy change are considered by Epple et al. (2017) who develop a model with American state and private colleges setting alternative objectives. State colleges maximise "aggregate achievement of their in-state residents" and, therefore, are less selective and enrol less able and poorer students, while private colleges maximise quality

and, consequently, are 'more elite' and serve more able and richer students (Epple et al. 2017, p. 172). The college quality, in turn, is a function of the student body (measured by the SAT score) and college expenditure per student.

In Kazakhstan, despite heterogeneity, all considered universities likely maximise their revenues through maximisation of the number of students, since funding from both public and private sources is heavily dependent on teaching due to limitations in other sources of funding, as discussed in the institutional chapter. Around 60% of public funding is allocated to teaching through the scholarship scheme[1]; at the same time, as the OECD country report notes, public funding only comprises about 30% of the total higher education funding, the main source of which is privately funded tuition fees (OECD 2017, p. 53). In addition, the state-funded scholarship is rather low and leaves little possibility to maximise profits without maximising the number of students, at least for those subjects that are relatively expensive to run. In turn, the state-funded scholarship serves as a price ceiling for the tuition fees set by the public and the majority of the private institutions, considering the fierce competition for students among them and from abroad. Thus, it is quite natural to expect them to reinforce their enrolment strategies and relax enrolment criteria (if such exist) to maintain enrolment as a result of the test toughening shock[2]. The results suggest that the latter was likely the case for all better-quality universities, regardless of their type.

The primary methodology employed by this study is the difference-in-differences (DiD) with varying treatment intensity. I develop three simple but rather noisy indicators of quality at a university-programme level in the pretreatment period, measuring it according to its freshmen quality, since other data on institutional academic quality in Kazakhstan is limited. I then compare relatively worse programmes' outcomes - the number of newly enrolled students and their quality - in the post-treatment period with the relatively better ones. With the administrative dataset on 54,839 individuals who entered higher education in 2010-12 and graduated in 2014-16 collapsed into 2,482 cells, each representing university-subject-cohort-level outcome, I have found the effects of the policy on the number of newly enrolled students to be entirely concentrated in public HEIs. A programme whose rank was 100 places (out of 710) lower in 2010, saw an 11-18% decrease in enrolment number in 2012 relative to a one with 100 places higher ranking as a result of the policy. Interestingly, the policy has not affected private institutions' enrolment. There are a number of possible explanations for this. First, at the national universities, the observed effects could be purely driven by the simultaneous test threshold increasing policy: those students who became ineligible to enter them in 2012 could well have redistributed themselves, possibly with a bias towards the state universities. This might explain

[1] As seen in figure 3.9; the Ministry of Education and Science data.

[2] There is no information available on how HEI's may have potentially changed their recruitment strategies because of the policy change.

a decrease in enrolment in the relatively worse-quality programmes run by the national universities, and a decrease in the average student body quality at all state universities observed in the data. Second, the government could provide additional administrative support to the public universities in the test tightening year in a form of better financial aid being made available to their applicants, possibly with a focus on the better-quality programmes among them. However, the estimations with the share of scholarship-holders per programme as an outcome variable allows me to rule out this particular hypothesis as it has not grown in better quality programmes, regardless of university type. Finally, at the state universities, the policy effect might also be driven by their subject composition. The policy likely had a more serious effect on those subjects enrolling a disproportionate number of students from the lower tail of the student body quality distribution across subjects (rather than universities), which are mostly delivered by the state and private higher education providers, with the latter being heavily under-represented in the upper tail. The latter additionally explains why the policy has not affected private university enrolment, as per the initial expectations.

The results further suggest that the quality of the student intake systematically dropped in the better programmes in all types of university regardless of the methodology (e.g., quality indicator). This possible long-term trend likely reflects the adverse demographic conditions and increasing competition for the limited pool of higher education enrollees in circumstances of limited alternative sources of funding and HEIs maximising their revenues through enrolment maximisation strategies. In addition, the better-quality programmes might have higher tuition costs and the higher pressure of increasing competition from abroad, which could drive them to relax their enrolment criteria to maintain enrolment.

Additionally, the study tests if the policy change had an effect on the affected cohort's labour market returns. A number of studies have shown how university quality contributes to heterogeneity in the returns to education: Solmon (1975), Loury and Garman (1995), Chevalier and Conlon (2003), McGuinness (2003), Black and Smith (2004), Hoekstra (2009), Dale and Krueger (2002), Dale and Krueger (2014). The majority have found the returns to be higher at the better-quality institutions. However, the causes of this positive association are not clear, and possibly indistinguishable in terms of whether it can be explained by human capital theory, peer effects or the signalling and sorting theory, as discussed in the previous chapter. Arteaga (2018) with a natural experiment in Colombia, where a very prestigious university with established reputation decreased its teaching hours, found that human capital accumulation matters beyond the market signals - the affected cohort earned less as it failed to perform sufficiently well during the recruitment process despite the university's reputation. On the other hand, employers might behave in a different manner when offering jobs and wages as depending on whether they receive signals about the quality of schooling a particular individual had acquired.

Ordine and Rose (2011) distinguish between innate ability and schooling ability, with the latter depending on the quality of the institution the individual graduated from. In the setting when universities lack the ability to signal their quality to the employers, there arises a 'separating equilibrium' whereby "wages reflect individual productivity" (ibid., p. 586). In the same manner, the study by Groh et al. (2015) found that introducing psychometrics and skill-based tests might significantly reduce mismatch and friction in the labour market in a setting where "education systems are such that graduates find it difficult to signal competence and achievement through grades and the quality of their institution" (ibid., p. S106). In contrast, when universities credibly signal their quality (good or bad) to employers, schooling ability is more important to the latter; Ordine and Rose (2011) refer to this as a 'pooling equilibrium'.

It is likely that in Kazakhstan's higher education setting, with its rapidly changing landscape, the signals transmitted from the HEIs to both employers and potential enrolees are rather vague due to very poor informational provisions (Roshchin 2006 suggests this is the case for the majority of the HEIs in Russia, which are generally similar in many ways). With this, it is possible that some institutions have better-established reputations and connections to the labour market, and these are likely more prestigious and expensive national and 'elite' private universities; thus, both separating and pooling equilibrium could coexist. Since I expect better-quality programmes to increase their enrolments relative to the worse-quality ones, I might observe improvement in the affected cohorts' labour market returns on average. However, the expectations regarding the comparison of the relatively better versus worse programme-level labour market outcomes over time are somewhat ambiguous.

The results do not suggest any significant effects of the policy shock on the graduates' labour market returns, either on average or when comparing more affected programmes with the less affected, at least for the first affected cohort and during their first year in employment. Notably, the declining student intake quality observed amongst the relatively better programmes also does not impact the graduates' employment and real wages.

The chapter is organised as follows. The following section sets up the institutional context of the entry test tightening policy by giving a brief history of the test's introduction and its subsequent developments. It additionally describes the data. The subsequent section explains the empirical strategy in detail, and is followed by the section presenting the results along with the possible explanations, discussion, and a set of concluding remarks.

5.2 Institutional context and the data

The Unified National Test (UNT) was introduced in Kazakhstan in 2004 and represents a combination of secondary school leaving qualifications, a higher education entry exam-

ination, and a framework for higher education funding. The key purpose to establishing centralised examination instead of university-administered admission was as "an attempt to implement a corruption-free, transparent admission procedure" (OECD 2007, p. 61) which would provide a common scale appropriate for further implementing a voucher system of funding. The UNT is believed to have improved the admission process in many ways, decreasing corruption, providing more equal access to higher education, and unifying minimum entry requirements across institutions. There is no research on Kazakhstan, however, as compared to a similar initiative in Russia which is known to have promoted social mobility, increasing admission of students from remote areas who were previously under-represented at the most prestigious universities in Moscow and St. Petersburg (Slonimczyk et al. 2017).

Despite its positive effects, the UNT does not compare well internationally as it does not meet the appropriate "standard of knowledge and skills" as evaluated by the "main school-leaving and university entry qualification... [examinations]... in most European countries" (OECD 2007, p. 43). The reason is both the content and the format of the test, which includes 125 multiple-choice questions evaluating memorised knowledge from five subjects, rather than examinees' skills and thinking abilities. These subjects are: mathematics, the history of Kazakhstan, first language (Kazakh or Russian), second language (Kazakh or Russian) and an elective subject based on the examinee's career choice. This is the case for the majority of academic subjects (or specialities - '*special'nosti vysshego obrazovaniya*'), except that 58 (out of 169) specialities having the right to disregard the UNT score for subjects other than history and languages when enrolling applicants upon conducting an additional subject-specific examination, as independently set by the universities themselves (*Decree* 2012). The list of these subjects (specialities) is documented in an appendix C.1; they are excluded from the analysis due to incomparability due to selective criteria. Another concern that is often referred to in public debates is that the UNT's introduction led to UNT-driven education during the two final university-preparatory years of a secondary school - 'teaching to the test', since higher education enrolment and funding opportunities are heavily dependent on the test score, as indeed is the secondary schools' performance, which is evaluated based on their students' scores. Moreover, "there is also distrust in the security and fairness of the test, expressed in many newspaper articles and other public fora" (OECD 2007, p. 63).

Albeit that the test is centralised, the admission itself is decentralised in the sense that the universities make enrolment decisions independently from each other; however, the process is highly mediated by the scholarship allocation, which is done centrally. The scholarship places are first placed across subjects with the priority given to those prone to being overlooked by the private decision-makers or those considered more in demand by the national economy. During the period under consideration, around 36% of all

scholarships were granted to Engineering and Technology, followed by Education (around 25%) and Healthcare and Medicine (16%). By contrast, the share of scholarships allocated for Social Sciences and Business comprised 2% of the total number of scholarships, and for Law less than 1% (*Decree* 2010; *Decree* 2011; *Decree* 2012). Further, the scholarship places are allocated across universities, in accordance with the certain criteria supporting larger public institutions with more diversified curricula and less attractive subjects, primarily, national universities. As a result, an average share of scholarship holders in a student body comprises 70% at national and 45% at state universities, as opposed to only 8% at private universities[3]. There is no test score threshold determining scholarship eligibility. The policy-makers centrally match applicants with the scholarship places based on their applications, namely where they specify their choices of subject and university (up to four options for each). The eligibility of an applicant is determined by their test score (for merit-based scholarships) or their socio-economic status (for scholarships for students from deprived background), with the type of scholarship being unobserved in the data. This also depends on the number of scholarship places available at a particular programme level, since for policy makers it is generally preferable to clear all available scholarship places allocated while matching applicants with places. Therefore, for the programmes getting more scholarship places, even an applicant with a relatively low test score can be granted a scholarship; this is especially true for less attractive subjects. Since the applicants normally are familiarised at least with a number of scholarships per programme at the university at which they physically complete their submission, they likely make their choices based on their known test score and pre-known allocation of available scholarships covering full tuition fees and a monthly allowance.

In 2012, there were three policy changes adopted simultaneously which all had an impact on the UNT country-level results and higher education enrolment. Firstly, measures to tighten up the test procedure were taken. The UNT is conducted in selected universities and secondary schools across the country over several days; starting from 2012, each university or school where the test was conducted was monitored by a representative of the Ministry of Education and Science, unlike in the previous years when they were monitored by the local officers, de facto, by the staff of the organizations in which they were held. Furthermore, in order to prevent cheating, the classrooms were equipped with video cameras and devices suppressing cellular signals (*Decree* 2011, Irsaliyev 2011). Secondly, the test content slightly changed in accord with the intention to gradually approach international standards. In addition to the normal annual practice of the replacement of 15-20% of the test questions, in 2012 a few logical questions were introduced (MES 2012). These two policies are the main scope of this analysis; however, there was another intervening policy that affected only ten national universities, but which might have spillover effects

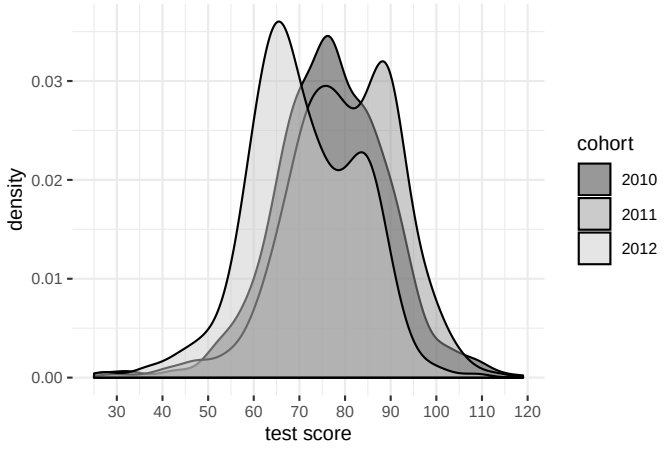
[3]Computed from IAC 2015b.

on other HEIs. In line with the government's expectations with their status of leading research-intensive institutions, the national universities were urged to improve selectivity: the minimum required UNT score to enter them was increased to 70 in contrast to the 50 that is sufficient to enter other public and private HEIs (*Decree* 2012).

Consequently, the average country-level UNT score dropped from 86.7 in 2011 to 70.9 in 2012 and the share of fails among the UNT-takers grew from 9.6% to 36.8%, respectively, as shown in figure 3.4. The 2012 changes represented a considerable external shock, especially in terms of the share of fails; however, one should note the anomalously low share of fails the country saw between 2009 and 2011 (figure 3.4), which likely was the reason for the toughening of the 2012 test policy, though this supposition has never actually been voiced. Increasing regulatory pressure in 2012 significantly contributed to decreased full-time higher education enrolment - it dropped from 119,590 persons in 2011 to 88,474 persons in 2012 (figure 3.2). Notably, the latter increased substantially in both 2010 and 2011 even despite the adverse demographic conditions which were the result of a drop in the university-age population due to the significant fall in birth rates during the 1990s recession (figure 3.5). This is likely related to the UNT statistics dynamic for those two years when the test was probably 'somewhat easier' than usual.

This study attempts to employ the external UNT shock of 2012 to assess the extent to which this changed a programme-level population and the composition of newly enrolled students and their later labour market returns. It uses the administrative data for 54,839 recent university graduates (appendix C.1.1) who entered four-year full-time Bachelor's (undergraduate) programmes in 108 subjects at 75 HEIs in 2010-2012, including the subject studied, their entry test score, and mandatory contributions to the state Unified Accumulative Pension Fund (10% of salary before tax in accordance with the *Pensions Act* 2013) during the year after graduating from higher education. As can be seen from the density plots for the sample data, there is a clear leftwards shift in the test score distribution in 2012, as consistent with the aggregated data shown earlier (figure 5.1).

Figure 5.1: Test score density plots for 2010-2012 cohorts

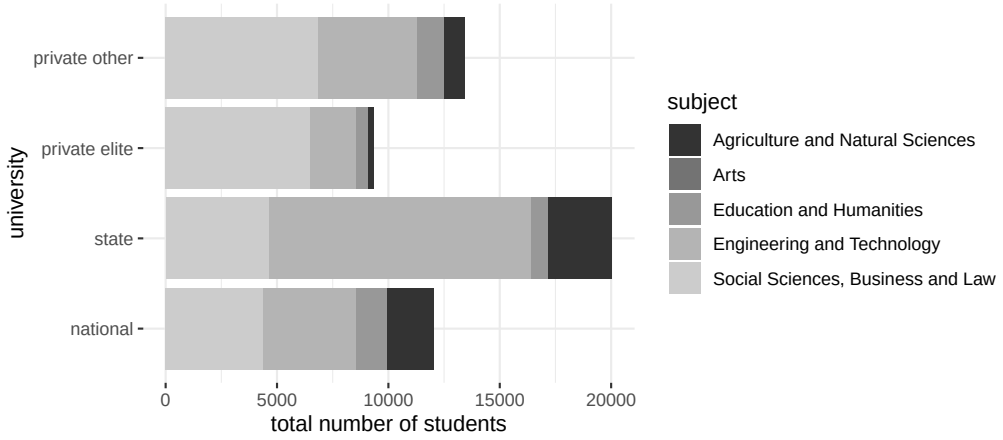


The individual-level data is collapsed into 2,482 cells, each representing a detailed subject (academic programme, herein referred to just as a 'programme') at each university for each cohort (higher education entry year) and their corresponding outcomes: total number of the corresponding year graduates; their mean test score; their mean pension contributions for one calendar year starting from January of the year following graduation; proportion of graduates in official employment during the same period; and certain university characteristics.

I classify HEIs into four groups: six national (343 programmes and 12,876 individuals), 26 state (1,129 programmes and 21,216 individuals), nine 'elite' private (225 programmes and 10,875 individuals) and 34 other private (785 programmes and 16,258 individuals). The group of 'elite' private universities is sorted based on tuition fees distribution as per those within the top-20% country-level tuition fees[4]. Along with the most prestigious public institutions - the national universities - they are located in the two largest and most economically successful cities, entail the highest costs of study and attract students from around the country. The latter additionally provide better financial aid opportunities due to the allocation of existing publicly funded scholarship schemes prioritising large public institutions and less lucrative subjects (or those subjects that yield lower returns and, therefore, are less attractive). By contrast, provincial state and remaining private HEIs accommodate students from their localities. The four types of institutions differ in terms of their subject compositions (figure 5.2 showing the total number of students for each university type and a wider group of subjects), with the private 'elite' being most

[4]This is a tuition fee above 605,400 KZT per 2017-18 academic year or approx. 1,800 USD by the 01/2018 exchange rate. For comparison: the average country-level nominal monthly per capita population incomes in 2018 - 93,135 KZT or about 290 USD varying from 43,938 KZT to 185,036 KZT depending on region, the Committee on Statistics data. The data on tuition fees for 2018 was provided by Kazakhstan's authorities upon request. Programme-level tuition fees are averaged across universities. Only tuition fees for the Bachelor's programmes are used for this analysis.

Figure 5.2: Subject composition at different types of institutions



oriented towards the relatively more lucrative subjects. Besides, some of the 'elite' private universities set their own additional enrolment criteria, unobservable to me, and therefore the UNT score alone might not be a sufficient indicator of their student intake quality. Considering the differences across university types, I conduct my analysis for the four groups separately. Descriptive statistics follow in appendix D.1.

The four outcome variables are:

(1) *Number of students* - a number of students enrolled in a particular academic programme (subject) run by a university in a given year and who graduated four years afterwards.

(2) *Mean test score decile* - the average position of students who entered a particular programme at a particular university in the national test score distribution for their entry year. The position of the students in the national distribution should more accurately reflect the changes in the students' composition than the mean test score because all universities likely had somewhat 'worse' student bodies in 2012 when measured by their test scores (as per figure 5.1).

(3) *Share of graduates observed in official employment* during the year after graduation, standardised across subjects for the pooled years. The share is standardised to capture possible differences in employment opportunities across subjects and to achieve approximately normal distributions.

(4) *Mean of real pension contributions* (for simplicity referred as the *wage*) deducted by the working graduates during a year in official employment for each university-subject-cell adjusted by the CPI for 2010 as the base year. As there is no information available on the reasons for graduates not being in formal employment, the mean pension contributions are computed excluding those month(s) when a person was not apparently employed.

The number of students and the mean real wages are log-transformed.

5.3 Empirical strategy

The study employs a difference-in-differences-type estimator with a continuously varying treatment intensity. It assumes that although a clear control group could not be found as the policy affected all higher education applicants, all universities, and all subjects in 2012, the difference-in-differences type design still might be considered as long as the effect of the policy varies across the units. Examples of its application start with the pioneering work of Card 1992, followed by few other empirical research efforts, for example, Braakmann and Jones 2014 and Braakmann and Mcdonald 2020. The DiD design allows one to interpret the results as a causal effect of a policy, in particularly here I consider the effects of the policy on the undergraduate academic programmes run by the universities. I exploit the fact that the programmes normally differ in the average quality of their student intake: some subjects and/or universities tend to have relatively better quality student intake (as measured by their test scores) while the others - relatively worse. This might be driven by institutional or subject quality or selectivity and financial aids availability. The 2012 UNT shock moved the whole test score distribution towards the minimum test score cut-off point, which might effectively be interpreted as an increase in the cut-off point. Therefore, the intensity of the shock might vary depending on how close the student intake typically enrolled by a given programme is to the cut-off point. I argue that relatively better programmes should be affected less by the shock, though their applicants might still get somewhat worse test score than normal, which I control for by accounting for the average position of the students in the national test score distribution for this year instead of their average test score. The outcomes for these better programmes might serve as counterfactuals to estimate the changes in enrolment and student composition of the relatively worse programmes (which are more heavily affected) due to the policy change.

Specifically, I develop the following empirical model:

$$\begin{aligned} y_{usc} = \alpha_u + \beta_s + \theta_c + \gamma_{quality_{us,2010}} + \tau_1 \times quality_{us,2010} \times cohort_{2011} \\ + \tau_2 \times quality_{us,2010} \times cohort_{2012} + \varepsilon \end{aligned} \tag{5.1}$$

where

y_{usc} - outcome variable for the university-subject-cohort cell;

$quality_{us,2010}$ - indicator of quality of the university-subject in the pretreatment period;

cohort - dummy variable for cohort (entry year);

α_u - university fixed effects;

β_s - subject fixed effects;

θ_c - cohort (time) fixed effects.

τ_2 is the coefficient of interest - *the average treatment effect.* I additionally assess the τ_1

coefficient (as a pseudo-intervention), generally expecting it to be insignificant if the 2011 cohort is 'similar' to the 2010 cohort. However, as observed from the national statistics for the UNT average score and share of fails among test-takers (figure 3.4), it might be that the test was somewhat easier in 2011 (compared to 2010), thus the estimated results might reveal this as well.

It is reasonable to expect intra-university correlation of the academic programmes since they share common learning facilities, administrative policies and support, funding opportunities, and so on. This means the standard errors have to be clustered at the university level to avoid overestimated precision. However, clustering standard errors at the university level is problematic due to few (and in some cases, very few) clusters inflating the Moulton factor (Angrist and Pischke 2009). I generally follow Abadie et al. (2017) in the suggestion that, "clustering at too aggregate a level is not innocuous, and can lead to standard errors that are unnecessarily conservative, even in large samples" (ibid., p. 2). Along with this, as a robustness exercise, following Cameron et al. (2008) I additionally perform Wild Block bootstrapping of the standard errors clustered at the university level (with the Rademacher distribution, MacKinnon and Webb 2017). Additionally, I rely on demeaned/aggregated data, since using group averages instead of microdata is a known strategy to solving the Moulton problem regardless of the asymptotic (Angrist and Pischke 2009), though the data is averaged at the university-subject, not the university, level. It should be noticed that Angrist and Pischke (ibid.) recommend performing a weighted least squares instead of OLS in this case, with the group size used as the weights. However, since the programmes vary substantially by the numbers of students enrolled even within the four types of HEIs, this will lead to undesirable penalising of the smaller programmes, and will switch the focus towards the larger ones. Therefore, I choose not to weight university-subject level observations by the number of students. The main estimations are clustered at the university-subject level on the assumption that the treatment varies at this level (Abadie et al. 2017).

The pretreatment quality per university-subject cell is measured by the freshmen UNT score, particularly by the following three indicators:

(1) mean of the test score for all observed students enrolled in a particular programme at a particular university in 2010;

(2) the share of observed students in a given programme at a given university with test scores above the median of the national test score distribution for this subject in 2010;

(3) the test score of the observed 'worst' student entered in a particular programme (subject) at a particular university in 2010.

The indicator of quality might be noisy for three reasons. First, not all students are observed with the data but a sample of them. Second, there is no data on drop-outs - if one reasonably assumes dropping out students being those with the lower test score, then

with the data on *survivors* the *initial point* quality is overestimated. Albeit to the best of my knowledge the drop-out rates are generally low in Kazakhstan, this possibility can not be fully ruled out. Finally, assessing the quality from one year of data might capture either any intervening effects that appeared during this year or the measurement errors for this year in the data. As a robustness exercise, the models with the quality measured by the average in both 2010 and 2011 are additionally estimated.

All programmes are ranked at the national level based on their quality in 2010. The mean test score quality indicator ranking varies in a [1; 710] interval with '1' being assigned to the 'worst' and '710' to the 'best' quality of the average student intake; the median test score quality ranking - in [1; 246] and the minimum test score quality ranking - in [1; 92]. Variation is smaller for the median and minimum test score quality rankings since there are more programmes with similar ranking positions, for example, many programmes have the 'worst' student with a test score of 50, and according to this quality indicator they are all given a ranking position of one (the worst quality).

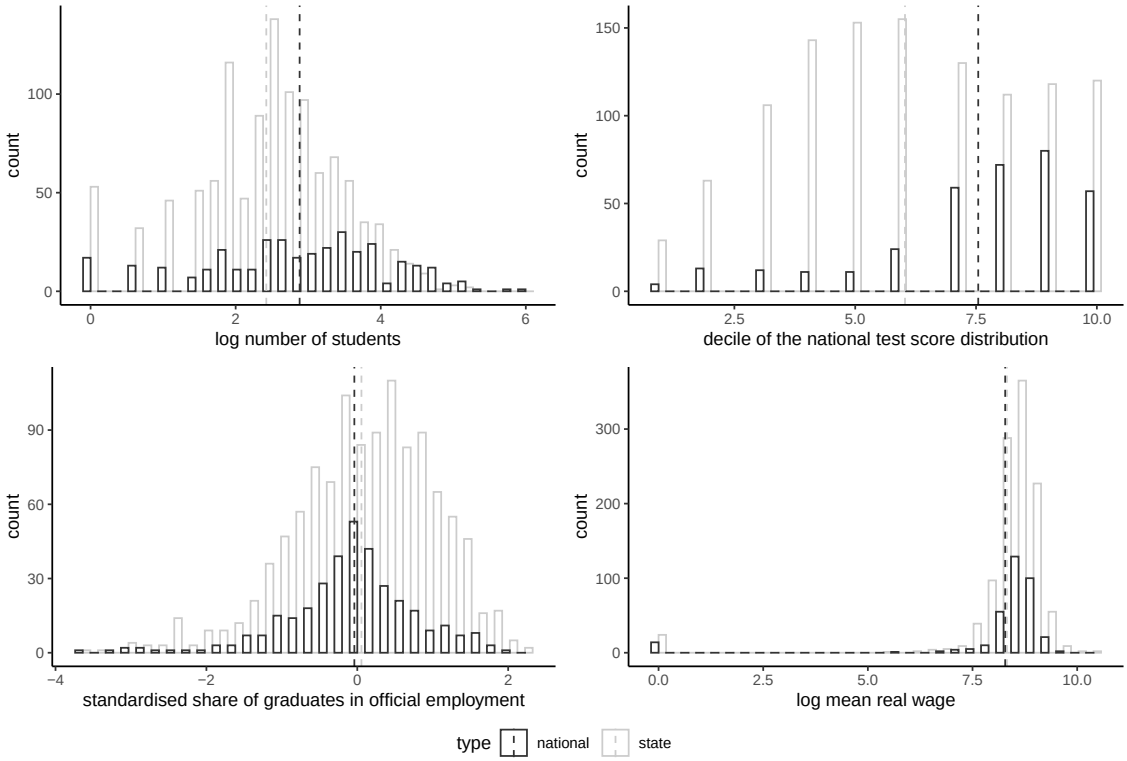
The mean and median indicators of quality point to the quality of an *'average student'*, although the median indicator additionally accounts for differences in this 'average student' between subjects. For example, for the subjects taught by the majority of universities (such as Law or Business Studies), the quality varies substantially from very poor to very good. By contrast, some subjects are delivered by only a limited number of HEIs and the quality is accordingly much less diverse. The country-level UNT score distribution for each subject follows in appendix D.2.

