# Competing with grades

## The effect of school choice on high school dropout rates

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# Preface

Though challenging and demanding at times, the process of writing this thesis has ultimately been a rewarding one. This is largely thanks to my supervisor Katrine Vellesen Løken, whose valuable insights and genuine interest has improved this study significantly. All the help and feedback is sincerely appreciated.

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Andreas Fidjeland, Bergen June 01. 2017.

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By

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# Abstract

As efforts are made to reduce dropouts among high school students, school choice remains a hotly debated policy. The subject is complicated by an apparent gender gap in the academic performance of boys and girls. As girls outperform boys in most subjects, such a policy might affect them differently. When students compete with grades, we would expect to see an increased clustering of girls in the best and most popular schools. Conversely, if boys have to settle for second- and third-tier schools more often, it might explain low motivation and high dropout rates among this group. This thesis exploit a policy change in Hordaland in 2005 to examine two topics: Firstly I look at the effect of increased choice on high school dropout rates. Secondly I explore whether the effects are heterogeneous for gender. Results suggests that in the wake of the reform dropout rates increased for students in academic track programs, with the strongest effect being present among boys. These results are substantiated by indications of similar effects in several other counties that implemented reforms of this kind.

All calculations and estimations were performed using Microsoft Excel and Stata IC 14.

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# 1 Introduction

Girls continue to outperform boys in academic settings. The reversal of the educational gender gap is present across borders and cultures, and does not seem to diminish in strength. Male students perform worse in most observable outcomes, such as grades, test scores, dropout rates and in obtaining higher education. This is no different in Norwegian schools. Data from the Norwegian Directory of Education and Training (2016) shows that female students score equal to, or better than their counterparts in every core subject at every grade. At the university level 42.3 % of woman age 19-24 were in higher education in 2016, compared to 27.2 % of men in the same age group (Statistics Norway, 2016b). This is not new, but despite the international trend we do not fully understand the cause. There is still debate on whether the boys are declining, or simply stagnating, being surpassed by soaring cohorts of female classmates. Although interest in the subject has increased in recent years no consensus has yet been reached, neither in economics nor other disciplines. The aim of this thesis is to add another piece to the puzzle and contribute to our understanding of why boys lag behind in the classroom.

A key policy objective in recent years has been to reduce the dropout rates from the secondary educational level. We observe that boys far outnumber girls in this category, with those in vocational track programs being most at risk. This potential gender gap comes with both private and social costs. For the individual, poor academic performance lingers throughout life. In the work place they run the risk of earning lower wages, with fewer possibilities to advance professionally than they otherwise might[1]. Those dropping out may fall outside the labor market completely, reducing tax revenue and increasing government spending on welfare. This direct cost is coupled with the indirect cost of inefficient use of resources. If the school system has students graduating with lower skills and lesser knowledge than they could have, the economy miss out on potential output. Hence, poor academic performance, from any group, can hinder economic growth in the long run. Policymakers should therefore have an interest in

[1] The effect of education on earnings is well established. See for example Kirkeboen et. al (2016).

research on this topic, perhaps so that changes can be made to increase the performance of schools and promote efficiency.

One of the main discussions of principals in Norwegian educational policy is how to determine admissions to high school. The system varies from county to county, and is generally centered on the question of *school choice*. This is similar to ongoing debates in other countries, for example Sweden and India[2]. The experiences from these countries are mixed, and remain controversial. Whether school choice is advantageous for students or not is hotly debated in national media, especially if being able to choose which high school to attend makes students more or less likely to drop out.

To explore this issue, I exploit a policy change in the county Hordaland in 2005 introducing school choice in high school education. The topic of research is two-folded: By comparing with counties were policy did not change, I try to isolate the effect of more choice on high school dropout rates. Secondly, I focus on differences between boys and girls, under the hypothesis that the policy might affect them differently. By effectively creating a market for education, where students compete with grades, school choice can prove favorable to female students. As girls outperform boys in most subjects we would expect to see an increased clustering of girls in the best and most popular schools. We would also expect boys to have to settle for their second or third option to a greater degree than girls. Failure to earn admittance to their preferred school might help explain faltering motivation and higher dropout rates among boys. If modern school systems are better suited to girls' preferences, school choice could exacerbate a gender divide present among adolescents. It could also prove consequential for labor market outcomes in the long term if boys fail to obtain their preferred level of education.

In the spirit of Card and Krueger (1994), Autor (2003) and other seminal empirical work, I employ a difference-in-differences framework, using comprehensive, aggregated data from Statistics Norway's "Statistical Bank". Data is available at the

[2] See Lindbohm (2010) and Rao (2013) for examples on the topic.

county level, divided by gender and type of educational track, providing