As opposed to the average quality, the quality of the programme as assessed by the *'worst' student's* test score might reveal another perspective. Specifically, it might better capture the university or programme selectivity, although it could be more prone to cases erroneously attributing better or worse quality due to only a few students being observed. Indeed, the mean and median quality rankings are highly correlated with each other, while the 'worst' student quality ranking is less correlated with them both, as seen from appendices D.3.1-D.3.3. As a robustness exercise, estimations are redone for a restricted sample consisting of only the programmes with no missing values for their students' test scores. This might ensure more accurate quality indicators and estimates, especially for that accounting for the worst student's quality, as it likely accounts for *the first* worst student's quality[5].

There are both good- and poor-quality programmes in terms of student intake at all types of university, though national and 'elite' private universities tend to be better while the other private universities are worse than the others, as seen from the dependent variables' histograms in figures 5.3-5.4 and the density plots for the mean test score rankings

[5]Not necessarily, though, since I observe the sample, not the population of the students and have no data on the actual number of the students enrolled or graduated a certain programme at a certain university in a given year.

Figure 5.3: Dependent variables histogram, public institutions



by university type, as seen from figure 5.5. The density plots for the median and minimum test score rankings follow in appendices D.4.1-D.4.2. The mean ranking density plots suggest that the poorer-quality programmes have shrunk whilst the better-quality programmes have expanded in 2012, in conformity with my hypothesis, but mostly at public universities.

DiD methodology is valid only under certain assumptions. First, it is crucial that "in the pretreatment period the treatment had no effect on the pretreatment population" (Lechner et al. 2011, p. 178). This assumption might be less relevant for DiD with varying intensity type methodology, as effectively all programmes at all universities were treated.

Second, the defining restrictions for DiD - 'common trend' and 'bias stability' assumptions - claim the presence of a common trend over time for both treated and control groups in the absence of the treatment. For my design, this essentially means that the difference between the better-quality versus worse-quality programmes was constant over time. If there was another intervention that led to a change in the differences between them, the DiD estimator mistakenly attributes this incremental difference to the treatment effect. The common trend assumption is not directly testable since the potential outcome in the absence of the treatment is unobserved.

Since the study design assumes comparison between better and worse quality pro-

Figure 5.4: Dependent variables histogram, private institutions

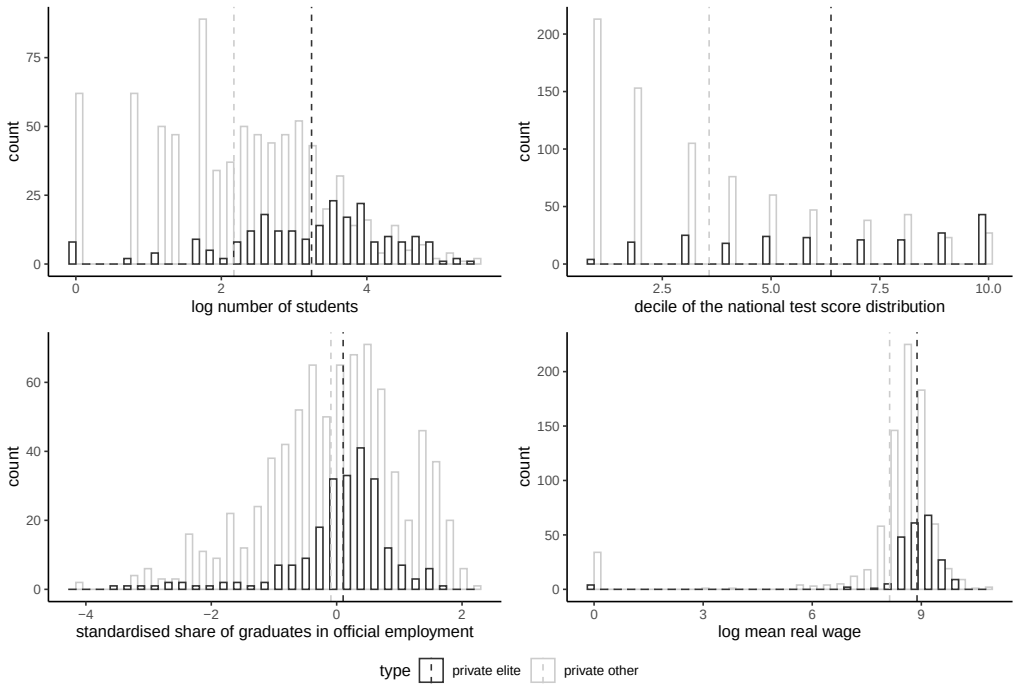


Figure 5.5: Density plots for the mean test score quality indicator distribution by university type and cohort

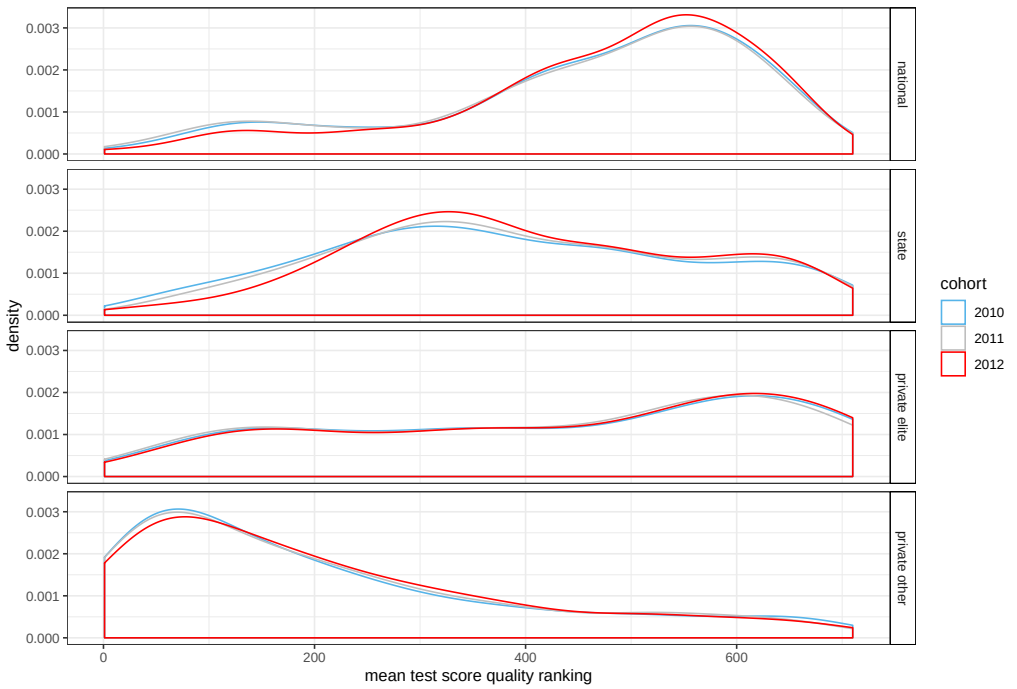
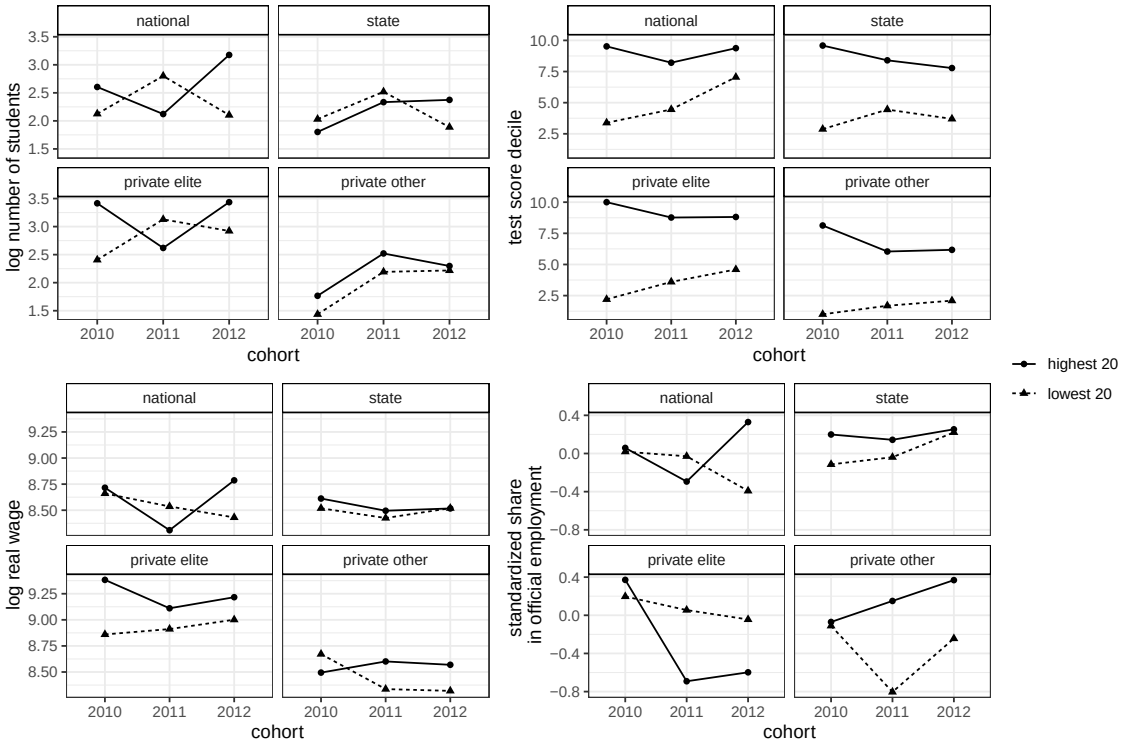


Figure 5.6: Mean values for four outcome variables for the top-20% and the bottom-20% of academic programmes



grammes, I depict unconditional plots approximating their outcomes. Particularly, figure 5.6 shows the mean values of the outcome variables for the top 20% and the bottom 20% of the academic programmes, where the programmes are ranged according to the mean test score quality ranking. Additionally, I show the same plots for the top 10% and the bottom 10% programmes (Appendix D.4.3). These are done separately for four university types on the assumption that if there were intervening effects, they rather affected the different *types* of universities than universities of a different quality *within* these types (such as, for example, the synchronous policy of the threshold jump at the national universities).

The unconditional plots generally do not confirm the presence of the common trend, although in some cases the trends look parallel – as for the number of enrolled students at the state and the other private universities. One possible explanation is the possible effects of the 2011 enrolment when the entry test likely was somewhat easier and this could benefit the worst quality programmes – for example, the absolute number of newly enrolled students increased at the worst quality programmes at the universities of any type. Test score decile (average position of the students at the national test score distribution) dropped at the better quality universities and grew at the worse quality ones for the universities of any type in both 2011 and 2012 (relative to 2010), and this reflects the estimations' findings reported in the results section. However, the labour market outcomes'

trends do not seem to be systematic (especially, for the employment) and this likely mirrors the measurement error (since I only observe those students who are employed). Another reason is that the plots are drawn for the sample, not the population. Therefore, I rely more on the estimations and, particularly, on the fixed effects and interaction terms coefficients and their t-statistics, which should help to mitigate any unobservables that may lead to differences in the observed trends in the plots.

5.4 Empirical results and discussion

5.4.1 Ordinary least square estimations

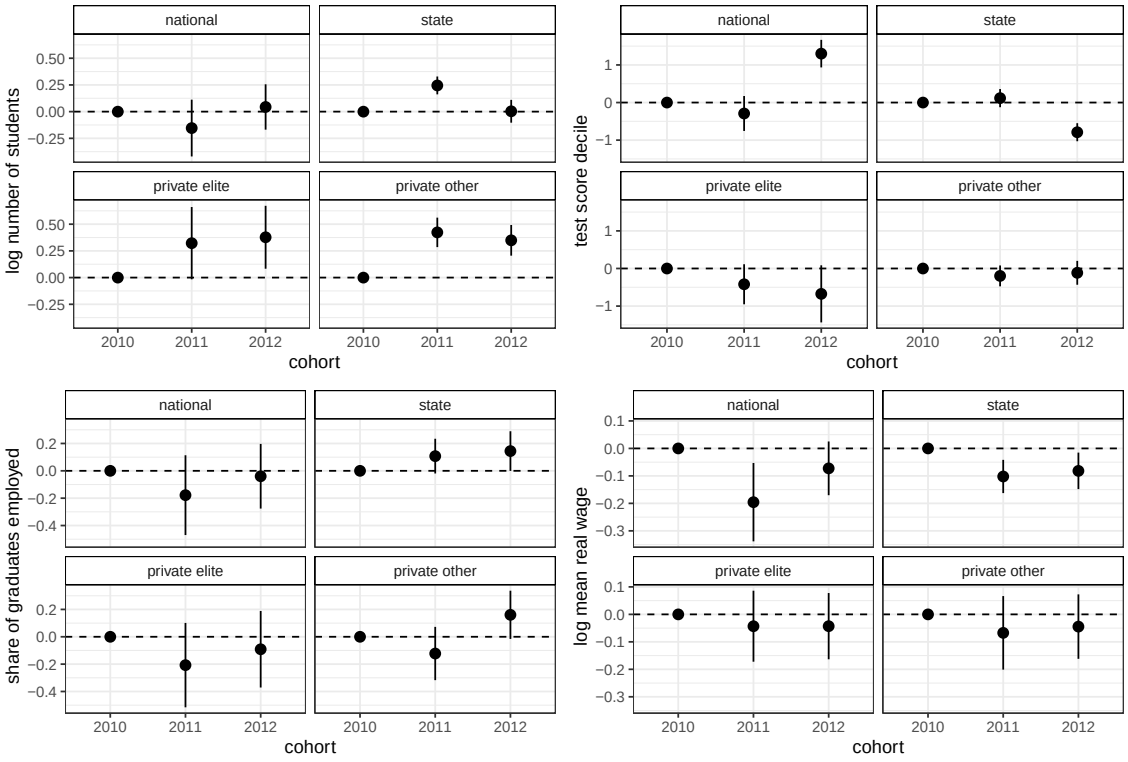
I start with basic OLS models regressing the outcome variables on cohort dummies, controlling for university-fixed and subject-fixed effects. They are computed for the four groups of universities separately. Figure 5.7 reports the cohort dummies' coefficients. The results only 'give a glance' to changes that have occurred over two years and are not treated as causal effects.

The number of students enrolled per programme increased in 2011 when the test likely became relatively easier and the country-level enrolment increased; however, it did not drop in 2012, which might be expected with the test-toughening policy. This can probably be explained by the consistently decreasing total number of HEIs and, possibly, the number of programmes in the remaining HEIs, as has taken place since the mid-2000s due to administrative pressure and toughening competition (figure 3.1). In particular, in 2012, the total number of HEIs dropped from 146 to 139[6]. Moreover, according to estimations, at private universities the number of students enrolled per programme grew consistently, and this might reflect the country-level expansion of privately provided higher education - according to the national statistics, since 2012 the number of students in such institutions has exceeded the number of students of public institutions - figure 3.7 (*CSRK* 2019).

The student composition, as measured by their position in the national test score distribution, only changed significantly at public universities in 2012, and the pattern appears intriguing. This could represent an effect of the enrolment policy change at the national universities (increase in the test score threshold in 2012). The policy might potentially lead to two different redistributional effects. First, if a strong sorting by ability normally takes place at them, so that the worst national university student is better than average other universities student, the average quality of the student intake at the other universities could go up. The opposite scenario assumes that the average student quality at the national versus other universities before the policy was approximately equal (this likely was the case for the 'elite' private and the state universities, to the best of my

[6]The Committee on Statistics of the Republic of Kazakhstan, www.stat.gov.kz.

Figure 5.7: Cohort dummies coefficients from models regressing the outcome variables on university dummies, subject dummies and cohort dummies

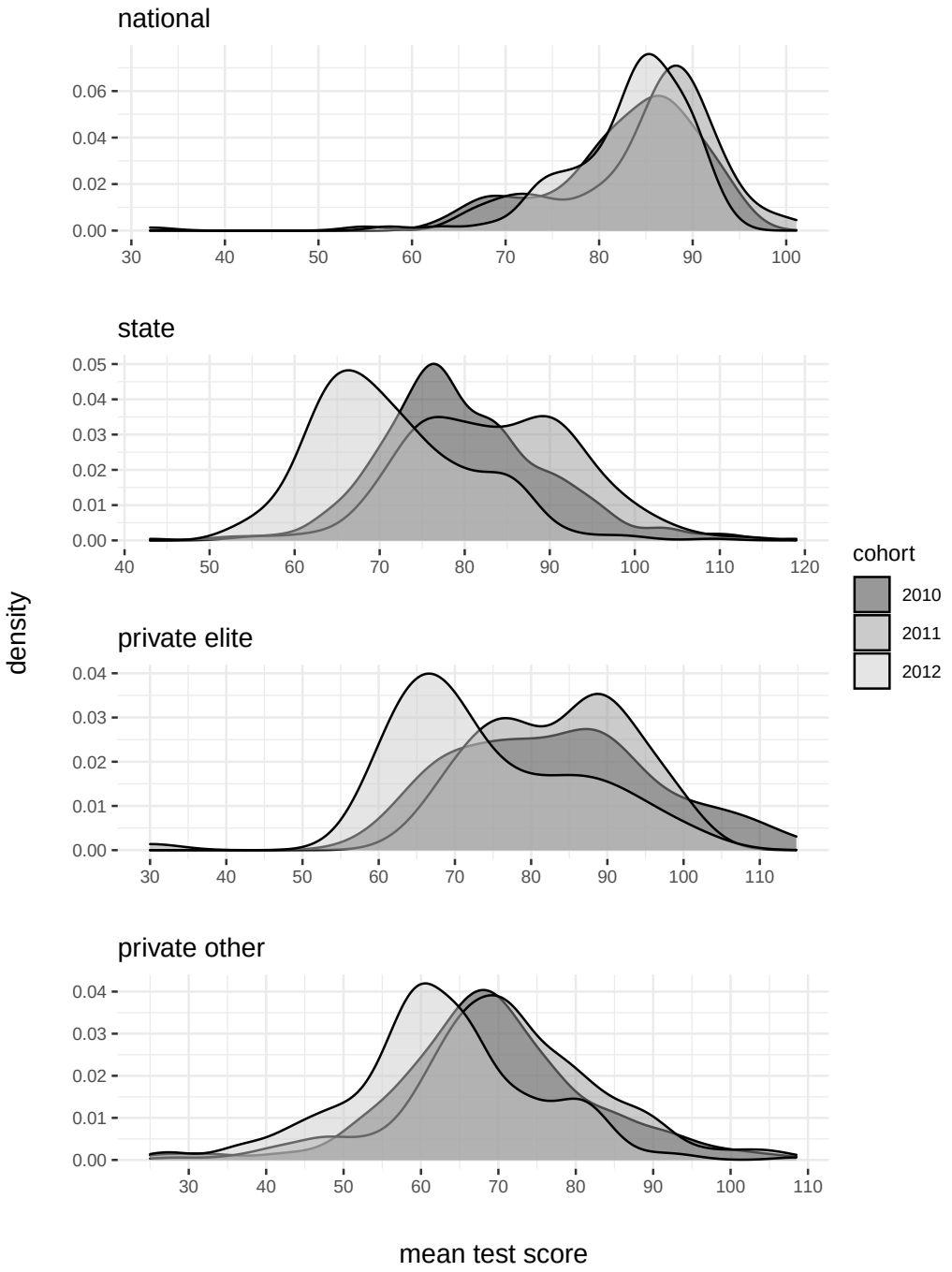


Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

knowledge on the situation of higher education entrants in Kazakhstan). In this case one might expect relatively worse students who would otherwise enter national universities to redistribute towards the other universities. As a result, the student body at these universities might get worse. Figure 5.8 shows the density plots for each university types and cohort. They suggest that the second scenario was likely the case. However, further estimations suggest that only at the state universities a decrease in the students' mean test score in 2012 was statistically significant (this might also be the case for the 'elite' private university, though the coefficient turned to be not statistically significant).

Due to the simultaneous change in the national universities' enrolment policy, their average student intake improved significantly, while the opposite occurred at state universities - the 2012 student intake quality dropped by almost a decile compared to 2010. However, the graduates' labour market outcomes appear essentially unaffected by changes over the years, though wages non-significantly decreased in both 2011 and 2012 for all universities. This might reflect the GDP dip which started in 2015 due to the drop in world commodity prices, causing a two-fold devaluation of the national currency. Along

Figure 5.8: Density plots for each university type and cohort



with that, the share of graduates observed in official employment is non-significant and unsystematic. Though I treat it as a proxy for the unobserved employment rate, it is likely a noisy proxy. As Mussurov et al. 2019 document, informality "may be a voluntary choice" for the graduates newly entering the labour market in Kazakhstan because it might be "equally attractive [for them] to work in [the informal vs. formal] sector" (p. 278).

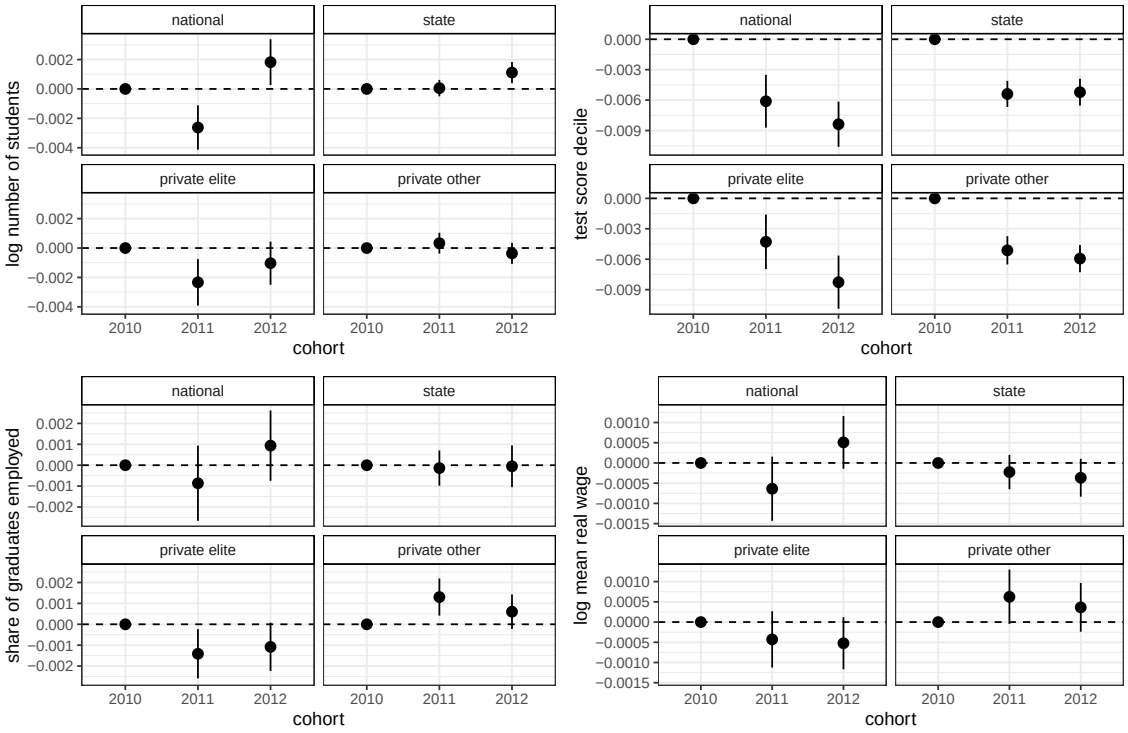
5.4.2 Difference in differences estimations

This section presents the main results of the DiD model, as estimated separately for the four university subgroups. Figure 5.9 documents the τ_1 and τ_2 coefficients with their 95% confidence intervals for the four different outcomes computed with the model 5.1 with the mean test score pre-policy quality indicator. The same models computed with the quality measured by the share of graduates above the median test score and the worst allowed student's test score are shown in the appendices D.5.1-D.5.2. Additionally, appendices D.7.1-D.7.3 report tables with regression results. The models where the standard errors are clustered at the university level and bootstrapped are shown in figure 5.10 for the mean test score quality indicator, and for the median and minimum test score quality ranking by appendices D.6.1-D.6.2.

As surmised, the mean and median indicators of the quality of the student intake generate somewhat similar results, while the quality assessed by the worst student's test score - different ones. With the mean test score, in 2012, the better programmes at public universities were found to have recruited more students relative to the worse programmes as a result of the test policy, though the effect is rather modest. A programme ranked 100 places out of 710 higher (better) in 2010, in 2012 recruited approximately 18% more students for national and 11% more students for state universities. This result is robust with the median indicator for the state universities, and significant for the national at a 10% level. However, this is not the case for private universities. Further, with the quality measured by the test score of the worst student enrolled, the per programme enrolment was found to increase for the better programmes run by the 'elite' private universities as well, though the magnitude was larger for public institutions (appendix D.5.2).

The magnitude of the policy effect while comparing the best and the worst university programmes ranked according to their average student body is much more modest than the magnitude of the ranking based on the quality of the worst student. For example, for the state universities, the best programme, as measured by the average quality indicators, has enrolled approximately 78% (mean ranking) and 53% (median ranking) more students than the worst programme, while the difference between the best and the worst programmes according to the minimum test score ranking was 276%. As mentioned above, the worst student quality ranking better reflects the university/programme selectivity. Therefore, it is likely that least selective programmes, as measured by the worst student admitted,

Figure 5.9: Interaction term coefficients (τ) with their 95% confidence intervals computed with the DiD model and the mean test score quality indicator, standard errors clustered at university-subject level



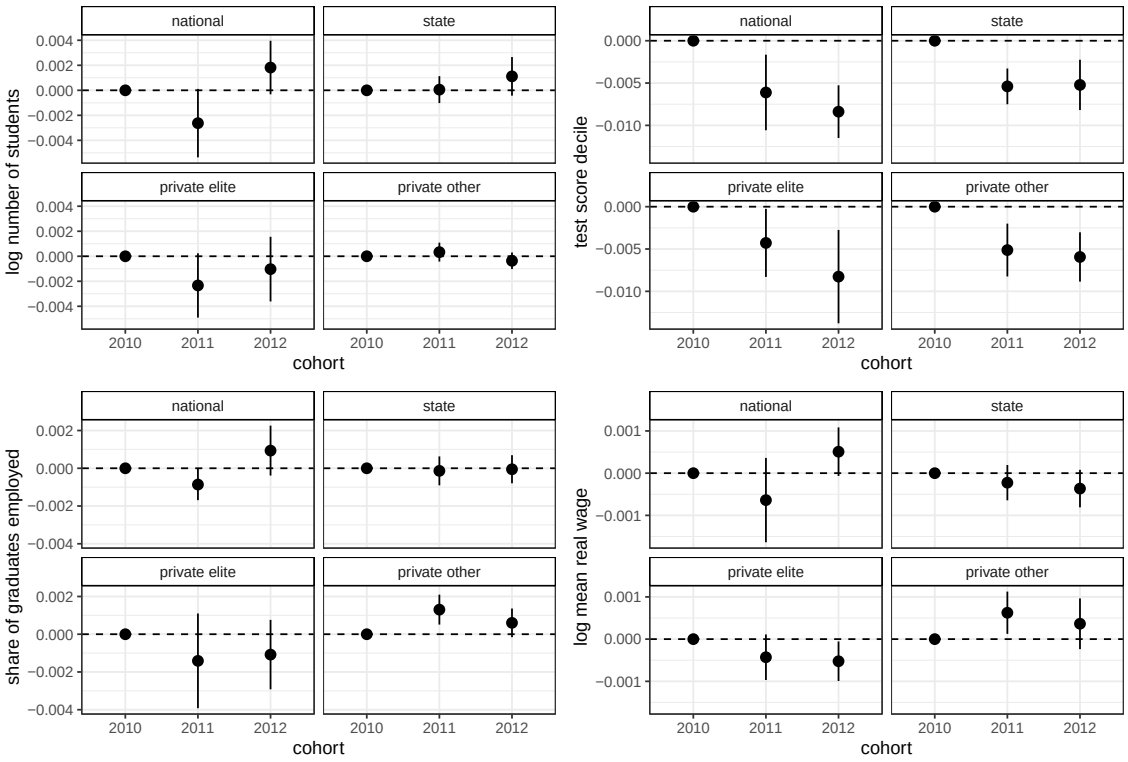
Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

have been more affected by the UNT tightening policy, at least for public and the most expensive private HEIs, in accordance with the hypothesis.

Interestingly, the enrolment per programme at the relatively better programmes dropped in 2011 at national and 'elite' private universities, which are likely characterised by sharper within-group heterogeneity in terms of prestige and selectivity than the relatively homogeneous group of the state and remaining private universities. Possibly, in 2011, when the entry requirements became comparatively easier, relatively worse national and 'elite' private universities recruited more new entrants, but their enrolment decreased further with the test-toughening shock. For more homogeneous and mostly regional state and other private universities, an increase in enrolment in 2011 could be evenly spread across programmes of variable quality, instead.

For the national universities, the effects of the test-tightening policy were indistinguishable from the effects of the simultaneous threshold jump policy; it is reasonable to expect that both policies affected the poorer-quality programmes at such institutions. It

Figure 5.10: Interaction term coefficients (τ) with their 95% confidence intervals computed with the DiD model and the mean test score quality indicator, standard errors clustered at university level



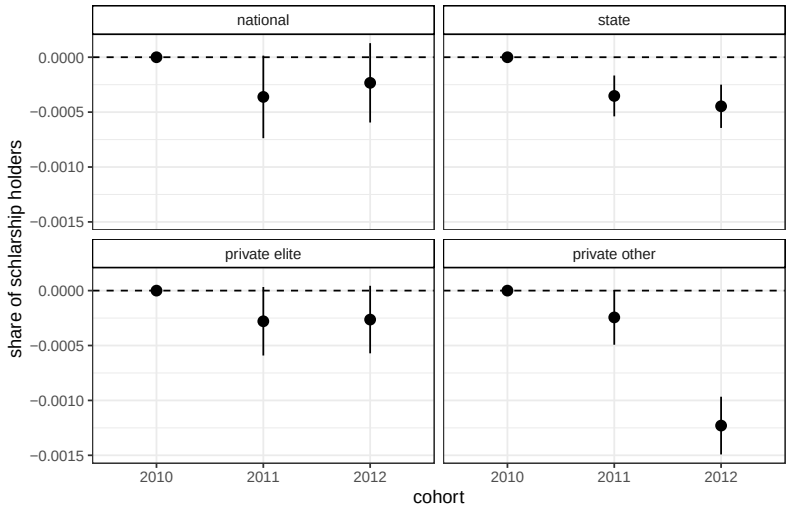
Wild block bootstrapped standard errors clustered at university level are computed in R with 'cluster.boot' command from 'multiwayvcov' package (Graham et al. 2016).

could be that enrollees with test scores below the newly established threshold reallocated towards state universities, and this additionally might explain their falling average test score, as shown in figure 5.7. These enrollees' possible choices in favour of state instead of private universities could be driven by the available scholarship opportunities, or they might simply have preferences for public higher education (there is still a certain public mistrust in private higher education in Kazakhstan).

There are two additional explanations for the policy effect observed at the public but not the private universities: it could be driven or mediated either by the centralised scholarship place allocation across universities or by the differences in the between-type subject composition.

First, the government might provide additional administrative support for public universities in 2012 in a form of better financial aids available for their applicants, possibly, with a focus on relatively better university programmes. To test this hypothesis, I run the same models with the share of scholarship holders per programme as an outcome

Figure 5.11: Interaction term coefficients (τ) with their 95% confidence intervals computed with the DiD model and the mean test score quality indicator, standard errors clustered at university-subject level

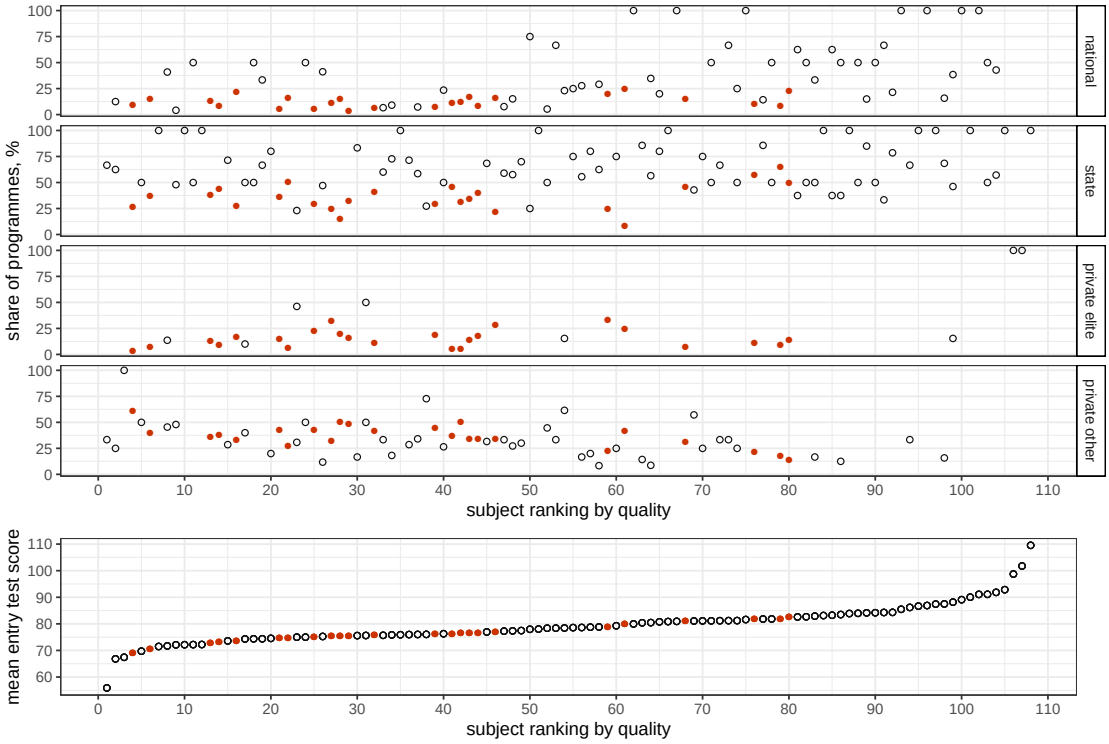


Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (ibid.).

variable. Since there are many zero values in the share of scholarship holders, I take an inverse hyperbolic sine transformation, approximating the log transformation but allowing the retention of zero values (Burbidge et al. 1988). Figure 5.11 presents the results obtained with the mean test score quality rankings; the results for the median, and the worst student's test score rankings are reported in appendices D.8.1-D.8.2. The share of students granted scholarships did not increase in either 2011 and 2012 in the better-quality programmes; moreover, it decreased for the state and other private universities. Based on this, the hypothesis that the number of students was driven by the scholarship allocation could be safely ruled out.

Secondly, the differences in public versus private university enrolment could be partially driven by subject composition. The model 5.1 effectively compares the outcomes concentrated on the lower tail of the test score distribution with those at the upper tail. If some subjects always tend to recruit lower-scored students, they might be affected by the test-tightening policy to a greater extent than those with the normally better student body. If, additionally, these subjects cluster, for example, for universities of a certain type, this might result in a relative decrease in enrolment for lower-scored subjects (programmes) or even with a cut in their numbers. Each dot at the upper panel of figure 5.12 represents a share of the academic programmes run by universities of a certain type in the total number of academic programmes for this subject in all years against the subject's position in the mean test score subject quality ranking in 2010. For the subject quality ranking, the

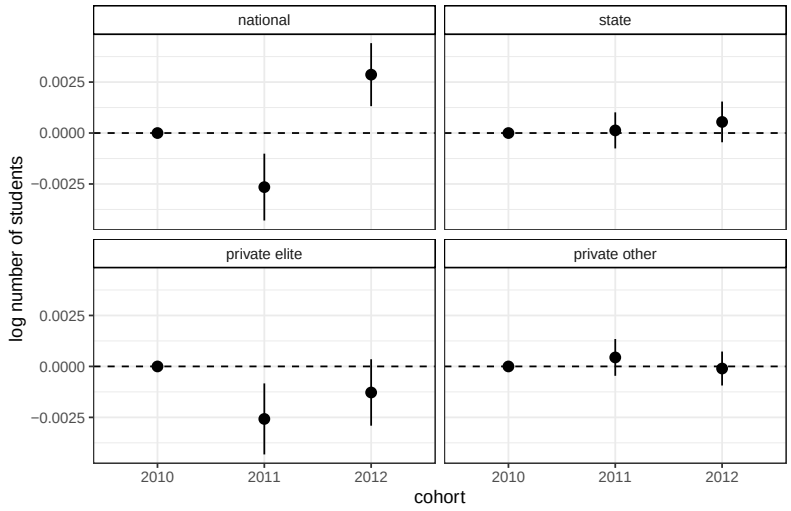
Figure 5.12: Share of academic programmes run by the universities of different type in the total number of programmes for a given subject and the subject's quality



mean test score is computed for each of the 108 subjects who are ranked accordingly, as shown by the lower panel (list of subjects with the number of programmes in 2010 follows in appendix D.2). For example, 67% of all programmes for a subject ranked number one according to its mean entry test score in 2010, which was a 55.9 UNT test score, were run by the state, whilst the remaining 33% by other private universities. Red-coloured dots represent the subjects delivered by universities of all types. It is noticeable that the worst programmes on the lower tail are run mostly either by the state or by other private universities, and possibly these programmes were affected more by the test-toughening policy. This, in turn, could result in a decrease in their enrolment relative to the better programmes; however, at the (other) private universities, there are much fewer best-score subjects and, additionally, their overall enrolment has grown during the analysed period. The national universities were also represented in the lower tail, and this could explain the drop in number of poor-quality programmes taught by such institutions in 2012 (figure 5.5).

To test this, I run the main model 5.1 on the subsample that includes only those subjects which were delivered by universities of all types. There are 24 such subjects taught by 64 HEIs (N = 1,340). The results of this analysis are shown in figure 5.13

Figure 5.13: Interaction term coefficients (τ) with their 95% confidence intervals computed with the DiD model and the mean test score quality indicator, standard errors clustered at university-subject level, sample including only subjects taught by all university types



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

and appendices D.9.1-D.9.2. They change for the state universities, suggesting that the effect of the test-tightening policy observed at them was likely driven by differences in the subject composition as mentioned above. In turn, at the national universities this could likely be attributed to the intervening effects of the jump in the test score threshold.

Further, the position of the better programmes' students within the national test score distribution drops for almost all universities both in 2011 and 2012 regardless of the quality rank indicator, as seen in figure 5.9 and appendices D.5.1 and D.5.2. Furthermore, this result is robust even with the standard errors clustered at the university level, which have vanished significance for the enrolment estimations, as expected (figure 5.10). The only exception is the most selective programmes at the 'elite' private universities which are not affected, as shown in the figure in appendix D.5.2. Accordingly, a programme ranked 100 places higher (better) in 2010, in 2012 would enrol students with around a 0.9 decile lower average test score at the national and private 'elite' universities, and around a 0.6 decile lower at the state and other private universities; and this appears to be a systematic pattern. The most realistic explanation for this observation is the universities' response to a long-term adverse demographic trend forcing them to decrease enrolment standards, if there are any, to maintain enrolment figures, and the ex-post effect of the UNT-2012 shock that pushed them to relax these standards even further and possibly reinforce their enrolment campaigns. Assuming that at least some of the better programmes might have higher teaching costs, it is quite natural to expect them to adapt their enrolment strategies

in order to maintain enrolment.

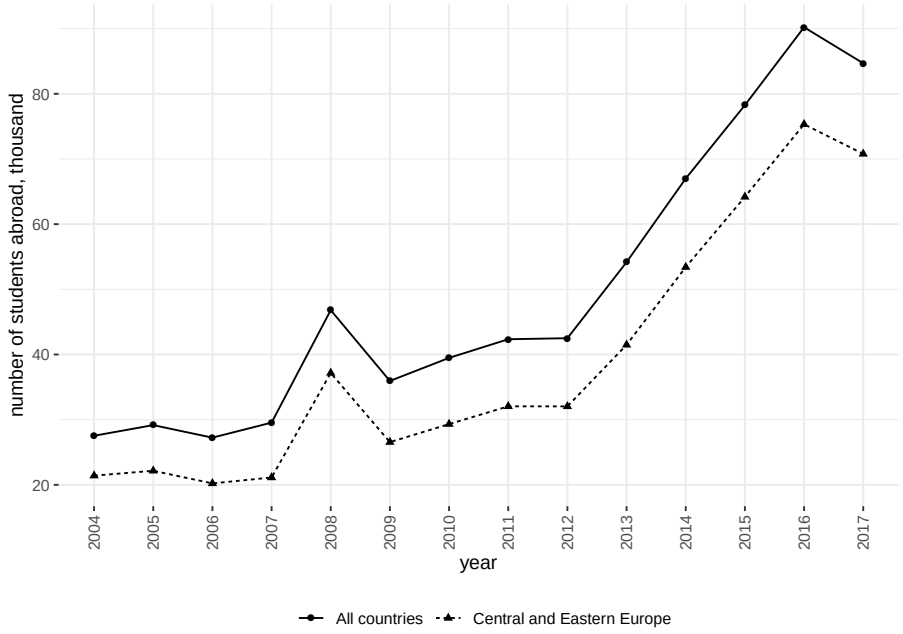
Another possible explanation is the expanding competition from abroad. The number of students from Kazakhstan studying abroad is growing consistently over time, as seen from the UIS data - figure 5.14 - with the largest proportion choosing Central and Eastern Europe, particularly Russia (according to data from the Embassy of Kazakhstan in the Russian Federation, the number of Kazakhstani students studying at Russian universities reached 65,571 in 2018[7]). It might be reasonable to expect that the majority of outbound students are those who are relatively more able, motivated and better prepared. Therefore, it is possible that the relatively better programmes at the Kazakhstani universities are primarily those competing with the foreign universities, and that freshmen quality drops within them as the result of this competition. This could be consistent with the larger magnitude of the τ coefficients for the test score decile observed at more expensive national and 'elite' private universities, if one reasonably expects the outbound students, or at least a part of them, to be relatively richer as well. However, considering the subjects chosen by the students from Kazakhstan studying in Russia, as shown in table 5.1, it is likely that public universities in Kazakhstan are mostly those competing with universities in Russia for students from Kazakhstan. Figure 5.14 might additionally suggest that the increased enrolment of Kazakhstani students in Russian universities observed from 2013 onwards could be related to the policy under consideration. The tightening of the UNT caused a public outcry and possibly triggered some Kazakhstani higher education enrollees to reconsider their choices with regard to studying abroad. Additionally, there is some anecdotal evidence that Russian universities intensified their enrolment campaigns within the Kazakhstani market of higher education entrants - through offers of financial aid and recruitment campaigns - at approximately the same time.

On the other hand, I can not rule out the possibility of observing a regression towards the mean phenomenon since I have only examined this variation over a very short run.

However, the worsening student body, as measured by the test score, does not seem to affect the better universities' graduates' employment and the inflation-adjusted starting wages. Based on theoretical background outlined in the introduction, these observations do not reject possible co-existence of the so-called pooling equilibrium (within the group of the relatively-better and more prestigious universities) and separating equilibrium (within the rest of HEIs). It might be that the employers of the relatively better-quality universities see the value added by these universities as a more important determinant of human capital quality than their freshmen quality measured by the entry test score. In this case, the decreasing quality of their student intake does not necessarily affect the graduates' labour market outcomes.

[7]The Embassy of the Republic of Kazakhstan in the Russian Federation, www.kazembassy.ru/rus/studenty/vuzy/

Figure 5.14: Total outbound internationally mobile tertiary students from Kazakhstan studying abroad



Data source: UNESCO Institute for Statistics (UIS), http://data.uis.unesco.org/

Table 5.1: Distribution of the students from Kazakhstan studying at the universities in Russian Federation by subject

Subject	Share
Humanities: education, history, philosophy, journalism, etc.	40%
Engineering and technology: metallurgy, mining, oil and chemical engineering, etc.	35%
Medicine and natural sciences: medicine, pharmaceuticals, physics, chemistry, etc.	25%
Data source: Embassy of the Republic of Kazakhstan in the Russian Federation, www.kazembassy.ru/rus/studenty/vuzy/, visited on 27/04/2020.	

Further, it is notable that quality measured by the test score better explains the labour market outcomes (at least, the log of the mean real wages) for the 'elite' private universities than for the others (as per R-squared values reported in the regression tables in the appendices D.7.1-D.7.3). Possibly, they more clearly transmit quality signals to their employers through their established reputations. Additionally, their employers might themselves be more market-focussed and respond more strongly to these signals, unlike the more 'traditional' employers of public institutions.

Finally, I run two sensitivity checks. First, I re-estimate the DiD model 5.1 with the quality ranking computed as an average for the test score distributions for both 2010 and 2011. Appendices D.10.1-D.10.3 plot the outcomes. Since the quality ranking explicitly accounts for 2011, the coefficients for the test score decile for this cohort lose significance for most of the models. For the other outcome variables, accounting for the two years' quality ranking does not substantially change the results.

Second, appendices D.11.1-D.11.3 report the interaction term τ coefficients computed on a sample consisting of only those university-subject level observations which do not have missing records for the students' test scores. There are only 733 such cells corresponding to 45 universities and 87 subjects. 99 out of 733 represent programmes taught by the national universities (comprising 29% of their total number); 335 by the state universities (30% of their total number); 51 by the 'elite' private (23% of their total number); and 248 by other private universities (32% of their total number). With the mean and the median quality ranking, the number of enrolled students is not statistically significant for this restricted sample. However, with the minimum quality ranking that I have been primarily interested in, it reasonably replicates the main results. For the test score decile, the outcomes are not that systematic, though.

5.5 Summary and conclusions

This chapter attempts to employ a unique country-level experiment - tightening the higher education centralised entry test in Kazakhstan in 2012 - and its effects on the number of students enrolled in academic programmes taught by HEIs, their average quality as measured by the test score, and their subsequent labour market returns. Despite the policy uniformity, I claim that the magnitude of the effect might vary depending on the average quality of the student body an academic programme tends to have. Since toughening the test essentially moved the entry cut-off point to the right, the programmes tending to enrol a greater number of students closer to the cut-off point are likely to be affected more intensively. This allowed me to apply the difference-in-differences type of research design. I first ranked all programmes depending on the average and minimum student intake quality in the previous year, and then estimated the effects of the test-toughening policy on the number of students enrolled in the programme, their quality, and their subsequent labour market outcomes, effectively comparing the relatively better programmes with the relatively worse ones.

The estimations were performed separately for four samples, namely the different types of university. They differed in terms of ownership, costs of study, availability of financial aid, location, subject, and student composition and, possibly, sensitivity to the public policy. I expand the official hierarchy which includes national, state (other public) and

private HEIs by separating the most expensive private universities into a distinct group. Despite between-group heterogeneity and relative within-group homogeneity, there are programmes of varying student body quality as measured by their test scores in each of these groups. Additionally, they all likely seek to maximise student enrolment due to lack of funding from the other sources and tough competition with each other and from abroad, though both the maximisation strategies and intensity of the competition might differ across groups as well.

The methodology employed has certain limitations. Firstly, it does not allow one to separate the relative decrease (increase) in the outcomes of the relatively worse programmes from the relative increase (decrease) in the outcomes of the relatively better programmes, in the sense that it is difficult to define exactly which of the two took place. Secondly, since the estimations are performed separately for the university-type subsamples, they compare the worse programmes' outcomes with those of the better programmes *within* these types, which complicates interpretation. For example, the counterintuitive result of no effect of the policy on the enrolment number found at the private universities (except the most expensive among them) might be driven by the fact that there are very few relatively better programmes among them.

The administrative dataset on three cohorts of individuals who entered four-year Bachelor programmes in 2010-2012 was aggregated into 2,482 academic programmes run by 75 HEIs for 108 subjects for three years. For each of these programmes, I computed the number of enrolled students, their average entry test score and further labour market outcomes, namely the share of those observed in official employment and inflation-adjusted average social security deductions during their first year after graduation. My results suggested the following findings.

With the programme level quality measured by the test score of the 'worst' student entered, which likely reflected the programme selectivity, nearly all better-quality programmes substantially increased their number of enrolled students relative to the worse ones due to the test-tightening policy. The only exception was the poorest quality private universities, where the result found to be consistent with the expectations but not statistically significant. However, this ranking of quality was likely more prone to measurement error than the quality measured by the average student entered, which generated more conservative results. With the latter quality indicator, I only found a statistically significant result for the number of enrolled students within the public university group. In particular, I found the better programmes saw an increase in number of freshmen students by around 18% relative to the worse ones at the national universities and by around 11% at the state as a result of the policy, but no effect was found for private universities. For the national universities, this finding possibly captures the effects of the other policy simultaneously enacted that affected them - the increase of the entry test score threshold from 50

to 70 UNT scores. It is reasonable to assume that both policies affected the worst-quality programmes at the national universities, decreasing their enrolment numbers. A possible explanation for the effect observed at the state universities but not private universities arose due to the differences in the subject composition across university type. The policy likely affected the worst-quality subjects, reducing their enrolment, and I found these subjects to be delivered mostly by the state and private universities (excluding the most expensive and prestigious among the private), with the latter being heavily underrepresented in the best-quality subjects' tail. Indeed, the statistical significance of the number of student estimations vanished for the state universities with the sample including only subjects delivered by all university types that were run to test this hypothesis.

Furthermore, I revealed a systematic and robust, though rather modest, decrease in the quality of the newly enrolled students at the better-quality programmes relative to the worse-quality ones, regardless of university type, sample restrictions, and the methodology used to construct the quality ranking. This possible longer trend likely reflects the surviving strategies of the universities in the face of increasing competition both in Kazakhstan and from abroad. Little is actually known about the admission criteria of the universities in Kazakhstan and how they responded given the pressure to recruit due to lack of evidence documented in the academic or indeed any other literature. However, it has become common knowledge that over the last several years the vast majority of them do not set selective criteria other than that required by the government due to student maximisation strategies in the face of lack of funding, mismanagement, and decreasing student numbers. Though this might vary across universities and subjects, this study suggests that even the best of them likely relax their selection criteria to cope with the increasing pressure possibly intensified by the policy under consideration. They might have higher tuition costs and experience stronger competition from abroad than the lower-quality programmes/universities. Thus, they might keen to decrease enrolment requirements (as measured by the centralised entry test) and reinforce their recruitment campaigns ex-ante, and ex-post the test-toughening shock. Therefore, it could be that the effect observed is not only driven by the direct effect of the policy in decreasing the number of enrolled students to the worse-quality programmes/institutions, but also by the indirect effect of increasing enrolment number via decreasing selectivity of the better-quality ones. This might question the effect of the policy if it was intended to curtail the worse-quality institutions.

However, the declining quality of the student body does not seem to affect better versus worse (or vice versa) programmes' graduates' labour market outcomes, which have not changed over the period in question. It is difficult to conclude why this was the case - either the labour market for the new entrants in Kazakhstan lacks the institutional quality signals and therefore sorts the workers according to their individual productivity,

or the institutional quality signals of the better-quality universities are more important to employers than the declining quality of the student body. Moreover, it is likely that in Kazakhstan the quality measured by the higher education entry test score has little to do with the value added by higher education itself, and does not necessarily reveal the labour market-relevant skills or true individual productivity that is prized by employers. Along with this, wages were only considered for the first affected cohort and over a very short period, therefore the timeframe might not have been sufficiently long to pick up possible distributional effects.

Chapter 6

Discussion and concluding remarks

This thesis aims to understand what the returns to education in post-Soviet Kazakhstan are, how they are affected by access to higher education, and what the effects of some of the relevant policies were. I used various theoretical frameworks, empirical strategies and two datasets to address these aims. I estimate the returns to education based on the wages of those individuals who are observed as working with the data, but do not focus on the probability of work due to data limitations. Consequently, my results likely underestimate the returns to education, as a number of previous studies have found the probability of working being positively correlated with higher levels of schooling in Kazakhstan (Mussurov and Arabsheibani 2015, Mussurov et al. 2019). Additionally, I have only focussed on private pecuniary returns without accounting for the study costs, as well as social returns and the risks associated with the investment in education.

The estimations of the returns to schooling in Kazakhstan and, generally, in the post-Soviet countries, are very limited. Nevertheless, they represent an interesting case: though the educational attainments were relatively high, most of knowledge and skills acquired within the Soviet economy were context-specific and immediately became outdated with the transition, while the accumulation of the relevant human capital was slow and challenging. This appeared to be the case despite the returns to education soaring with the transition, apparently due to removal of the restriction imposed by the planning economy. Based on Mincer's theoretical model, Deaton's pseudo-panel technique and the panel data empirical methods allowing me to deal with endogeneity problem, at least partially, I computed the returns to an additional year of schooling on the Kazakhstani labour market for 2002-2016. In line with the few existing examinations of such (Arabsheibani and Mussurov 2007, Fleisher et al. 2005, Barro and Lee 2010), my results suggest that they have developed with the country's transition, from the low rates supposedly typical of the Soviet economy to the current internationally comparable rates.

It might be difficult to reconcile these findings with existing evidence regarding the

decreasing quality of tertiary education in Kazakhstan (OECD 2019). However, exploiting an advantage of a long series of cross-sectional data, unlike the previous studies I found the returns systematically decreased over the years under analysis and for the younger cohorts. This likely reflects the decreasing quality along with a striking increase in quantity of education. Both possibly induce a mismatch between labour demand and supply and ultimately result in over-education. Moreover, I found that the returns to schooling were higher in the private sector, in line with the international observations suggesting that, in the words of Patrinos and Psacharoupolos, "where productivity matters, education is recognised" (Patrinos and Psacharopoulos 2020, p. 57). However, they decline systematically in the private sector over the period under consideration. For men – who tend to be employed by the private sector – the returns in the private sector dropped below the returns in the public sector from 2012 onwards. It is reasonable to expect the private sector to be more sensitive to the changes in value added by education to the human capital productivity than the more rigid public sector. Therefore, the decreasing trend in the returns might reflect a depreciating quality of tertiary education. The slowdown of the economic growth in the 'post-oil-boom' era might additionally contribute to the decrease in returns. However, these hypotheses could not be further tested, as this would require more sophisticated data.

To the best of my knowledge, there has been no previous research attempting to assess how access to higher education and educational reforms have affected returns to education in Kazakhstan or, indeed, other post-Soviet bloc countries.

Higher education went through a series of dramatic reforms and changes with the transition. While during the Soviet era access to higher education was relatively equal though competitive, this changed drastically with the transformation of the country's economic agenda. During the years of reform, the education policymakers in Kazakhstan were balancing between over-estimating the power of markets in achieving efficiency, reducing excessive supply, and improving the quality of higher education on the one hand and purely administrative instruments on the other. However, both extremes seem to lack efficiency. The liberal agenda in the 1990s allowed many new universities to open that were delivering a similar set of subjects but which were of poor quality. On a background of severe unemployment, this increased access to higher education and its relative affordability created an associated demand. During the first decade of the 2000s, the agenda changed to one of increased administrative pressure on higher education providers to improve their quality. I studied two of these policies and found both were not achieving their intended goals, since the improved quality of the student intake is not associated with either the graduates' improved labour market outcomes or with reshaping the market of higher education.

I found substantial heterogeneity in the returns to higher education, as driven by uni-

versity type rather than by subject. In turn, within the group of the most prestigious and expensive universities, the higher returns are associated with the higher tuition fees. The causal paths between the 'elite' status of these HEIs and the better labour market outcomes of their graduates are not clear and could not be disentangled with the data at hand. However, for the public universities among them, the higher returns seem to be fully driven by their selectivity, as found by exploiting the natural experiment of their increased entry test scores and fuzzy regression discontinuity design. This finding suggests national universities do not provide a better quality of education and do not add value to the human capital productivity relative to remaining public universities, despite having access to relatively better funding and administrative support and, possibly, better-paid labour markets. Although I cannot rule out possible bias due to the data and methodological limitations, these results might call for a reconsideration of the relevant policies. Specifically, they stress the importance of the quality of an institution, as opposed to the quality of its student body alone, in shaping the graduates' further labour market returns. Additionally, they imply that though the poor institutional quality is likely related to poor funding in Kazakhstan, better funding in itself is not sufficient to ensure quality, as measured by the value added by a given institution. Additionally, they might raise questions of equality of higher education opportunities in Kazakhstan.

Another policy analysed in the thesis was designed to improve student body quality through tightening the requirements of the entry examination. I found that this has only affected the public universities, decreasing the number of enrolled students in the relatively worse quality programmes/universities among them, as measured by their student test scores. It would be reasonable to assume that the policy was intended to affect the relatively poor-quality universities (or programmes) which are primarily concentrated among the private higher education providers, if we measure quality by students' average test scores. If so, the results suggest that this might not be efficient, as their outcomes were not found to be statistically different from those of previous years. Along with that, I found a relative decrease in the quality of student intake of the relatively better programmes, as measured by their average student's test score over the analysed period. A plausible interpretation of this robust result arises from the increasing competition between the HEIs for students due to adverse demographic trends, funding being heavily dependent on teaching workloads, and limited access to other sources of funding. These findings might question the efficiency of purely administrative restrictive policies under the existing circumstances.

I derive these conclusions with caution, primarily due to the possibility of biases induced by the constrains of the data. In particular, my analysis provides an insight into the nature of the entry test, suggesting it might not be an appropriate indicator to sort students according to qualities relevant to the labour market. It might also not be sufficient to infer a given university's quality since the average student test score has nothing

to do with the value added by the universities themselves. However, there are no reliable alternative indicators of the quality of the student population and institutional quality in Kazakhstan. Additionally, the students' demographics from the administrative dataset limit the possibilities to control for their socio-economic status and test some promising hypotheses which might otherwise shed light on the mechanisms determining their labour market outcomes. Other topics, which I leave for future research, are heterogeneity in the returns to higher education driven by regional and sectoral (e.g., public vs. private) disparities in the Kazakhstani labour market, and educational mismatch.

Appendix A

A.1 Distribution of primary sampling units by strata

Region/Province	Number of households			Number of PSUs		
	Urban	Rural	Total	Urban	Rural	Total
Metropolis:						
City of Astana	148587	-	148587	22	-	22
City of Almaty	386251	-	386251	30	-	30
Central:						
Akmola	115888	79089	194977	12	16	28
Karaganda	378012	66854	444866	20	12	32
East-Kazakhstan	299061	171035	470096	14	16	30
North:						
Kostanai	179666	127047	306713	12	15	27
Pavlodar	190793	63953	254746	12	16	28
North-Kazakhstan	97757	114127	211884	9	13	22
South:						
Almaty	110045	260502	370547	8	16	24
Zhambyl	123593	117878	241471	9	14	23
South-Kazakhstan	232170	260099	492269	10	16	26
Kyzyl-Orda	55226	69545	124771	8	12	20
West:						
Aktobe	133540	32803	166343	12	16	28
Atyrau	56823	31931	88754	10	8	18
West-Kazakhstan	100630	76727	177357	8	14	22
Mangustau	73270	16828	90098	12	8	20
Total	2681312	1488418	4169730	208	192	400
'Region' is a dummy variable combining several provinces geographically. East Kazakhstan province is combined with 'central' for simplicity.						

A.2 Higher education rate, male cohorts

cohort	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
male1954	0.151	0.181	0.189	0.187	0.22	0.178	0.204	0.216	0.209	0.202	0.246	0.242	0.223	0.227	0.239
male1955	0.194	0.205	0.219	0.176	0.137	0.151	0.165	0.173	0.193	0.215	0.192	0.193	0.182	0.159	0.145
male1956	0.198	0.207	0.2	0.188	0.196	0.254	0.267	0.164	0.175	0.184	0.171	0.192	0.182	0.183	0.225
male1957	0.188	0.193	0.201	0.194	0.194	0.193	0.211	0.236	0.23	0.168	0.167	0.168	0.144	0.142	0.146
male1958	0.157	0.151	0.157	0.147	0.206	0.201	0.204	0.13	0.149	0.191	0.221	0.241	0.212	0.214	0.198
male1959	0.212	0.164	0.158	0.161	0.165	0.157	0.156	0.248	0.228	0.153	0.2	0.197	0.187	0.174	0.179
male1960	0.144	0.157	0.154	0.159	0.205	0.212	0.22	0.204	0.17	0.181	0.216	0.22	0.256	0.287	0.254
male1961	0.153	0.17	0.176	0.18	0.189	0.183	0.198	0.221	0.218	0.214	0.192	0.176	0.156	0.144	0.183
male1962	0.179	0.171	0.168	0.183	0.177	0.189	0.199	0.184	0.199	0.227	0.212	0.191	0.208	0.226	0.234
male1963	0.192	0.238	0.229	0.205	0.211	0.218	0.222	0.223	0.214	0.276	0.243	0.259	0.236	0.196	0.179
male1964	0.164	0.173	0.18	0.164	0.165	0.176	0.168	0.199	0.194	0.207	0.204	0.198	0.223	0.265	0.253
male1965	0.217	0.215	0.232	0.203	0.215	0.199	0.179	0.158	0.161	0.206	0.248	0.258	0.201	0.246	0.244
male1966	0.145	0.169	0.188	0.174	0.15	0.162	0.171	0.24	0.241	0.234	0.22	0.179	0.204	0.2	0.196
male1967	0.134	0.172	0.173	0.184	0.245	0.228	0.242	0.177	0.206	0.292	0.287	0.269	0.242	0.229	0.209
male1968	0.174	0.167	0.209	0.196	0.175	0.183	0.181	0.197	0.239	0.226	0.228	0.231	0.24	0.228	0.239
male1969	0.156	0.155	0.18	0.193	0.207	0.198	0.197	0.246	0.207	0.23	0.209	0.2	0.206	0.213	0.214
male1970	0.14	0.165	0.18	0.162	0.226	0.245	0.246	0.22	0.201	0.256	0.236	0.253	0.22	0.245	0.235
male1971	0.172	0.18	0.184	0.217	0.237	0.229	0.21	0.207	0.239	0.257	0.255	0.24	0.259	0.263	0.268
male1972	0.166	0.177	0.193	0.218	0.182	0.191	0.209	0.232	0.219	0.23	0.164	0.194	0.189	0.223	0.248
male1973	0.147	0.181	0.142	0.161	0.174	0.165	0.178	0.225	0.243	0.249	0.272	0.253	0.241	0.233	0.233
male1974	0.143	0.136	0.162	0.148	0.253	0.299	0.287	0.203	0.214	0.285	0.299	0.295	0.252	0.264	0.251
male1975	0.199	0.203	0.221	0.213	0.26	0.257	0.265	0.217	0.234	0.242	0.226	0.259	0.256	0.243	0.273
male1976	0.239	0.19	0.17	0.164	0.207	0.231	0.236	0.286	0.291	0.367	0.313	0.283	0.286	0.277	0.267
male1977	0.181	0.198	0.197	0.213	0.236	0.222	0.203	0.264	0.247	0.333	0.286	0.306	0.274	0.262	0.241
male1978	0.168	0.174	0.207	0.219	0.247	0.236	0.272	0.246	0.265	0.312	0.306	0.293	0.28	0.252	0.259
male1979	0.207	0.23	0.272	0.252	0.264	0.315	0.335	0.316	0.32	0.314	0.294	0.331	0.337	0.285	0.261
male1980	0.144	0.221	0.235	0.264	0.216	0.265	0.282	0.339	0.364	0.318	0.35	0.374	0.336	0.335	0.321
male1981	0.097	0.144	0.232	0.229	0.276	0.276	0.322	0.323	0.354	0.305	0.378	0.409	0.364	0.368	0.332
male1982		0.083	0.184	0.237	0.232	0.293	0.333	0.323	0.311	0.367	0.388	0.395	0.38	0.376	0.371
male1983			0.07	0.173	0.236	0.267	0.307	0.342	0.321	0.371	0.351	0.334	0.333	0.353	0.431
male1984			0.002	0.069	0.19	0.244	0.309	0.321	0.349	0.4	0.394	0.38	0.371	0.367	0.364
male1985				0.008	0.043	0.137	0.262	0.348	0.336	0.36	0.39	0.377	0.427	0.395	0.391
male1986						0.046	0.163	0.297	0.312	0.363	0.406	0.384	0.342	0.379	0.362

A.3 Higher education rate, female cohorts

cohort	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
fem1959	0.316	0.314	0.3	0.297	0.317	0.32	0.298	0.31	0.295	0.315	0.295	0.319	0.371	0.316	0.329
fem1960	0.238	0.269	0.297	0.312	0.259	0.307	0.309	0.266	0.288	0.363	0.314	0.307	0.28	0.285	0.298
fem1961	0.291	0.307	0.312	0.276	0.297	0.294	0.321	0.312	0.315	0.287	0.306	0.284	0.284	0.273	0.289
fem1962	0.209	0.224	0.259	0.29	0.316	0.302	0.285	0.292	0.29	0.338	0.339	0.339	0.335	0.337	0.329
fem1963	0.3	0.352	0.338	0.334	0.278	0.309	0.331	0.357	0.367	0.317	0.3	0.308	0.287	0.357	0.351
fem1964	0.247	0.242	0.278	0.311	0.296	0.295	0.297	0.336	0.345	0.324	0.346	0.338	0.349	0.323	0.317
fem1965	0.302	0.293	0.287	0.287	0.308	0.308	0.303	0.31	0.299	0.359	0.367	0.376	0.36	0.34	0.384
fem1966	0.269	0.272	0.269	0.289	0.275	0.299	0.291	0.309	0.315	0.33	0.338	0.335	0.322	0.31	0.33
fem1967	0.286	0.318	0.316	0.307	0.328	0.34	0.328	0.29	0.296	0.432	0.389	0.36	0.367	0.353	0.333
fem1968	0.288	0.328	0.307	0.299	0.306	0.331	0.384	0.317	0.372	0.351	0.372	0.368	0.373	0.334	0.337
fem1969	0.305	0.311	0.352	0.327	0.338	0.333	0.336	0.365	0.361	0.339	0.338	0.386	0.376	0.334	0.317
fem1970	0.271	0.253	0.266	0.298	0.32	0.338	0.277	0.338	0.342	0.42	0.419	0.395	0.382	0.381	0.391
fem1971	0.227	0.254	0.277	0.29	0.297	0.311	0.303	0.265	0.253	0.347	0.371	0.344	0.374	0.339	0.355
fem1972	0.323	0.3	0.324	0.336	0.406	0.393	0.399	0.342	0.323	0.362	0.402	0.346	0.346	0.34	0.328
fem1973	0.27	0.323	0.33	0.313	0.335	0.376	0.386	0.354	0.343	0.366	0.355	0.36	0.344	0.393	0.432
fem1974	0.33	0.308	0.335	0.362	0.305	0.301	0.342	0.346	0.324	0.408	0.395	0.354	0.353	0.361	0.341
fem1975	0.302	0.306	0.293	0.278	0.338	0.34	0.326	0.325	0.332	0.463	0.413	0.415	0.407	0.39	0.382
fem1976	0.319	0.322	0.316	0.298	0.363	0.424	0.426	0.433	0.434	0.407	0.398	0.458	0.442	0.44	0.486
fem1977	0.307	0.331	0.305	0.334	0.346	0.409	0.401	0.363	0.401	0.486	0.455	0.428	0.405	0.379	0.411
fem1978	0.317	0.316	0.321	0.336	0.414	0.43	0.417	0.437	0.411	0.488	0.464	0.462	0.44	0.416	0.389
fem1979	0.276	0.33	0.339	0.359	0.359	0.392	0.441	0.412	0.427	0.44	0.409	0.444	0.445	0.451	0.492
fem1980	0.276	0.331	0.411	0.408	0.428	0.474	0.452	0.485	0.497	0.504	0.544	0.495	0.508	0.476	0.462
fem1981	0.178	0.271	0.39	0.334	0.441	0.503	0.494	0.477	0.52	0.504	0.52	0.569	0.531	0.487	0.479
fem1982		0.203	0.328	0.414	0.416	0.48	0.482	0.532	0.561	0.52	0.536	0.543	0.591	0.496	0.523
fem1983		0.011	0.238	0.321	0.409	0.479	0.523	0.521	0.511	0.563	0.551	0.573	0.568	0.56	0.494
fem1984			0.027	0.194	0.326	0.472	0.47	0.505	0.491	0.575	0.519	0.578	0.538	0.49	0.512
fem1985					0.175	0.327	0.486	0.538	0.589	0.581	0.604	0.629	0.582	0.586	0.537
fem1986						0.123	0.318	0.499	0.519	0.605	0.575	0.557	0.567	0.6	0.588

A.4 Cohort size in each year, male cohorts

cohort	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	size
male1954	542	564	593	555	150	152	157	518	253	560	565	450	422	440	431	6352
male1955	581	664	603	591	161	166	158	579	301	606	594	497	501	421	380	6803
male1956	587	653	660	649	199	177	180	708	342	643	627	525	506	504	467	7427
male1957	656	715	786	769	206	223	199	712	343	719	705	624	570	557	515	8299
male1958	670	717	791	798	204	224	230	813	404	792	754	752	746	668	632	9195
male1959	751	793	772	741	243	236	231	787	400	756	796	763	723	742	631	9365
male1960	840	937	951	955	278	274	286	972	481	880	791	772	726	698	712	10553
male1961	894	998	1014	1044	243	251	248	1093	510	915	902	880	814	776	761	11343
male1962	839	899	948	930	220	212	216	980	493	874	976	914	921	876	824	11122
male1963	776	898	900	926	218	216	234	938	472	906	820	856	797	812	797	10566
male1964	639	742	771	812	249	262	256	969	494	842	861	898	783	845	779	10202
male1965	785	871	859	905	209	211	207	943	459	898	929	916	826	836	769	10623
male1966	650	741	794	777	193	191	199	850	432	748	785	809	827	761	774	9531
male1967	620	717	723	795	196	193	198	879	423	784	798	806	781	860	834	9607
male1968	718	718	714	786	189	180	204	752	372	739	837	775	780	806	856	9426
male1969	582	651	682	742	169	197	203	771	411	880	869	881	885	844	781	9548
male1970	644	689	677	715	190	184	167	864	452	857	825	787	814	871	869	9605
male1971	621	699	675	664	169	188	210	605	331	864	933	879	789	783	761	9171
male1972	627	693	699	737	192	199	182	771	383	820	807	814	838	860	746	9368
male1973	607	646	640	652	167	176	174	644	362	786	874	817	805	790	741	8881
male1974	588	618	668	675	182	164	167	680	336	741	839	837	759	727	752	8733
male1975	579	635	671	682	169	175	162	728	350	776	766	808	862	950	867	9180
male1976	560	674	652	675	169	182	174	693	382	852	840	861	873	839	845	9271
male1977	585	607	594	602	191	198	187	770	405	914	893	890	928	862	821	9447
male1978	512	574	593	639	178	191	195	829	422	799	830	878	870	846	804	9160
male1979	546	582	625	647	163	143	164	680	369	940	887	866	799	820	824	9055
male1980	402	521	544	647	167	170	181	635	302	916	1002	927	878	786	785	8863
male1981	475	521	639	698	196	203	199	724	370	944	974	957	872	825	904	9501
male1982	394	545	635	683	164	147	153	727	350	900	796	822	859	962	842	8979
male1983	299	439	532	590	174	195	218	717	390	898	949	937	910	939	813	9000
male1984	241	341	471	590	216	225	233	797	410	1034	952	971	1002	910	876	9269
male1985	145	265	431	598	163	182	206	867	443	979	1039	1048	1066	1080	1053	9565
male1986	44	113	263	432	122	175	227	794	416	1112	1126	1155	1076	946	979	8980

A.5 Cohort size in each year, female cohorts

cohort	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	size
fem1959	776	925	924	999	278	294	285	1140	599	1027	1034	1025	958	829	835	11928
fem1960	919	996	1099	1132	320	335	353	1173	611	1055	1033	1049	989	927	885	12876
fem1961	906	1035	1152	1153	340	354	346	1438	714	961	1009	1066	1059	1071	1037	13641
fem1962	884	1076	1154	1221	310	308	319	1435	694	1045	1037	1023	969	906	867	13248
fem1963	813	992	1083	1066	241	243	251	1147	618	1018	913	890	883	861	885	11904
fem1964	687	795	928	959	294	288	293	1083	548	1065	1062	1131	1003	945	936	12017
fem1965	765	935	1011	1000	234	240	264	1134	569	1009	1105	1108	1125	1132	1115	12746
fem1966	632	764	863	909	265	278	275	1144	568	1050	1100	1144	1181	1006	1002	12181
fem1967	612	760	805	915	241	253	253	1111	561	910	933	999	935	932	885	11105
fem1968	619	753	838	916	235	236	255	1136	565	1051	974	987	974	949	833	11321
fem1969	537	659	765	879	207	228	238	1031	502	813	859	955	1026	935	983	10617
fem1970	538	653	672	719	200	204	213	887	483	878	953	971	964	1008	984	10327
fem1971	578	721	737	699	185	190	221	917	458	999	958	933	925	949	975	10445
fem1972	539	634	688	693	165	191	203	928	470	889	977	884	914	986	1005	10166
fem1973	481	617	664	649	161	181	189	824	414	918	958	835	957	947	957	9752
fem1974	546	598	585	641	174	176	193	731	407	773	795	836	886	934	972	9247
fem1975	514	599	659	663	195	194	184	794	449	846	908	896	879	841	866	9487
fem1976	565	544	582	657	171	184	188	841	399	835	893	878	850	877	854	9318
fem1977	486	543	591	620	159	149	182	755	374	773	827	871	855	811	799	8795
fem1978	419	469	489	559	162	179	192	774	401	801	801	807	856	889	835	8633
fem1979	431	479	567	502	153	153	152	723	384	747	809	849	880	912	890	8631
fem1980	377	489	523	510	152	156	146	656	332	792	860	895	823	804	808	8323
fem1981	388	487	533	536	136	143	154	606	331	770	757	745	808	755	770	7919
fem1982	272	385	476	505	161	148	168	652	344	700	796	774	799	796	765	7741
fem1983	211	370	484	527	137	163	155	628	370	796	719	726	808	835	871	7800
fem1984	102	217	297	428	144	159	166	618	334	845	859	849	892	843	855	7608
fem1985	102	178	241	378	103	153	185	716	314	802	857	854	763	778	732	7156
fem1986	15	70	209	308	98	114	148	690	389	946	835	814	946	825	771	7178

A.6 Descriptive statistics, pseudo-panel, male cohorts

cohort	log real wage mean	log real wage sd	schooling mean	schooling sd	age mean	age sd	central mean	north mean	south mean	west mean	rural mean	private mean
male1954	10.92	0.38	11.88	0.15	55	4.47	0.26	0.19	0.26	0.18	0.45	0.69
male1955	10.89	0.39	11.77	0.19	54	4.47	0.28	0.18	0.25	0.2	0.47	0.67
male1956	10.95	0.38	11.85	0.28	53	4.47	0.28	0.18	0.25	0.18	0.44	0.72
male1957	10.96	0.39	11.85	0.32	52	4.47	0.27	0.18	0.28	0.17	0.5	0.72
male1958	10.95	0.41	11.84	0.14	51	4.47	0.28	0.18	0.26	0.17	0.49	0.7
male1959	10.97	0.39	11.83	0.23	50	4.47	0.27	0.18	0.28	0.19	0.49	0.7
male1960	10.97	0.38	11.9	0.18	49	4.47	0.28	0.18	0.26	0.18	0.5	0.7
male1961	11	0.36	11.83	0.25	48	4.47	0.25	0.19	0.27	0.19	0.49	0.71
male1962	10.98	0.35	11.86	0.14	47	4.47	0.28	0.17	0.29	0.18	0.5	0.69
male1963	11	0.36	11.99	0.16	46	4.47	0.25	0.19	0.29	0.18	0.49	0.7
male1964	10.98	0.43	11.88	0.11	45	4.47	0.24	0.21	0.29	0.18	0.51	0.7
male1965	11	0.41	11.95	0.14	44	4.47	0.25	0.16	0.29	0.2	0.52	0.7
male1966	11.02	0.45	11.85	0.17	43	4.47	0.24	0.17	0.31	0.18	0.51	0.7
male1967	11.04	0.42	11.95	0.15	42	4.47	0.24	0.16	0.29	0.19	0.47	0.68
male1968	11.07	0.45	11.92	0.11	41	4.47	0.25	0.17	0.27	0.2	0.46	0.7
male1969	11.05	0.44	11.87	0.17	40	4.47	0.26	0.12	0.3	0.19	0.48	0.68
male1970	11.09	0.4	11.97	0.16	39	4.47	0.24	0.17	0.28	0.18	0.45	0.7
male1971	11.05	0.42	11.98	0.14	38	4.47	0.22	0.19	0.28	0.2	0.46	0.7
male1972	11.05	0.39	11.87	0.18	37	4.47	0.23	0.19	0.29	0.18	0.45	0.69
male1973	11.04	0.45	11.9	0.1	36	4.47	0.21	0.17	0.33	0.17	0.48	0.7
male1974	11.05	0.45	12	0.22	35	4.47	0.24	0.17	0.3	0.19	0.47	0.7
male1975	11.04	0.49	12	0.16	34	4.47	0.22	0.17	0.3	0.18	0.45	0.69
male1976	11.02	0.49	12.05	0.16	33	4.47	0.23	0.17	0.3	0.18	0.43	0.72
male1977	11.01	0.49	11.97	0.16	32	4.47	0.2	0.17	0.31	0.21	0.42	0.7
male1978	10.98	0.5	12	0.16	31	4.47	0.19	0.19	0.3	0.2	0.46	0.72
male1979	10.97	0.55	12.14	0.21	30	4.47	0.24	0.15	0.27	0.22	0.44	0.72
male1980	10.95	0.54	12.15	0.26	29	4.47	0.23	0.15	0.3	0.2	0.44	0.73
male1981	10.95	0.58	12.14	0.35	28	4.47	0.23	0.16	0.29	0.2	0.45	0.74
male1982	10.92	0.61	12.13	0.48	27	4.47	0.22	0.17	0.28	0.2	0.44	0.75
male1983	10.85	0.64	12	0.59	26	4.47	0.23	0.16	0.28	0.22	0.47	0.75
male1984	10.82	0.7	12.03	0.62	25	4.47	0.23	0.15	0.29	0.22	0.46	0.77
male1985	10.8	0.72	11.89	0.82	24	4.47	0.21	0.13	0.33	0.21	0.46	0.8
male1986	10.73	0.71	11.52	1.27	23	4.47	0.21	0.17	0.3	0.2	0.47	0.8

A.7 Descriptive statistics, pseudo-panel, female cohorts

cohort	log real wage mean	log real wage sd	schooling mean	schooling sd	age mean	age sd	central mean	north mean	south mean	west mean	rural mean	private mean
fem1959	10.74	0.41	12.45	0.21	50	4.47	0.31	0.17	0.23	0.18	0.4	0.44
fem1960	10.75	0.4	12.38	0.2	49	4.47	0.26	0.19	0.24	0.18	0.42	0.4
fem1961	10.71	0.4	12.37	0.26	48	4.47	0.26	0.21	0.24	0.16	0.44	0.4
fem1962	10.74	0.4	12.38	0.14	47	4.47	0.26	0.18	0.26	0.16	0.44	0.41
fem1963	10.76	0.41	12.48	0.26	46	4.47	0.27	0.17	0.27	0.18	0.43	0.4
fem1964	10.74	0.45	12.42	0.17	45	4.47	0.27	0.16	0.29	0.17	0.42	0.42
fem1965	10.76	0.46	12.51	0.1	44	4.47	0.25	0.19	0.28	0.18	0.42	0.41
fem1966	10.76	0.44	12.43	0.14	43	4.47	0.26	0.19	0.27	0.18	0.46	0.41
fem1967	10.78	0.44	12.55	0.13	42	4.47	0.27	0.17	0.26	0.19	0.43	0.4
fem1968	10.73	0.45	12.55	0.19	41	4.47	0.24	0.19	0.27	0.17	0.44	0.41
fem1969	10.74	0.44	12.54	0.21	40	4.47	0.27	0.19	0.25	0.16	0.44	0.44
fem1970	10.75	0.46	12.55	0.12	39	4.47	0.26	0.19	0.23	0.17	0.39	0.42
fem1971	10.73	0.46	12.41	0.11	38	4.47	0.22	0.19	0.27	0.19	0.4	0.44
fem1972	10.72	0.46	12.58	0.25	37	4.47	0.24	0.18	0.27	0.18	0.42	0.43
fem1973	10.7	0.49	12.58	0.18	36	4.47	0.26	0.19	0.26	0.16	0.4	0.43
fem1974	10.7	0.45	12.51	0.12	35	4.47	0.26	0.2	0.25	0.15	0.37	0.48
fem1975	10.72	0.47	12.53	0.1	34	4.47	0.25	0.19	0.25	0.17	0.39	0.47
fem1976	10.73	0.5	12.72	0.18	33	4.47	0.24	0.17	0.28	0.18	0.38	0.48
fem1977	10.7	0.47	12.65	0.16	32	4.47	0.25	0.18	0.25	0.18	0.4	0.48
fem1978	10.73	0.48	12.74	0.18	31	4.47	0.24	0.16	0.25	0.2	0.37	0.46
fem1979	10.65	0.52	12.72	0.17	30	4.47	0.25	0.18	0.23	0.22	0.37	0.5
fem1980	10.71	0.51	12.91	0.21	29	4.47	0.23	0.19	0.21	0.23	0.37	0.53
fem1981	10.68	0.5	12.87	0.38	28	4.47	0.23	0.17	0.25	0.22	0.4	0.49
fem1982	10.65	0.54	12.86	0.56	27	4.47	0.22	0.16	0.27	0.21	0.36	0.52
fem1983	10.63	0.53	12.79	0.72	26	4.47	0.25	0.17	0.24	0.22	0.38	0.54
fem1984	10.59	0.61	12.6	0.85	25	4.47	0.25	0.15	0.27	0.19	0.38	0.55
fem1985	10.59	0.62	12.56	1.07	24	4.47	0.24	0.15	0.25	0.21	0.39	0.59
fem1986	10.56	0.66	12.23	1.36	23	4.47	0.21	0.14	0.28	0.23	0.4	0.61

A.8 Descriptive statistics, the first and the final year subsamples

Variable	Male subsample, N=44,224		Female subsample, N=39,686	
	2002 N=18,999	2016 N=25,225	2002 N=14714	2016 N=24972
Schooling:				
mean	11.74	11.96	12.37	12.53
s.d.	1.65	1.88	1.73	2.03
Age:				
mean	34.3	44.59	32.92	43.97
s.d.	8.42	9.18	7.12	7.92
Log real wage:				
mean	10.15	11.5	9.92	11.25
s.d.	0.87	0.59	0.77	0.53
Number of observations:				
Region:				
metropolis:	1949	3122	1948	3395
central:	5062	5125	3971	5482
north:	3275	4352	2781	4471
south:	5966	6174	3950	5775
west:	2747	6452	2064	5849
Residence:				
urban	11509	12267	10087	13261
rural	7490	12958	4627	11711
Sector of employment:				
public	6938	5720	8362	13140
private	12061	19505	6352	11832

A.9 Returns to schooling estimated by OLS with schooling*year interaction term, men

	Dependent variable:			
	log real wage			
	(1)	(2)	(3)	(4)
schooling	0.151***	0.135***	0.121***	0.122***
	(0.004)	(0.004)	(0.003)	(0.003)
age	0.061***	0.062***	0.063***	0.063***
	(0.001)	(0.001)	(0.001)	(0.001)
age squared	-0.001***	-0.001***	-0.001***	-0.001***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
schooling*year 2003	-0.003	-0.006	-0.005	-0.005
	(0.005)	(0.005)	(0.004)	(0.004)
schooling*year 2004	-0.011**	-0.010**	-0.011***	-0.011***
	(0.005)	(0.005)	(0.004)	(0.004)
schooling*year 2005	-0.022***	-0.021***	-0.023***	-0.023***
	(0.005)	(0.004)	(0.004)	(0.004)
schooling*year 2006	-0.036***	-0.035***	-0.037***	-0.037***
	(0.006)	(0.006)	(0.006)	(0.006)
schooling*year 2007	-0.052***	-0.050***	-0.052***	-0.052***
	(0.006)	(0.006)	(0.005)	(0.005)
schooling*year 2008	-0.060***	-0.058***	-0.060***	-0.060***
	(0.006)	(0.005)	(0.005)	(0.005)
schooling*year 2009	-0.043***	-0.045***	-0.047***	-0.047***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2010	-0.040***	-0.042***	-0.045***	-0.045***
	(0.005)	(0.005)	(0.004)	(0.004)
schooling*year 2011	-0.062***	-0.064***	-0.066***	-0.066***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2012	-0.054***	-0.057***	-0.059***	-0.059***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2013	-0.058***	-0.059***	-0.063***	-0.063***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2014	-0.056***	-0.057***	-0.062***	-0.062***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2015	-0.051***	-0.055***	-0.060***	-0.060***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2016	-0.043***	-0.049***	-0.054***	-0.054***
	(0.004)	(0.004)	(0.004)	(0.004)
additional control variables	year	year region	year region residence	year region residence sector
F Statistic	5518.2***	6444.9***	7235.3***	7088***
N	305,990	305,990	305,990	305,990
Adj. R2	0.386	0.439	0.488	0.488

A.10 Returns to schooling estimated OLS with schooling*year interaction term, women

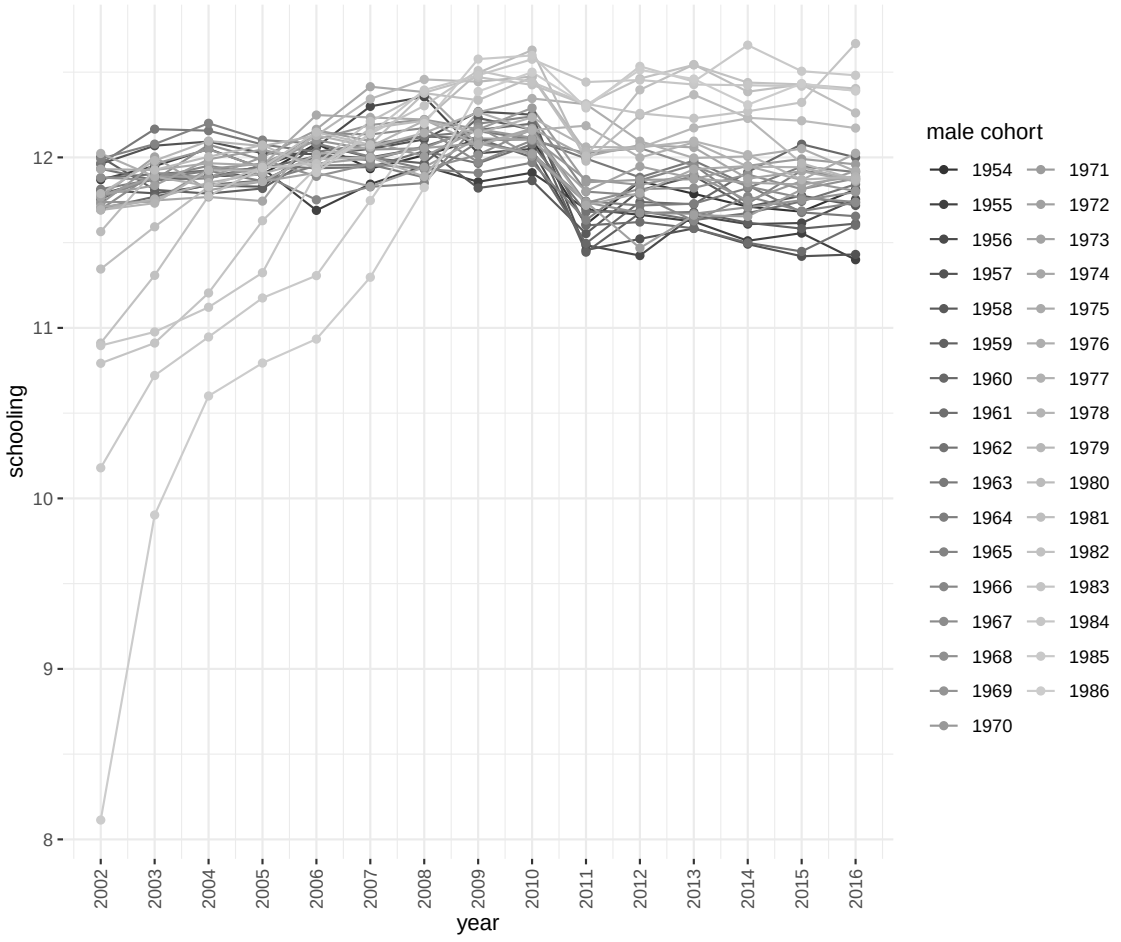
	Dependent variable:			
	log real wage			
	(1)	(2)	(3)	(4)
schooling	0.144***	0.130***	0.125***	0.123***
	(0.004)	(0.004)	(0.004)	(0.004)
age	0.033***	0.036***	0.036***	0.036***
	(0.001)	(0.001)	(0.001)	(0.001)
age squared	-0.0004***	-0.0004***	-0.0004***	-0.0004***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
schooling*year 2003	0.0004	-0.0001	-0.001	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)
schooling*year 2004	0.005	0.006	0.004	0.004
	(0.005)	(0.005)	(0.005)	(0.005)
schooling*year 2005	-0.009*	-0.008*	-0.011**	-0.011**
	(0.005)	(0.005)	(0.005)	(0.005)
schooling*year 2006	-0.015**	-0.014**	-0.016***	-0.016***
	(0.006)	(0.006)	(0.006)	(0.006)
schooling*year 2007	-0.011*	-0.008	-0.012**	-0.011**
	(0.006)	(0.006)	(0.006)	(0.006)
schooling*year 2008	-0.029***	-0.026***	-0.029***	-0.029***
	(0.006)	(0.006)	(0.006)	(0.006)
schooling*year 2009	-0.009*	-0.009**	-0.013***	-0.013***
	(0.005)	(0.004)	(0.004)	(0.004)
schooling*year 2010	-0.021***	-0.021***	-0.025***	-0.024***
	(0.005)	(0.005)	(0.005)	(0.005)
schooling*year 2011	-0.040***	-0.040***	-0.043***	-0.042***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2012	-0.042***	-0.042***	-0.044***	-0.044***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2013	-0.034***	-0.033***	-0.036***	-0.036***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2014	-0.036***	-0.035***	-0.038***	-0.037***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2015	-0.033***	-0.032***	-0.035***	-0.034***
	(0.004)	(0.004)	(0.004)	(0.004)
schooling*year 2016	-0.025***	-0.025***	-0.027***	-0.027***
	(0.004)	(0.004)	(0.004)	(0.004)
additional control variables	year	year region	year region residence	year region residence sector
F Statistic	6181.2***	6466.7***	6671.1***	6498.9***
N	282,110	282,110	282,110	282,110
Adj. R2	0.419	0.454	0.467	0.468

A.11 Returns to schooling estimated on pooled individual data by OLS with schooling*gender interaction term

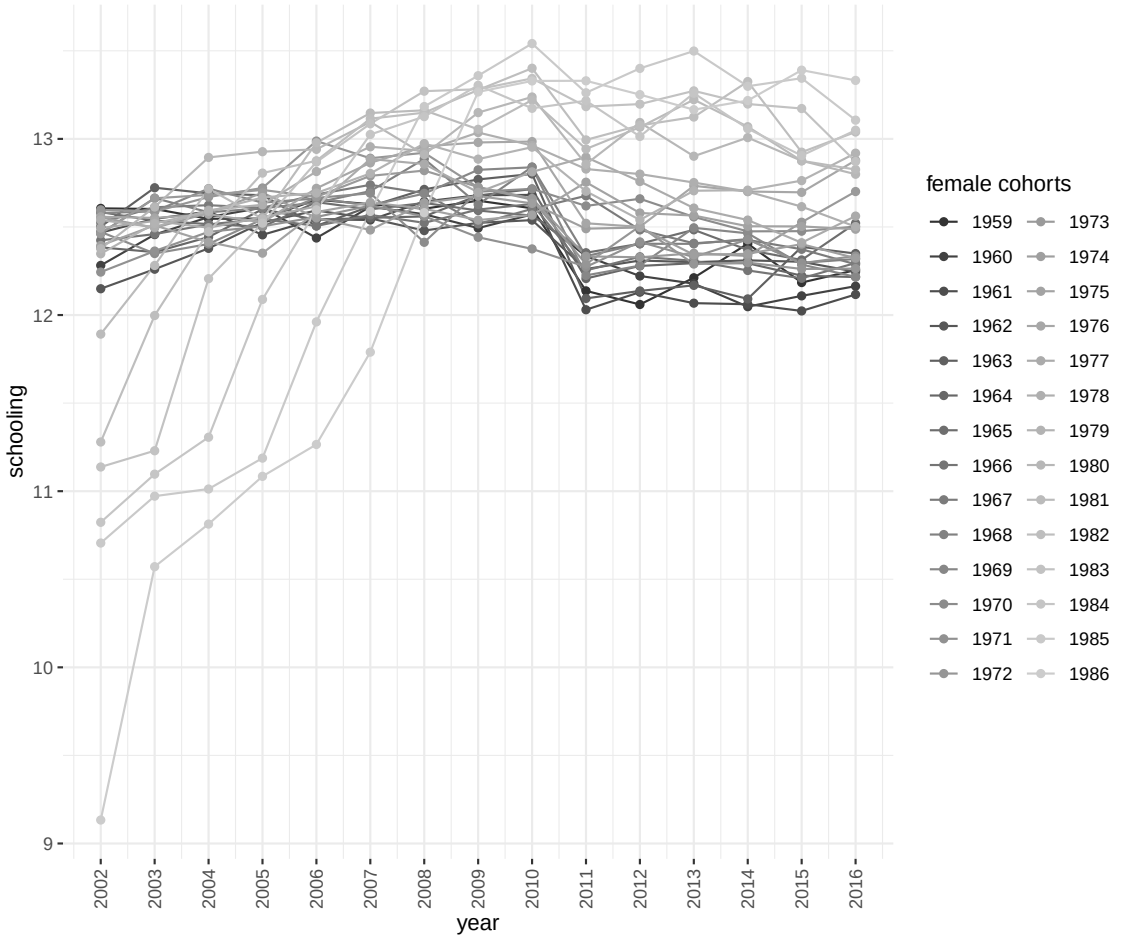
	Dependent variable:			
	log real wage			
	(1)	(2)	(3)	(4)
schooling	0.119***	0.104***	0.093***	0.092***
	(0.001)	(0.001)	(0.001)	(0.001)
age	0.053***	0.055***	0.056***	0.055***
	(0.001)	(0.001)	(0.001)	(0.001)
age squared	-0.001***	-0.001***	-0.001***	-0.001***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
male	0.452***	0.478***	0.509***	0.516***
	(0.011)	(0.010)	(0.010)	(0.010)
schooling*male	-0.009***	-0.011***	-0.013***	-0.013***
	(0.001)	(0.001)	(0.001)	(0.001)
constant	7.401***	7.493***	7.390***	7.398***
	(0.016)	(0.015)	(0.015)	(0.015)
additional control variables	year	year region	year region residence	year region residence sector
F Statistic	19634***	19985***	21188***	20404***
N	588,100	588,100	588,100	588,100
Adjusted R2	0.412	0.454	0.482	0.482

Notes: (1) OLS computed in R. HC1 robust standard errors computed with 'sandwich' package (Zeileis 2004 in parentheses.
*p<0.1; **p<0.05; ***p<0.01

A.12 Mean of schooling across cohorts and years, male cohorts



A.13 Mean of schooling across cohorts and years, female cohorts

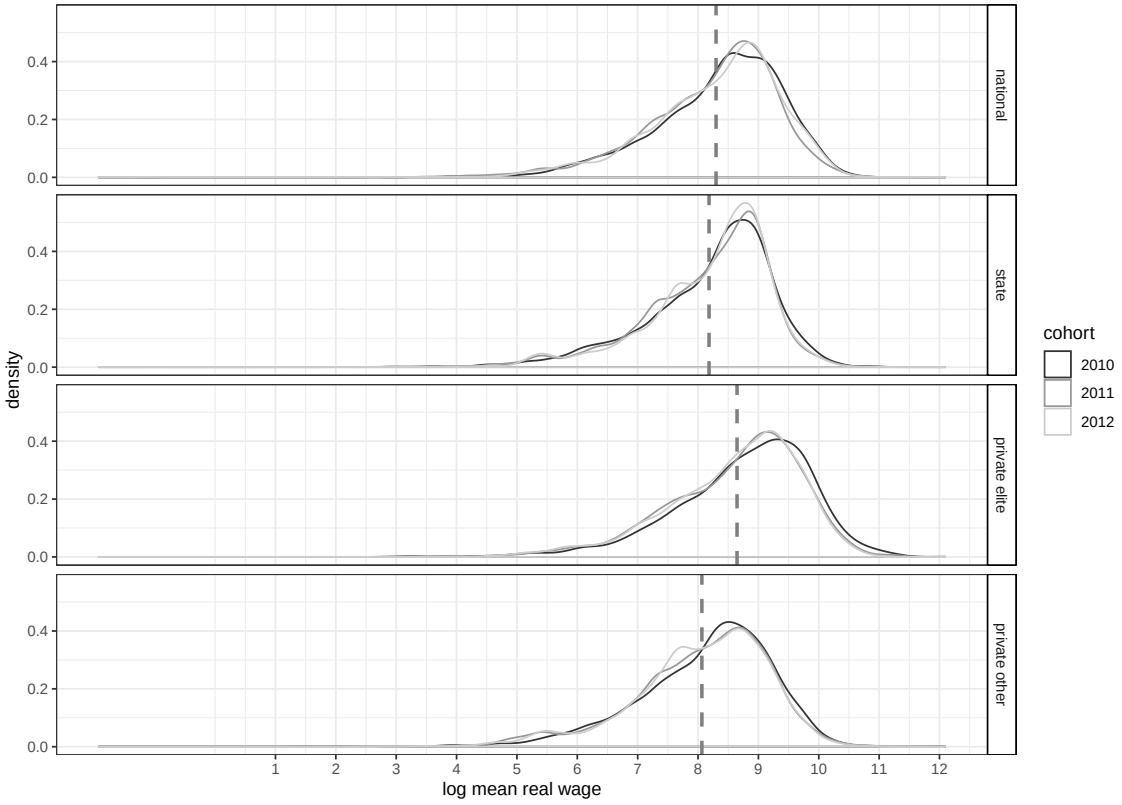


Appendix B

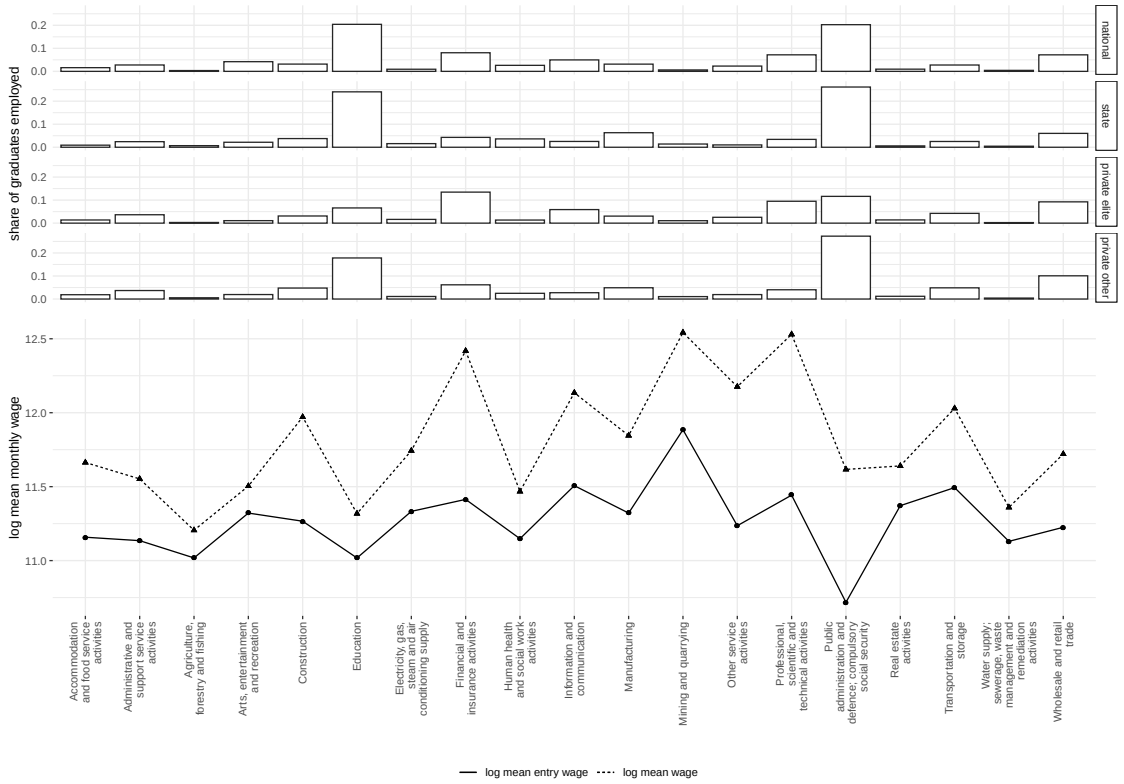
B.1 The country map

The map shows the cities with HEIs. The size of the dots representing cities depends on the number of HEIs. Red dots represent the country's biggest cities.

B.2 Log of real mean wage density plots for four types of institutions

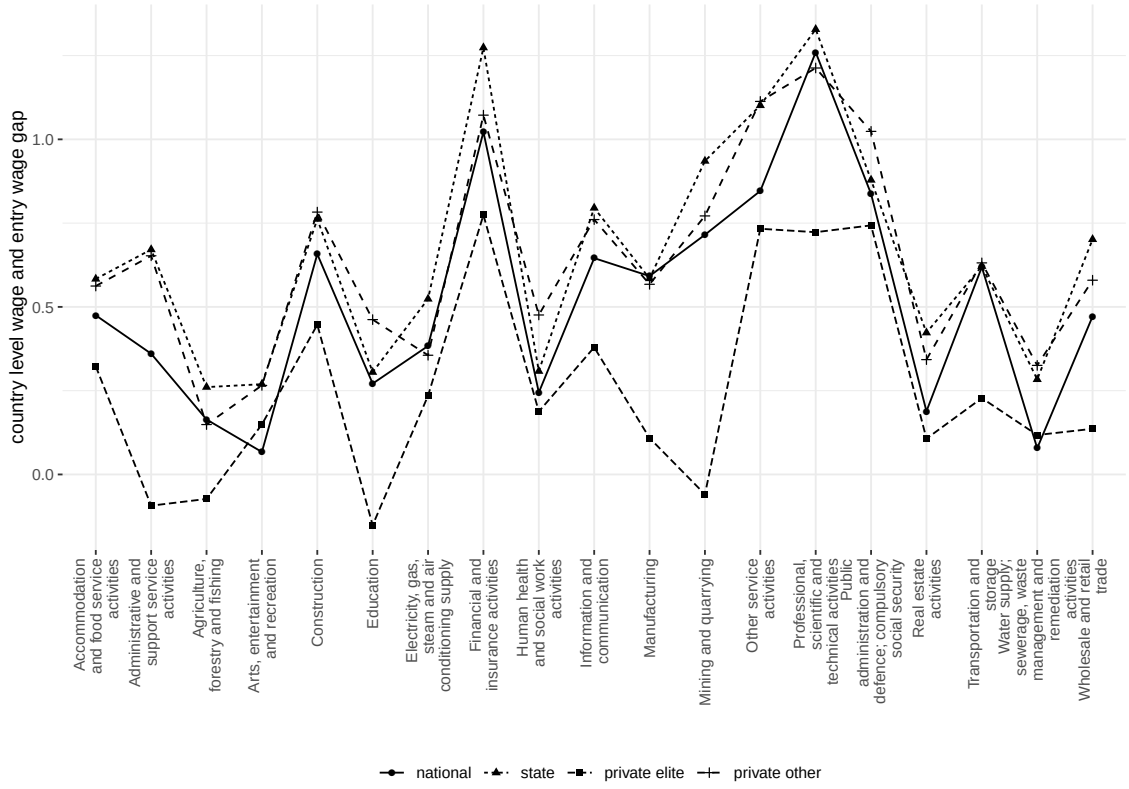


B.3 Share of the graduates employed by industry and log of mean monthly wage by industry from the country level statistics (log mean wage) and from the data (log mean entry wage)



Data source: country level average monthly wages in 2014-2016 computed from the Committee on Statistics of the Republic of Kazakhstan data, www.stat.gov.kz.

B.4 Gap between country level average wages and entry wages, log



Data source: country level average monthly wages in 2014-2016 computed from the Committee on Statistics of the Republic of Kazakhstan data, www.stat.gov.kz.

Appendix C

C.1 List of subjects setting separate entry examination

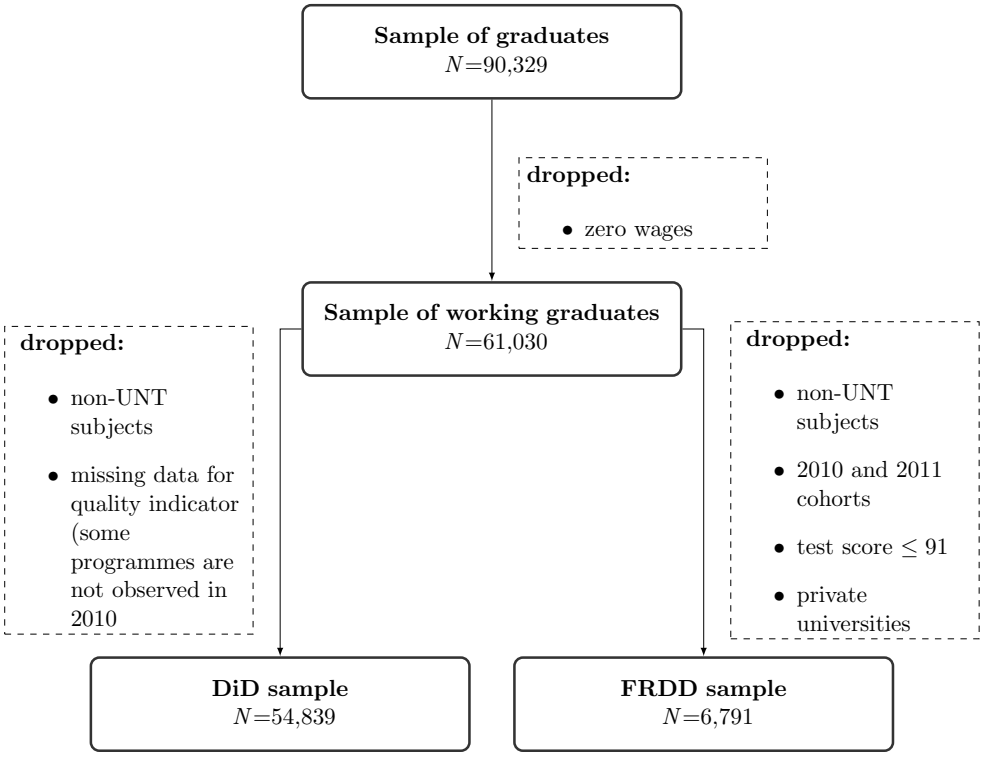
Subject group	Subjects (specialities)
Education and Humanities	Preschool Education
	Primary Education
	Education and Psychology
	Defectology
	Mathematics (Education)
	Physics (Education)
	Computer Studies (Education)
	Chemistry (Education)
	Biology (Education)
	History (Education)
	Fundamentals of Law and Economics
	Geography (Education)
	Kazakh Language and Literature
	Russian Language and Literature
	Foreign Language
	Vocational Education
	Kazakh Language and Literature
	Russian Language and Literature
	Social Pedagogy
	Chemistry (Education)
	Mathematics (Education)

	Mathematics (Education)
	Physics (Education)
	Geography (Education)
	History (Education)
	Elementary Military Training
	Music Education
	Fine Arts
	Physical Education and Sports
	Religion Studies
	Islamic Studies
Arts	Music Studies
	Instrumental Performance
	Vocal Arts
	Traditional Musical Arts
	Musical Conducting
	Art Direction
	Dramatics
	Variety Arts
	Choreography
	Scenic Design
	Composition
	Cinematography
	Pictural Arts
	Graphic Arts
	Plastic Arts
	Study of Arts
	Decorative Arts
	Architecture
	Design
	Publishing Business
	Art Management

	Performing Arts
	Folk Instruments
	Singing
Social Sciences, Business and Law	Journalism
	Public Relations
	Recreation and Leisure Studies

Notes: (1) Subject group is not an official classification, it is used by the author for simplification. (2) Subjects' titles are translated by the author.

C.1.1 Data processing diagram



C.2 Summary statistics, N=6,791

Variable	National			State		
	N	social contributions		N	social contributions	
		mean	s.d.		mean	s.d.
Gender:						
Male	1094	9.00	0.75	2076	8.82	0.84
Female	1629	8.98	0.65	1992	8.78	0.56
State-funded scholarship holder:*						
yes	2229	8.99	0.70	2219	8.81	0.74
no	494	8.96	0.66	1743	8.79	0.70
Subject:						
Agricultural Sciences	106	8.74	0.68	364	8.69	0.64
Arts	9	8.87	0.58	6	8.62	0.64
Engineering and Technology	1212	9.00	0.71	2232	8.84	0.77
Healthcare and Medicine	0	-	-	42	8.99	0.47
Humanities	222	8.95	0.67	184	8.88	0.57
Law	251	8.97	0.70	244	8.64	0.71
Natural Sciences	378	8.95	0.64	283	8.74	0.59
Military and Security	0	-	-	10	8.60	0.47
Services	178	8.98	0.66	248	8.69	0.77
Social Sciences and Business	367	9.10	0.71	454	8.86	0.63
Veterinary Science	0	-	-	1	10.44	-
	mean	s.d.	median	mean	s.d.	median
Log mean pension contributions for the months when a person worked:						
	8.99	0.69	9.04	8.81	0.72	8.85
Log mean pension contributions for all months:						
	8.23	1.14	8.40	8.10	1.13	8.30
Test score:						
	85.05	8.77	85	72.57	13.68	71
*106 missing values for scholarship in state universities						

C.3 Broadly defined subject area and corresponding subjects (specialities)

Broad subject	**Subject**
Agricultural Sciences	Agricultural Studies
	Livestock Products Technology
	Hunting and Fur Farming
	Industrial Fisheries
	Water Management

be continued

Broad subject	Subject
	Agricultural Engineering
	Forest Management
	Soil Science and Agricultural Chemistry
	Plant Production
	Land Reclamation and Protection
	Plant Protection
	Power Supply Engineering in Agriculture
Arts	Music Studies
	Instrumental Performance
	Vocal Arts
	Traditional Musical Arts
	Musical Conducting
	Art Direction
	Dramatics
	Variety Arts
	Choreography
	Scenic Design
	Composition
	Cinematography
	Picture Arts
	Graphic Arts
	Plastic Arts
	Study of Arts
	Decorative Arts
	Museum Studies
	Architecture
	Design
	Publishing Business
	Art Management
Education (teacher training)	Preschool Education
	Primary Education
	Education and Psychology
	Elementary Military Training
	Defectology
	Music Education

be continued

Broad subject	Subject
	Fine Arts
	Physical Education and Sports
	Mathematics (Education)
	Physics (Education)
	Computer Studies (Education)
	Chemistry (Education)
	Biology (Education)
	History (Education)
	Fundamentals of Law and Economics
	Geography (Education)
	Kazakh Language and Literature
	Russian Language and Literature
	Foreign Language
	Vocational Education
	Social Pedagogy
Engineering and Technology	Engineering Systems
	Biotechnology
	Automation and Control
	IT
	Computer Science
	Mathematical and Computer Modelling
	Geology and Exploration
	Mining and Quarrying
	Oil and Gas Engineering
	Metallurgy
	Material Science and Technology of New Materials
	Geodesy and Cartography
	Mechanic Engineering
	Transport and Transport Technology
	Aviation Technology
	Marine Engineering and Technology
	Instrument Engineering
	Heat Power Engineering
	Electrical Power Engineering
	Radio Engineering, Electronics and Telecommunications

be continued

Broad subject	Subject
	Inorganic Chemical Engineering
	Organic Chemical Engineering
	Physical Engineering
	Technological Machines and Equipment
	Woodworking Technology
	Clothing Technology and Design
	Food Products Technology
	Processing Industries Technology
	Construction Engineering
	Construction Material Manufacturing
	Health and Safety
	Standardization, Certification and Metrology
	Textile Technology and Design
	Minerals Enrichment
	Materials-Processing Technology
	Flight Operations
	Construction Engineering in Transport
	Space-System Engineering
	Industrial Pharmaceutical Technology
	Chemical Technology of Silicate Materials
Healthcare and Medicine	Public Healthcare
	Nursing
	Pharmacy
	Medical and Preventative Care
	General Medicine
	Dentistry
Humanities	Philosophy
	International Relations
	History
	Cultural Studies
	Philology
	Religion Studies
	Translation Studies
	Archaeology and Ethnology
	Oriental Studies

be continued

Broad subject	Subject
	Foreign Philology
	Theology
	Turkic Studies
	Islamic Studies
Law	Law
	International Law
	Law Enforcement Activities
	Customs Affairs
Natural Sciences	Mathematics
	Computer Studies
	Mechanical Science
	Physics
	Nuclear Physics
	Chemistry
	Biology
	Environmental Studies
	Geography
	Hydrology
	Astronomy
	Meteorology
Military and Security	Fire Safety
	Information Security Systems
Services	Transport Management and Transport Operations
	Tourism Management
	Land Planning
	Socio-Cultural Services
	Social Work
	Recreation and Leisure Studies
	Cadaster
	Business Appraisal
	Logistics
	Library Science
	Hospitality Management
Social Sciences and Business	Sociology
	Political Science

be continued

Broad subject	Subject
	Psychology
	Journalism
	Regional Studies
	Economics
	Management
	Accounting and Auditing
	Finance
	Public Administration
	Marketing
	Statistics
	Global Economy
	Public Relations
	Archival Studies and Documentation
	Labour Organization and Norming
Veterinary Science	Veterinary Medicine
	Veterinary Sanitation

Appendix D

D.1 Summary statistics, pooled cohorts

Variable	**National**		**State**		**'Elite' private**		**Other private**	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Number of enrolled students	35.08	44.8	17.76	19.05	41.42	39.39	17.12	25.46
Test score	83.55	7.93	78.61	10.92	80.19	12.62	67.89	13.04
Share of students employed, %	65.76	20.35	70.18	20.63	70.91	17.32	66.29	23.85
Log mean real wage	8.63	0.44	8.5	0.48	9.04	0.45	8.5	0.69
Share of scholarship holders, %	66.88	37.91	43.7	39.81	15.25	26.36	9.77	23.82

D.2 Country-level descriptive statistics for subjects, 2010

Rank	Subjects (specialities)	mean test score	s.d.	median test score	N	Subject group
1	Clothing Technology and Design	55.91	21.77	76	3	ET
2	Library Science	66.83	27.22	83	4	SSBL
3	Woodworking Technology	67.43		68.5	1	ET
4	Law	69.23	12.93	76	34	SSBL
5	Socio-Cultural Services	69.72	10.5	77	5	SSBL
6	Radio Engineering, Electronics and Telecommunications	70.68	20.39	77	14	ET
7	Veterinary Medicine	71.5	0.26	72	2	ANS
8	International Law	71.71	8.38	75	8	SSBL
9	Transport Management and Transport Operations	72.11	13.2	68	17	SSBL
10	Power Supply Engineering in Agriculture	72.16		74	1	ANS
11	Astronomy	72.19	7.03	76	2	ANS
12	Textile Technology and Design	72.24		75	1	ET
13	Tourism Management	72.97	10.97	83	24	SSBL
14	Automation and Control	73.18	12.06	73.5	13	ET
15	Processing Industries Technology	73.59	11.05	77	7	ET
16	Psychology	73.67	8.14	73	13	SSBL
17	Oil and Gas Engineering	74.32	11.65	83	10	ET
18	Materials-Processing Technology	74.38	4.41	73	2	ET
19	Industrial Fisheries	74.4	4.94	80	3	ANS
20	Soil Science and Agrochemistry	74.55	8.13	80	5	ANS
21	Accounting and Auditing	74.61	12.8	83	38	SSBL
22	Environmental Studies	74.78	10.49	81	18	ANS
23	Business Appraisal	75	11.48	77	5	SSBL
24	Plant Production	75	26.87	92	2	ANS
25	Economics	75.24	14.28	82	36	SSBL
26	Chemistry	75.26	9.65	84	7	ANS
27	Management	75.32	11.25	79	29	SSBL

28	Customs Affairs	75.56	14.08	79	8	SSBL
29	Computer Science	75.57	15.45	86	27	ET
30	Agricultural Engineering	75.58	11.49	77	6	ANS
31	Law Enforcement Activities	75.63	5.62	76	2	SSBL
32	Public Administration	75.67	9.43	78	29	SSBL
33	Electrical Power Engineering	75.69	11.33	79	17	ET
34	Agricultural Studies	75.85	16.35	80	11	ANS
35	Theology	75.91		77	1	EH
36	Food Products Technology	75.97	11.26	80	9	ET
37	Transport and Transport Technology	76.02	10.93	84	16	ET
38	Construction Engineering in Transport	76.04	15.61	71.5	4	ET
39	Finance	76.23	10.27	79	47	SSBL
40	Biology	76.3	6.56	77	13	ANS
41	Standardization, Certification and Metrology	76.39	8.45	82	18	ET
42	Translation Studies	76.52	15.06	82	22	EH
43	Social Work	76.77	10.8	75	13	SSBL
44	IT	76.79	13.35	87	35	ET
45	Construction Material Manufacturing	76.96	8.12	79.5	7	ET
46	Marketing	77.05	11.93	82	14	SSBL
47	Health and Safety	77.26	10.92	80	15	ET
48	Biotechnology	77.35	9.09	80	12	ET
49	Mining and Quarrying	77.47	15.07	87	4	ET
50	Philosophy	77.97	14.09	87	2	EH
51	Forest Management	78.05	3.11	79.5	5	ANS
52	Construction Engineering	78.37	15.96	82	21	ET
53	Regional Studies	78.39	15.18	91	3	SSBL
54	Global Economy	78.44	13.66	90	5	SSBL
55	Hunting and Fur Farming	78.58	10.11	73	3	ANS
56	Foreign Philology	78.63	9.4	87	7	EH
57	Metallurgy	78.75	5.75	78	6	ET

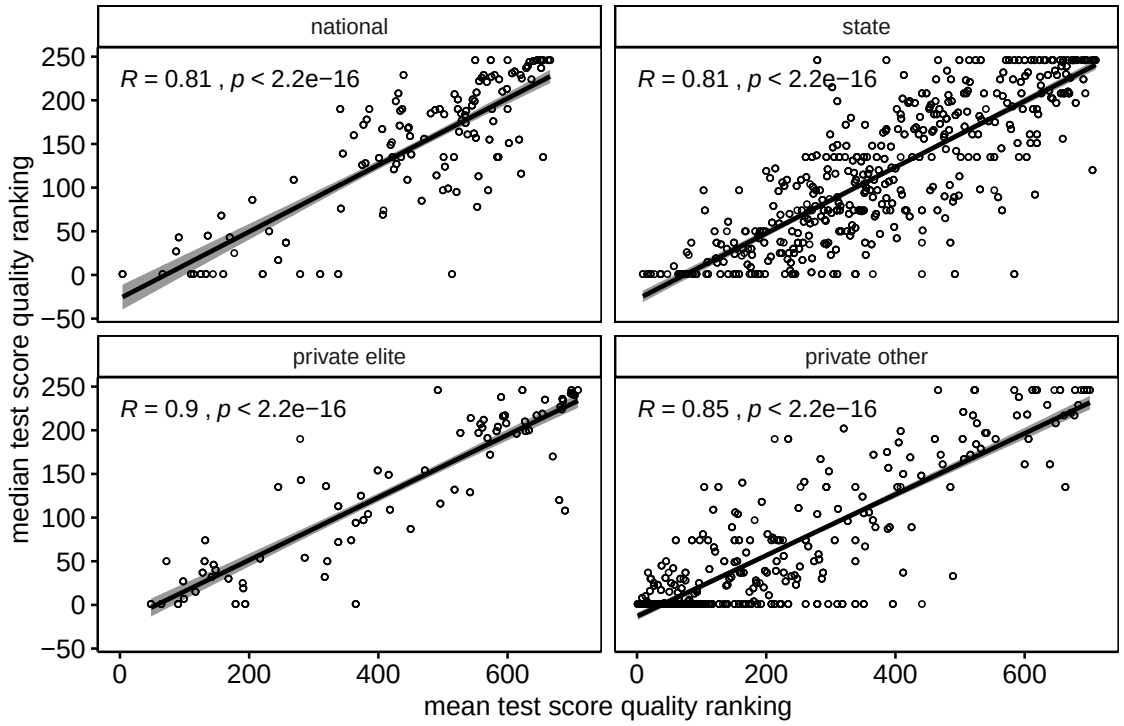
58	Philology	78.83	11.73	82	9	EH
59	International Relations	78.87	9.68	81	17	EH
60	Technological Machines and Equipment	79.28	10.88	79	12	ET
61	Logistics	79.86	18.68	81	5	SSBL
62	Mechanical Science	79.98	5.63	86	2	ANS
63	Livestock Products Production Technology	80.4	8.58	79	7	ANS
64	History	80.47	9.83	83	9	EH
65	Instrument Engineering	80.77	8.37	78	5	ET
66	Medical and Preventative Care	80.86	15.3	85	5	ET
67	Turkic Studies	80.94	8.4	91.5	2	EH
68	Computer Studies	81.05	16.37	84	15	ANS
69	Hospitality Management	81.07	18.28	92.5	3	SSBL
70	Mechanic Engineering	81.13	7.03	79	12	ET
71	Land Reclamation and Protection	81.14	12.92	93	2	ANS
72	Veterinary Sanitation	81.19	13.54	84.5	3	ANS
73	Oriental Studies	81.22	3.89	80	3	EH
74	Physics	81.23	10.42	86	8	ANS
75	Archival Studies and Documentation	81.62		81.5	1	SSBL
76	Heat Power Engineering	81.81	10.1	83	12	ET
77	Dentistry	81.82	17.33	83	5	ET
78	Plant Protection	81.85	9.17	78	2	ANS
79	Organic Chemical Engineering	82.01	9.91	89	12	ET
80	Mathematics	82.46	12.68	87	9	ANS
81	Cultural Studies	82.6	5.21	86	3	EH
82	Museum Studies	82.67	2.36	84	2	A
83	Geodesy and Cartography	82.91	8.75	89	6	ET
84	General Medicine	83.13	26.21	70	2	ET
85	Physical Engineering	83.25	9.22	89	3	ET
86	Geography	83.5	10.64	90.5	6	ANS
87	Nursing	83.89	9.49	82	4	ET
88	Minerals Enrichment	83.97	9.59	79	2	ET

89	Cadaster	84.14	13	81	7	SSBL
90	Sociology	84.19	11.51	91	4	SSBL
91	Political Science	84.29	8.15	83	3	SSBL
92	Land Planning	84.33	18.09	76.5	5	SSBL
93	Hydrology	85.48		87	1	ANS
94	Geology and Exploration	86.19	7.53	92	3	ET
95	Marine Engineering and Technology	86.67		88.5	1	ET
96	Meteorology	86.9		88	1	ANS
97	Public Healthcare	87.43	9.72	87	5	ET
98	Inorganic Chemical Engineering	87.49	10.33	84	7	ET
99	Mathematical and Computer Modelling	88.17	16.7	90	5	ET
100	Nuclear Physics	89.1		89.5	1	ANS
101	Pharmacy	90.04	12.14	88.5	3	ET
102	Space-System Engineering	91.09		91	1	ET
103	Material Science and Technology of New Materials	91.12	11.43	84	2	ET
104	Archeology and Ethnology	91.85	18.37	85.5	3	EH
105	Water Management	92.86	7.84	89.5	2	ANS
106	Statistics	98.73		109	1	SSBL
107	Labour Organization and Norming	101.76		105	1	SSBL
108	Information Security Systems	109.53		109	1	ET

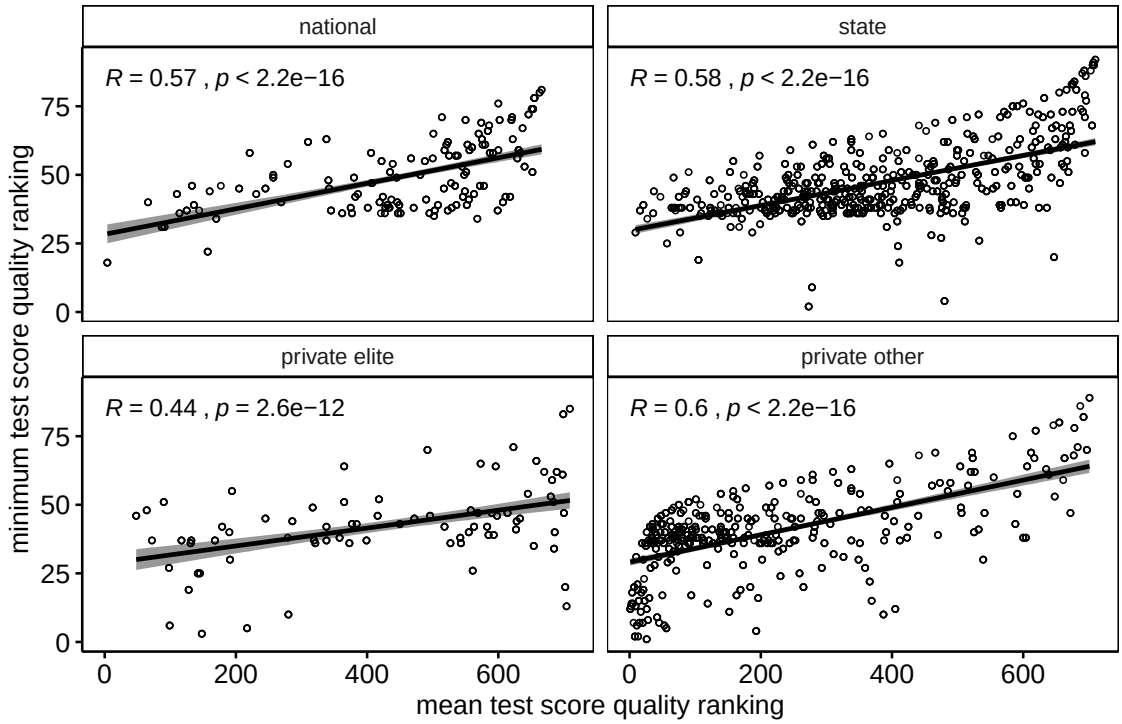
Notes: (1) Rank is the subjects ranking by its mean test score in 2010. (2) N is the number of programmes for this subject in 2010. (3) Subject groups: A - Arts; ANS - Agriculture and Natural Sciences; EH - Education and Humanities; ET - Engineering and Technology; SSBL - Social Sciences, Business and Law. Subject group is not official classification, it is used by the author for simplification. (4) Subjects' titles are translated by the author.

D.3 Correlation between quality indicators

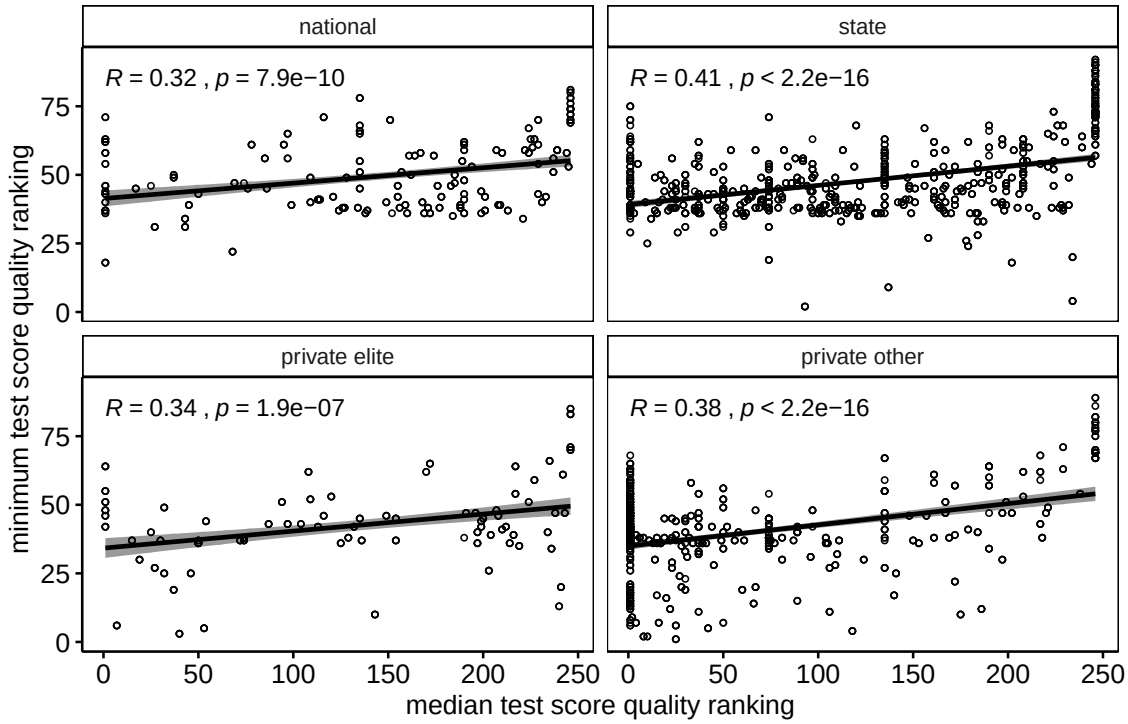
D.3.1 Correlation between mean and median quality indicators, Pearson correlation coefficient



D.3.2 Correlation between mean and 'worst' student quality indicators, Pearson correlation coefficient

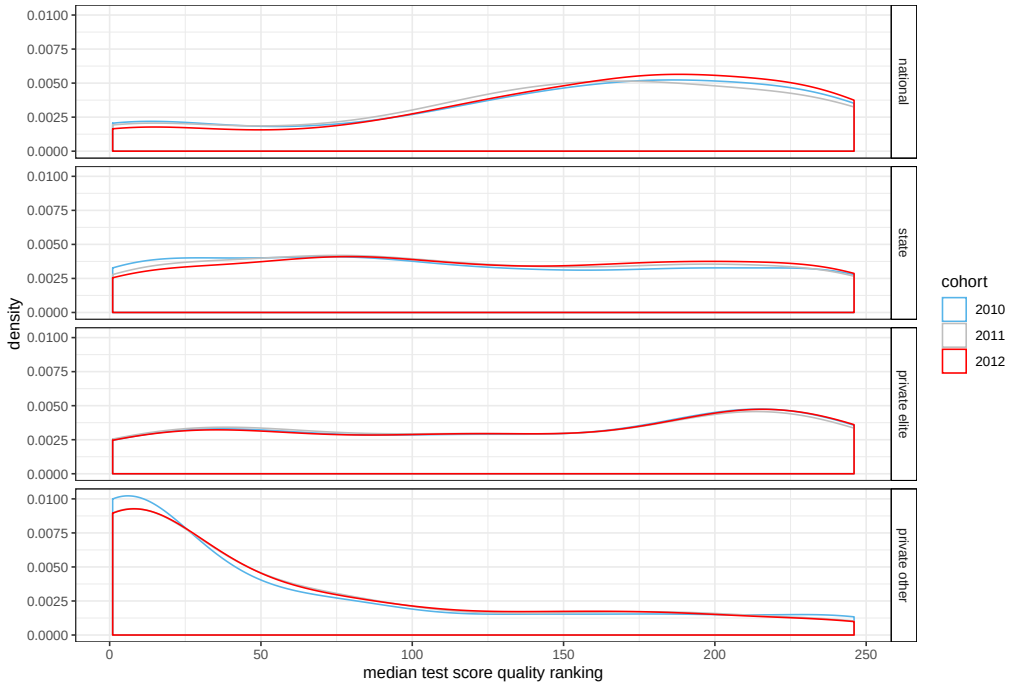


D.3.3 Correlation between median and 'worst' student quality indicators, Pearson correlation coefficient

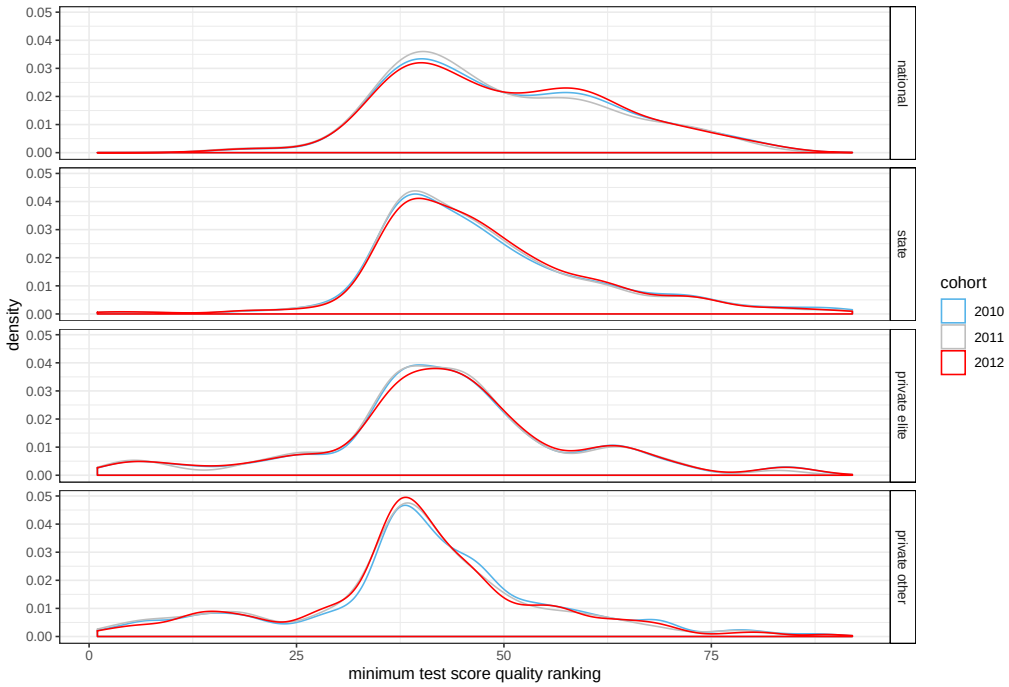


D.4 Density plots for median and minimum test score quality indicator distribution by university type and cohort

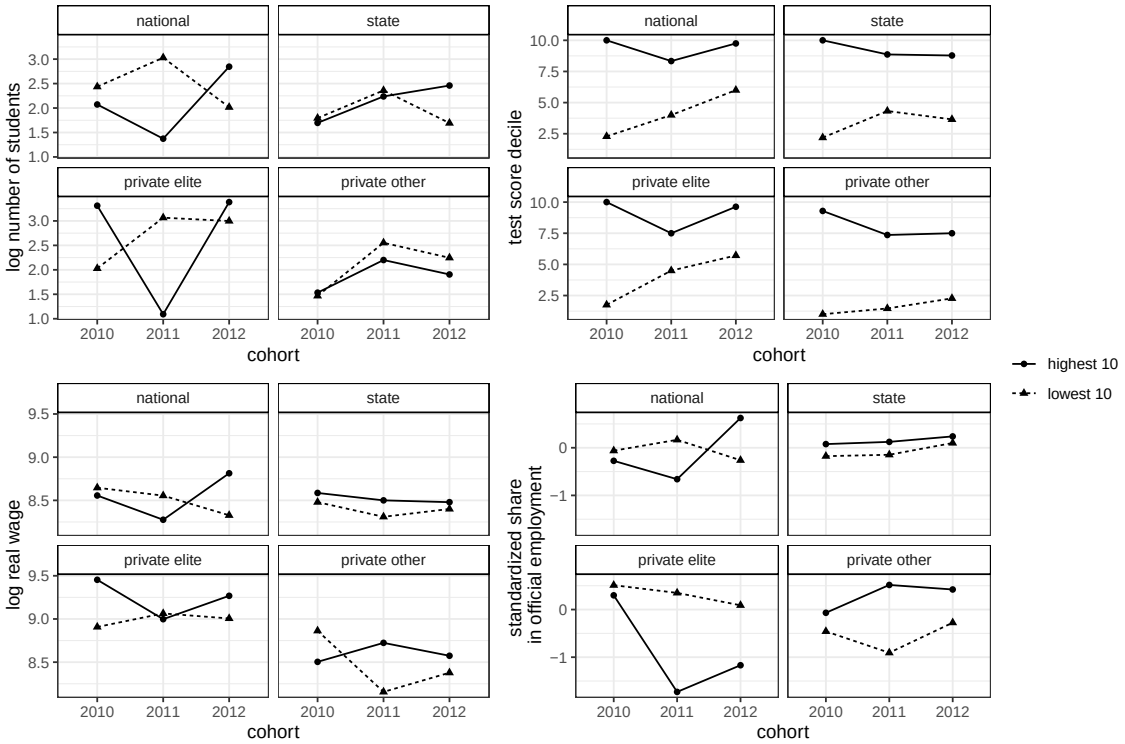
D.4.1 Density plots for median test score quality indicator distribution by university type and cohort



D.4.2 Density plots for minimum test score quality indicator distribution by university type and cohort

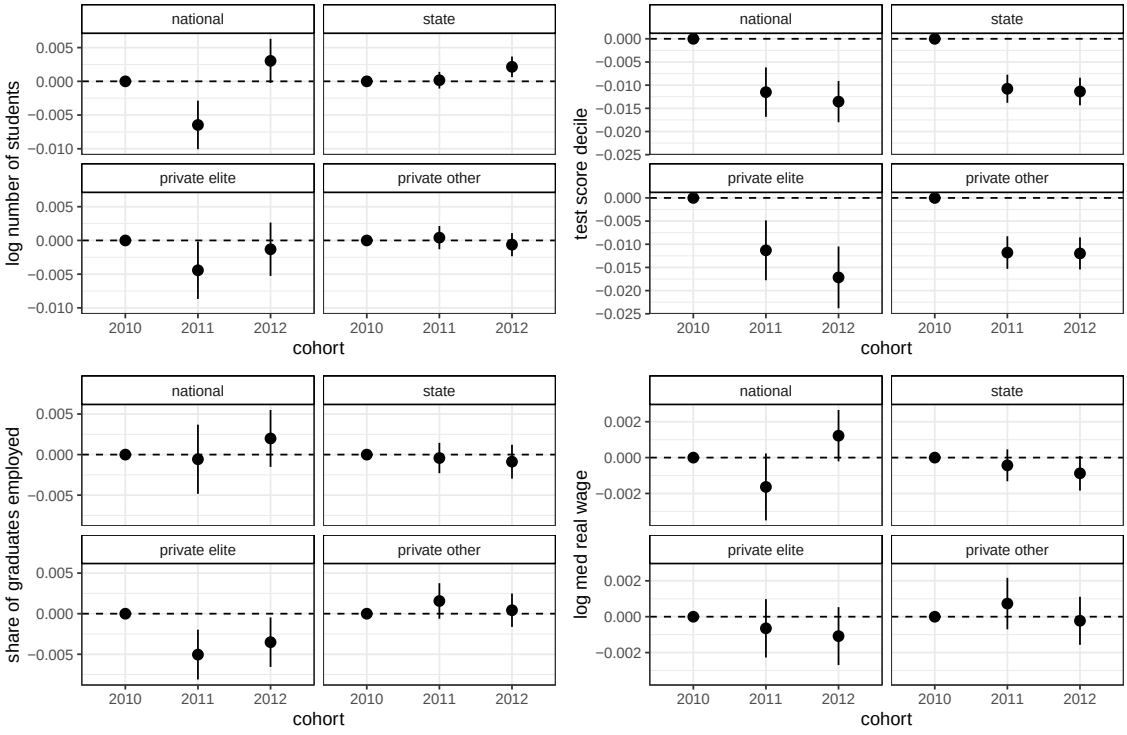


D.4.3 Mean values for four outcome variables for the top-10% and the bottom-10% of academic programmes



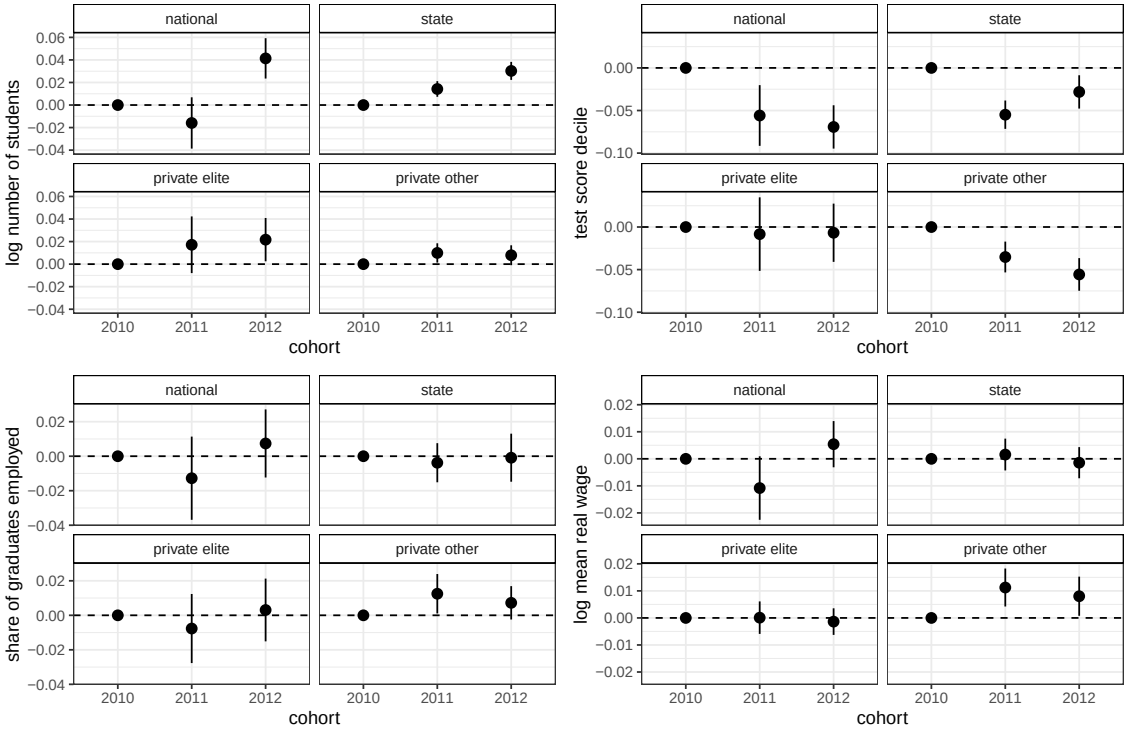
D.5 Interaction term coefficients (τ) computed with the DiD model, standard errors clustered at university-subject level

D.5.1 τ coefficients from the models with the median test score quality indicator, standard errors clustered at university-subject level



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

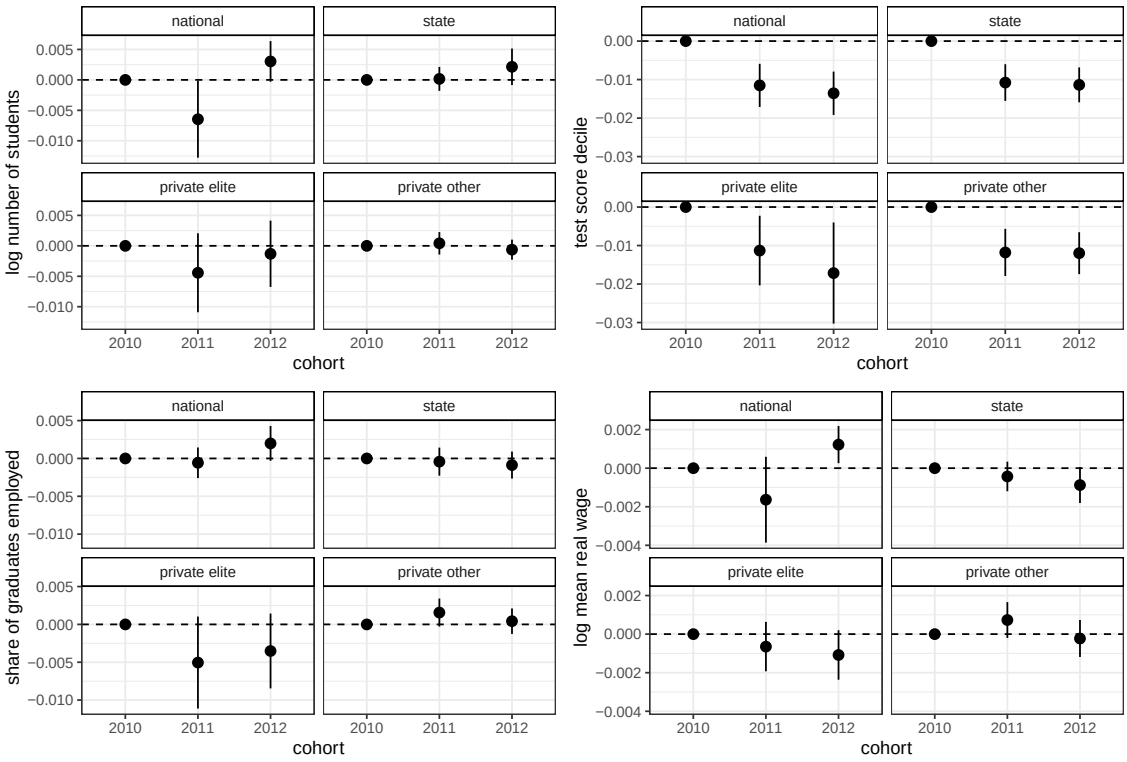
D.5.2 τ coefficients from the models with the minimum test score quality indicator, standard errors clustered at university-subject level



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

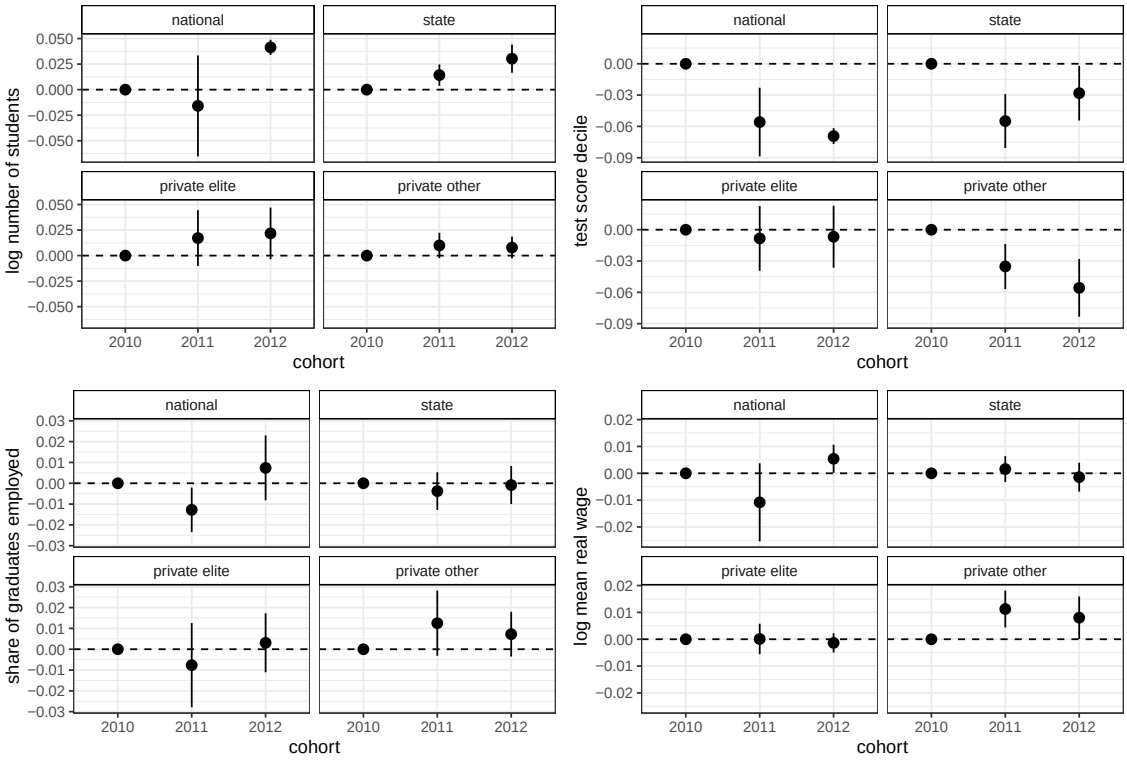
D.6 Interaction term coefficients (τ) computed with the DiD model, standard errors clustered at university level

D.6.1 τ coefficients from the models with the median test score quality indicator



Wild block bootstrapped standard errors clustered at university level are computed in R with 'cluster.boot' command from 'multiwayvcov' package (Graham et al. 2016).

D.6.2 τ coefficients from the models with the minimum test score quality indicator



Wild block bootstrapped standard errors clustered at university level are computed in R with 'cluster.boot' command from 'multiwayvcov' package (Graham et al. 2016).

D.7 DiD models regression tables

D.7.1 Mean test score quality indicator

Number of students enrolled

	national	**state**	**private elite**	**private other**
	Dep.var.: ln number of students			
cohort 2011	1.0246**	0.225	1.3232***	0.3535**
	(0.3598)	(0.1193)	(0.3579)	(0.1129)
cohort 2012	-0.8202*	-0.4452**	0.8221*	0.4291***
	(0.3987)	(0.1597)	(0.3778)	(0.1128)
mean test score	0.0002	-0.0012**	0.0032*	0.0007
quality ranking	(0.0008)	(0.0004)	(0.0013)	(0.0005)
cohort 2011*quality	-0.0026***	0.0001	-0.0023**	0.0003
	(0.0008)	(0.0003)	(0.0008)	(0.0004)
cohort 2012*quality	0.0018*	0.0011**	-0.001	-0.0004
	(0.0008)	(0.0004)	(0.0007)	(0.0004)
N	343	1129	225	785
Adj. R2	0.61	0.49	0.44	0.53
F Statistic	7.621***	9.932***	28.53***	24.15***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Test score decile

	national	**state**	**private elite**	**private other**
	Dep.var.: test score decile			
cohort 2011	2.4699***	2.2269***	1.4507*	0.8808***
	(0.6483)	(0.3001)	(0.6037)	(0.1561)
cohort 2012	5.1886***	1.2814***	2.9334***	1.1687***
	(0.6022)	(0.2912)	(0.6222)	(0.1831)
mean test score	0.0104***	0.01***	0.0099***	0.01***
quality ranking	(0.0011)	(0.0004)	(0.0017)	(0.0008)
cohort 2011*quality	-0.0061***	-0.0054***	-0.0043**	-0.0051***
	(0.0013)	(0.0007)	(0.0014)	(0.0007)
cohort 2012*quality	-0.0084***	-0.0052***	-0.0083***	-0.0059***
	(0.0011)	(0.0007)	(0.0013)	(0.0007)
N	343	1129	225	785
Adj. R2	0.73	0.67	0.66	0.72
F Statistic	12.56***	19.58***	26.06***	45.08***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Standardised share of graduates employed

	national	**state**	**private elite**	**private other**
	Dep.var.: share of graduates employed			
cohort 2011	0.202	0.1612	0.3951	-0.3964**
	(0.4262)	(0.179)	(0.2481)	(0.149)
cohort 2012	-0.4828	0.1649	0.3789	0.0314
	(0.4338)	(0.2143)	(0.2627)	(0.1418)
mean test score	0.0014	0.0005	0.0004	-0.0013*
quality ranking	(0.0009)	(0.0005)	(0.0007)	(0.0005)
cohort 2011*quality	-0.0009	-0.0001	-0.0014*	0.0013**
	(0.0009)	(0.0004)	(0.0006)	(0.0005)
cohort 2012*quality	0.0009	-0.0001	-0.0011	0.0006
	(0.0009)	(0.0005)	(0.0006)	(0.0004)
N	343	1129	225	785
Adj. R2	-0.04	0.15	0.25	0.18
F Statistic	0.84	2.667***	4.654***	6.869***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Mean real wage

	national	**state**	**private elite**	**private other**
	Dep.var.: ln mean real wage			
cohort 2011	0.0838	-0.0141	0.1404	-0.2043
	(0.1795)	(0.0909)	(0.1913)	(0.1146)
cohort 2012	-0.3128	0.0641	0.186	-0.1232
	(0.162)	(0.1037)	(0.1827)	(0.0926)
mean test score	0.0001	0.0002	0.0005	0.000
quality ranking	(0.0005)	(0.0002)	(0.0005)	(0.0004)
cohort 2011*quality	-0.0006	-0.0002	-0.0004	0.0006
	(0.0004)	(0.0002)	(0.0004)	(0.0003)
cohort 2012*quality	0.0005	-0.0004	-0.0005	0.0004
	(0.0003)	(0.0002)	(0.0003)	(0.0003)
N	343	1129	225	785
Adj. R2	0.23	0.25	0.47	0.11
F Statistic	2.221***	3.989***	103***	1.854***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

D.7.2 Median test score quality indicator

Number of students enrolled

	national	**state**	**private elite**	**private other**
	Dep.var.: ln number of students			
cohort 2011	0.7799**	0.225**	0.9138**	0.3983***
	(0.2872)	(0.0822)	(0.2831)	(0.0966)
cohort 2012	-0.4318	-0.2651*	0.5572	0.3904***
	(0.2872)	(0.1144)	(0.3104)	(0.0955)
mean test score	0.0008	-0.0014	0.0055	0.001
quality ranking	(0.0016)	(0.0007)	(0.0032)	(0.001)
cohort 2011*quality	-0.0065***	0.0002	-0.0044*	0.0004
	(0.0018)	(0.0006)	(0.0022)	(0.0009)
cohort 2012*quality	0.003	0.0022**	-0.0013	-0.0006
	(0.0017)	(0.0008)	(0.002)	(0.0009)
N	343	1129	225	785
Adj. R2	0.61	0.48	0.42	0.53
F Statistic	7.651***	9.763***	70.82***	22.41***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Test score decile

	national	**state**	**private elite**	**private other**
	Dep.var.: test score decile			
cohort 2011	1.3815**	1.4179***	1.1153*	0.5268***
	(0.466)	(0.2428)	(0.4762)	(0.1487)
cohort 2012	3.3341***	0.6042**	1.6632**	0.6421***
	(0.4238)	(0.2214)	(0.5261)	(0.1768)
mean test score	0.017***	0.016***	0.0199***	0.0168***
quality ranking	(0.0025)	(0.0011)	(0.0037)	(0.0017)
cohort 2011*quality	-0.0115***	-0.0108***	-0.0113***	-0.0118***
	(0.0027)	(0.0015)	(0.0033)	(0.0018)
cohort 2012*quality	-0.0135***	-0.0114***	-0.0172***	-0.012***
	(0.0023)	(0.0015)	(0.0034)	(0.0018)
N	343	1129	225	785
Adj. R2	0.69	0.64	0.63	0.69
F Statistic	10.52***	17.82***	29.56***	204.6***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Standardised share of graduates employed

	national	**state**	**private elite**	**private other**
	Dep.var.: share of graduates employed			
cohort 2011	-0.103	0.1585	0.4646*	-0.2182
	(0.3397)	(0.1313)	(0.2262)	(0.1291)
cohort 2012	-0.3467	0.2525	0.3848	0.1319
	(0.3164)	(0.1482)	(0.2363)	(0.1209)
mean test score	0.0033	0.0008	0.0023	-0.0016
quality ranking	(0.0019)	(0.0009)	(0.0015)	(0.0011)
cohort 2011*quality	-0.0006	-0.0004	-0.005**	0.0016
	(0.0022)	(0.001)	(0.0016)	(0.0011)
cohort 2012*quality	0.002	-0.0009	-0.0035*	0.0004
	(0.0018)	(0.0011)	(0.0016)	(0.001)
N	343	1129	225	785
Adj. R2	-0.04	0.15	0.27	0.17
F Statistic	0.84	2.666***	2.97***	9.304***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Mean real wage

	national	**state**	**private elite**	**private other**
	Dep.var.: ln mean real wage			
cohort 2011	0.0343	-0.0499	0.0455	-0.1137
	(0.1352)	(0.0634)	(0.1482)	(0.0942)
cohort 2012	-0.2644*	0.027	0.1055	-0.029
	(0.1207)	(0.0697)	(0.1504)	(0.079)
mean test score	0.0000	0.0007	0.0007	0.0004
quality ranking	(0.001)	(0.0004)	(0.0012)	(0.0008)
cohort 2011*quality	-0.0016	-0.0004	-0.0006	0.0007
	(0.001)	(0.0005)	(0.0008)	(0.0007)
cohort 2012*quality	0.0012	-0.0009	-0.0011	-0.0002
	(0.0007)	(0.0005)	(0.0008)	(0.0007)
N	343	1129	225	785
Adj. R2	0.24	0.25	0.46	0.10
F Statistic	2.291***	4.016***	38.24***	1.821***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

D.7.3 Minimum test score quality indicator

Number of students enrolled

	national	**state**	**private elite**	**private other**
	Dep.var.: ln number of students			
cohort 2011	0.6105	-0.4389**	-0.4129	0.0214
	(0.5396)	(0.1628)	(0.527)	(0.1893)
cohort 2012	-2.0267***	-1.4496***	-0.5509	0.0226
	(0.4637)	(0.2013)	(0.4102)	(0.1966)
mean test score	-0.0204**	-0.037***	-0.0287**	-0.0233***
quality ranking	(0.0075)	(0.0039)	(0.0099)	(0.0042)
cohort 2011*quality	-0.0159	0.0142***	0.0172	0.0099*
	(0.0116)	(0.0035)	(0.0128)	(0.0044)
cohort 2012*quality	0.0414***	0.0303***	0.0217*	0.0079
	(0.0091)	(0.0041)	(0.0098)	(0.0045)
N	343	1129	225	785
Adj. R2	0.62	0.25	0.42	0.55
F Statistic	8.025***	4.016***	42.25***	25.24***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Test score decile

	national	**state**	**private elite**	**private other**
	Dep.var.: test score decile			
cohort 2011	2.4764**	2.7286***	-0.0554	1.2209***
	(0.8843)	(0.4284)	(0.8796)	(0.3463)
cohort 2012	4.7725***	0.5677	-0.3867	2.1163***
	(0.7046)	(0.4997)	(0.6952)	(0.3913)
mean test score	0.0641***	0.0625***	0.0383**	0.0545***
quality ranking	(0.0112)	(0.0069)	(0.0143)	(0.0088)
cohort 2011*quality	-0.0558**	-0.0549***	-0.0083	-0.0352***
	(0.0182)	(0.0085)	(0.022)	(0.0092)
cohort 2012*quality	-0.0693***	-0.0282**	-0.0067	-0.0557***
	(0.013)	(0.0100)	(0.0174)	(0.0098)
N	343	1129	225	785
Adj. R2	0.66	0.61	0.56	0.66
F Statistic	9.343***	15.78***	45.83***	146.7***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Standardised share of graduates employed

	national	**state**	**private elite**	**private other**
	Dep.var.: share of graduates employed			
cohort 2011	0.4456	0.2874	0.1161	-0.6177**
	(0.5517)	(0.2592)	(0.4156)	(0.2358)
cohort 2012	-0.4086	0.187	-0.2234	-0.1307
	(0.4901)	(0.3249)	(0.3841)	(0.2100)
mean test score	-0.0016	0.0049	0.0058	-0.0101
quality ranking	(0.0088)	(0.0055)	(0.0088)	(0.0053)
cohort 2011*quality	-0.0128	-0.0038	-0.0077	0.0125*
	(0.0123)	(0.0058)	(0.0102)	(0.0058)
cohort 2012*quality	0.0074	-0.0009	0.0031	0.0072
	(0.0101)	(0.0071)	(0.0093)	(0.0049)
N	343	1129	225	785
Adj. R2	-0.05	0.15	0.23	0.18
F Statistic	0.78	2.67***	4.916***	7.24***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

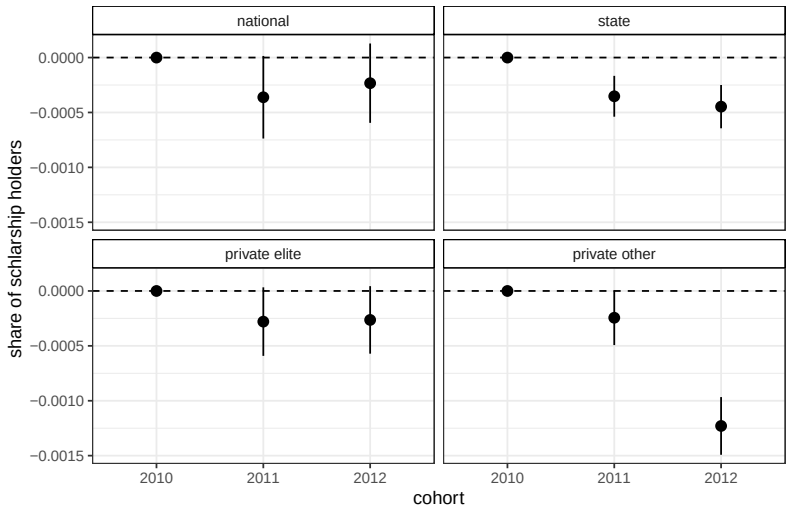
Mean real wage

	national	**state**	**private elite**	**private other**
	Dep.var.: ln mean real wage			
cohort 2011	0.3151	-0.1765	-0.0467	-0.5072***
	(0.2674)	(0.1369)	(0.1281)	(0.1456)
cohort 2012	-0.3399	-0.0132	0.0152	-0.3614*
	(0.2058)	(0.1374)	(0.1135)	(0.1415)
mean test score	0.0016	-0.0009	0.0025	-0.0056
quality ranking	(0.005)	(0.0022)	(0.0029)	(0.0039)
cohort 2011*quality	-0.0108	0.0016	0.0001	0.0112**
	(0.006)	(0.003)	(0.0031)	(0.0036)
cohort 2012*quality	0.0054	-0.0014	-0.0014	0.008*
	(0.0044)	(0.0029)	(0.0025)	(0.0037)
N	343	1129	225	785
Adj. R2	0.23	0.24	0.46	0.11
F Statistic	2.274***	3.965***	59.35***	1.911***
university dummies	yes	yes	yes	yes
subject dummies	yes	yes	yes	yes

Computations are done in R. Robust standard errors clustered at university-subject level computed in R with 'miceadds' package (Robitzsch and Grund 2020) in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

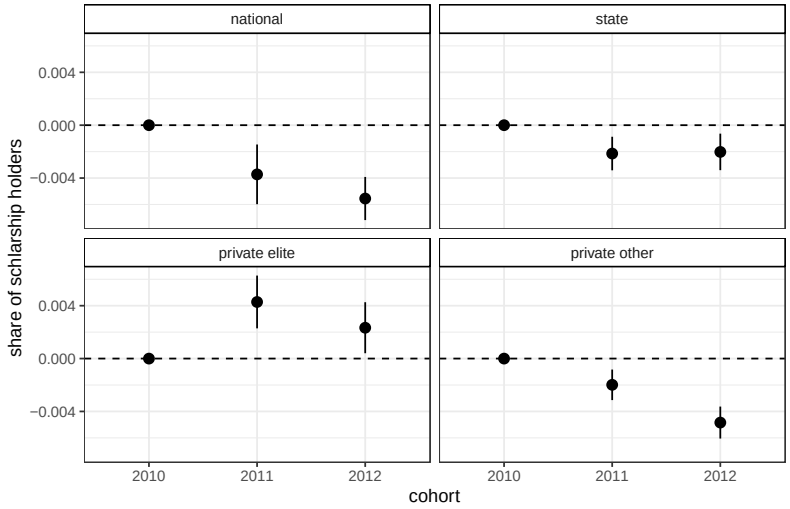
D.8 Interaction term coefficients (τ) computed with the DiD model and the share of scholarship-holders per a programme as an outcome variable

D.8.1 τ coefficients from the models with the median test score quality indicator



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

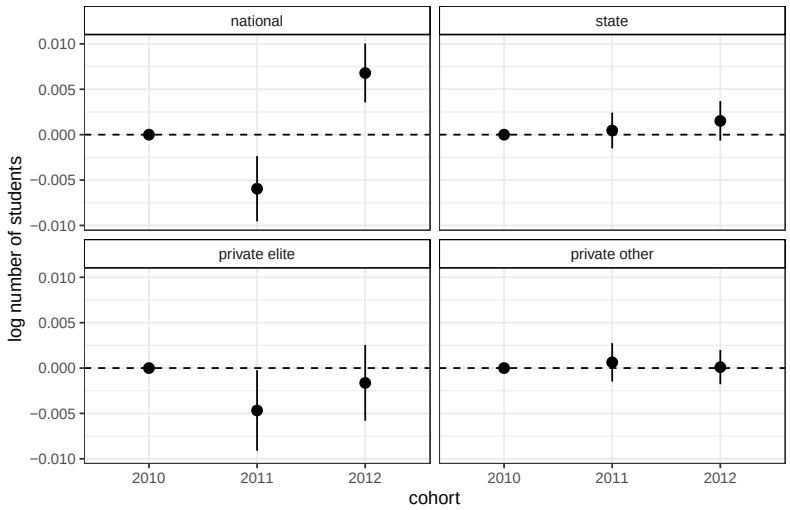
D.8.2 τ coefficients from the models with the minimum test score quality indicator



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

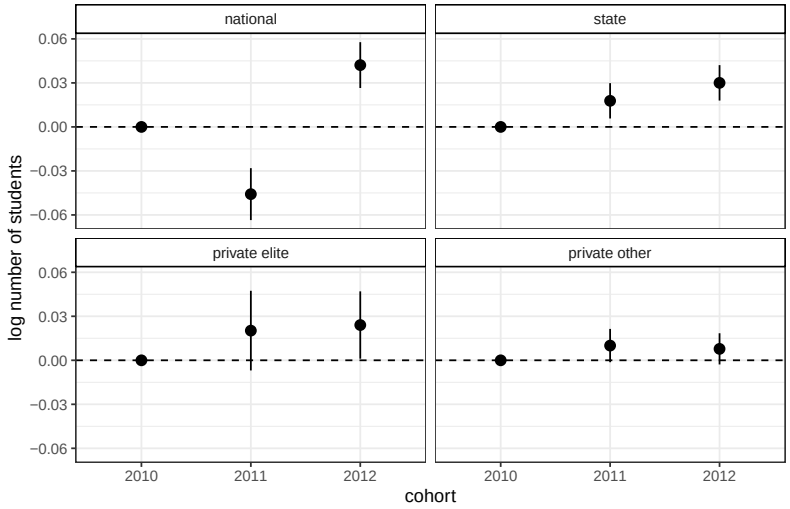
D.9 Interaction term coefficients (τ) computed with the DiD model, sample including only subjects taught by all university types

D.9.1 τ coefficients from the models with the median test score quality indicator



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

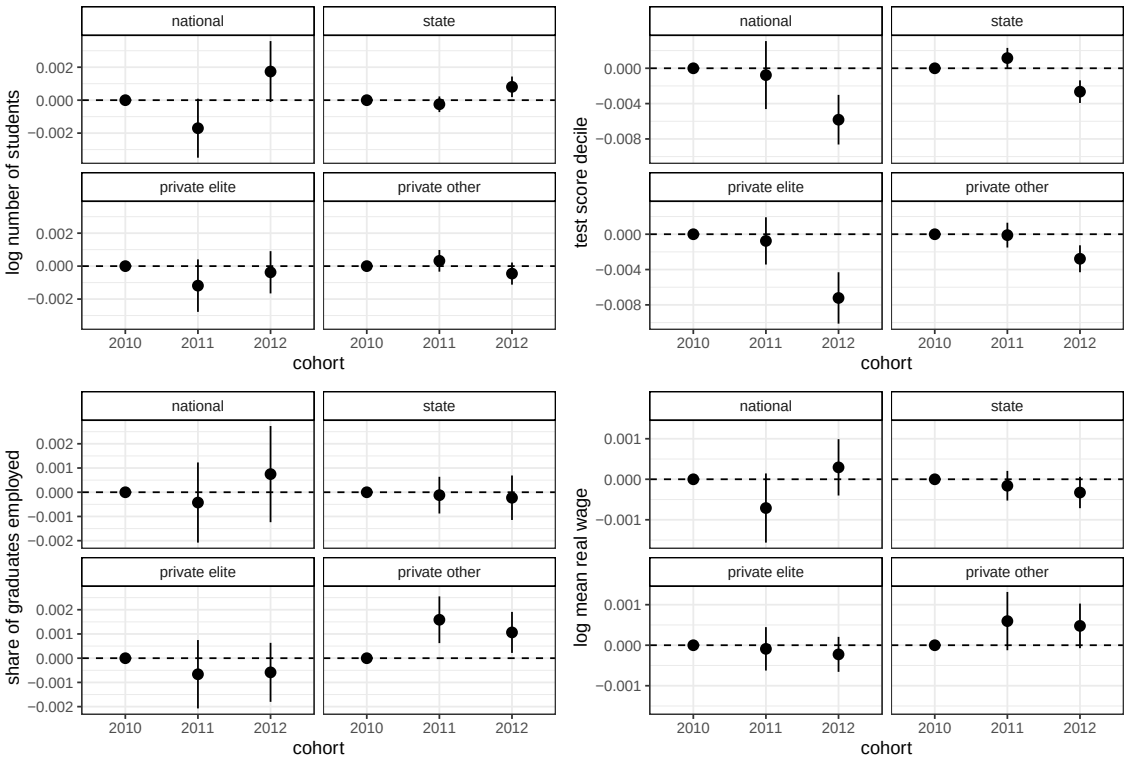
D.9.2 τ coefficients from the models with the minimum test score quality indicator



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

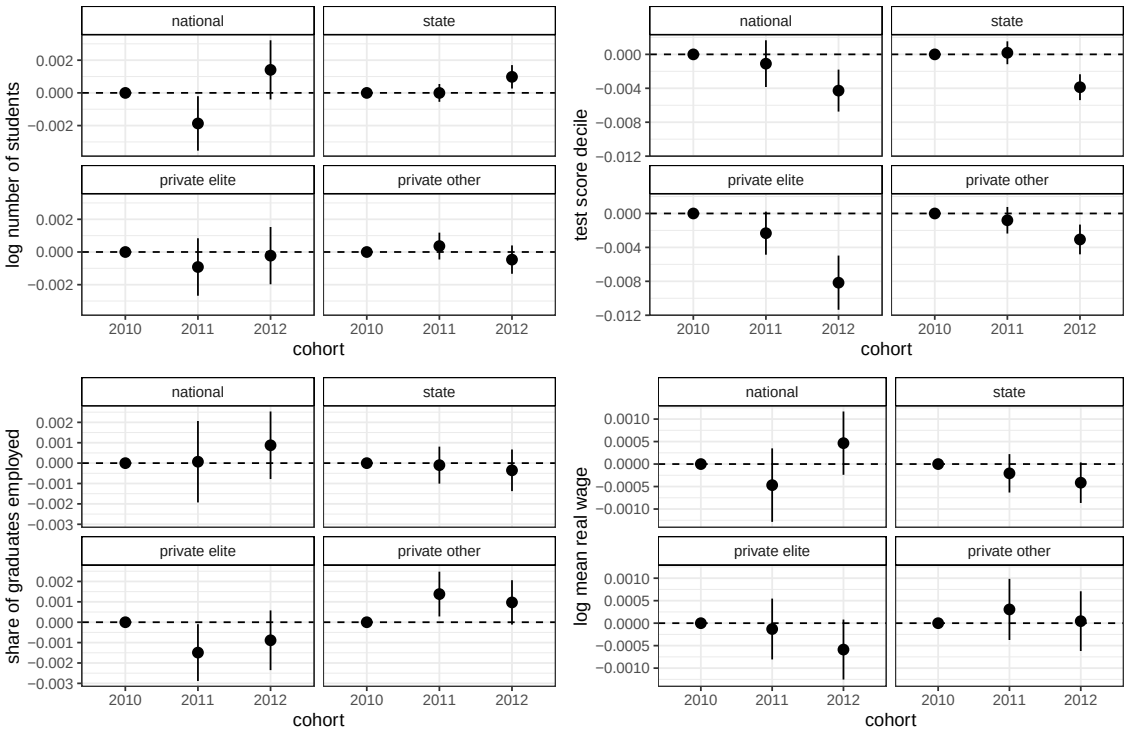
D.10 Interaction term coefficients (τ) computed with the DiD model and quality measured as average quality in 2010 and 2011

D.10.1 τ coefficients from the models with the mean test score quality indicator



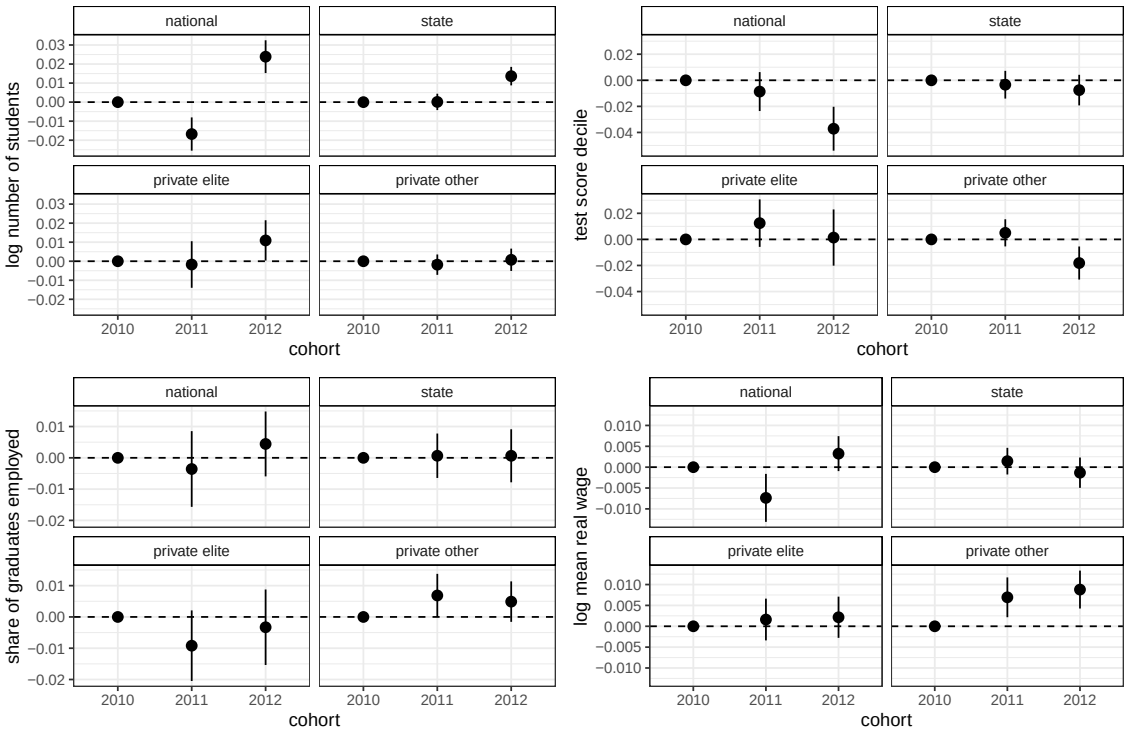
Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

D.10.2 τ coefficients from the models with the median test score quality indicator



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

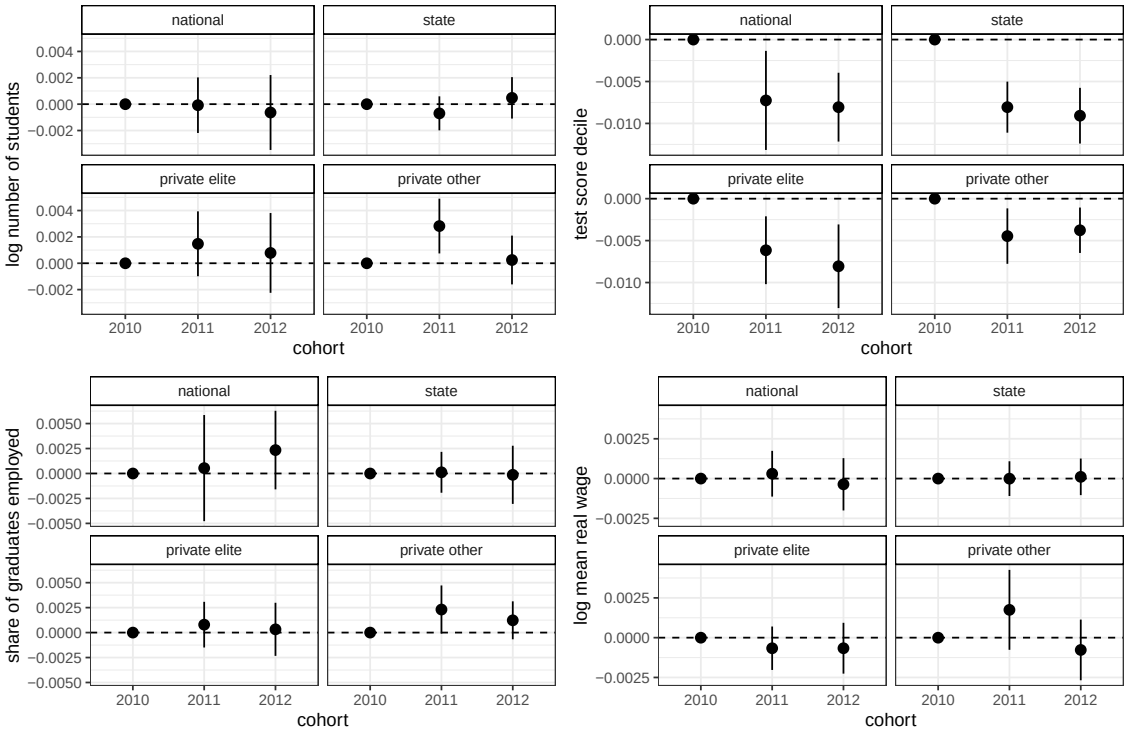
D.10.3 τ coefficients from the models with the minimum test score quality indicator



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

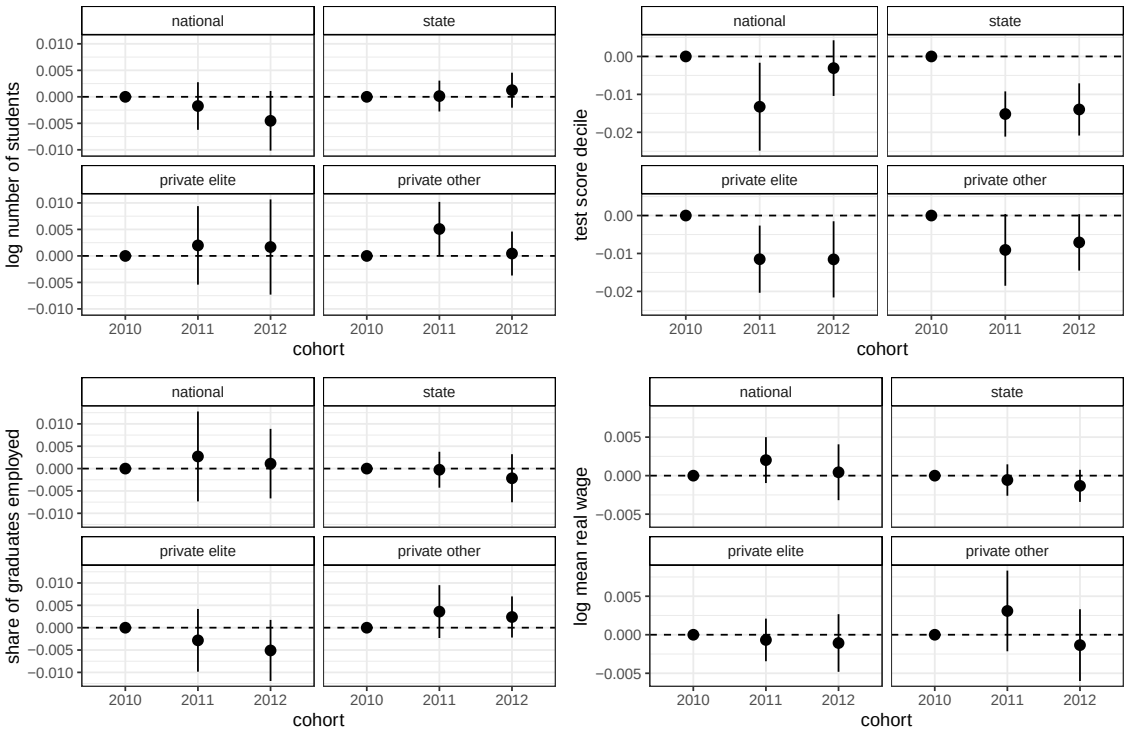
D.11 Interaction term coefficients (τ) computed with the DiD model, sample with no missing test score

D.11.1 τ coefficients from the models with the mean test score quality indicator



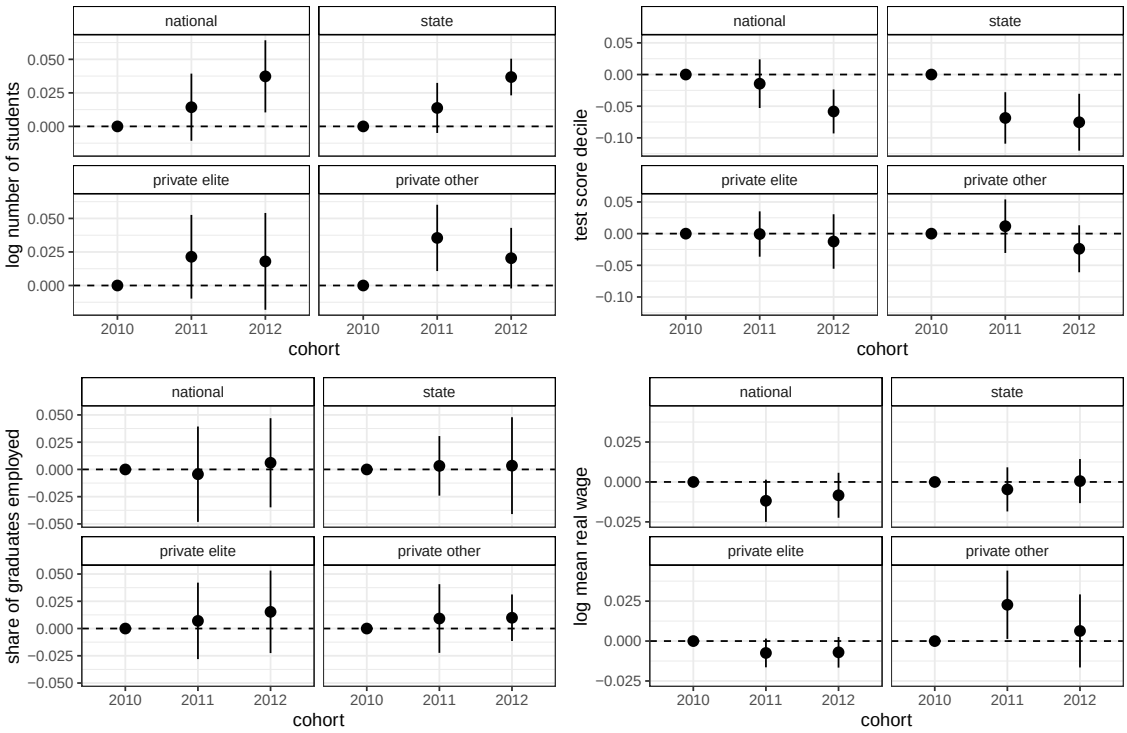
Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

D.11.2 τ coefficients from the models with the median test score quality indicator



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

D.11.3 τ coefficients from the models with the minimum test score quality indicator



Robust standard errors clustered at university-subject level are computed in R with 'lm.cluster' command from 'miceadds' package (Robitzsch and Grund 2020).

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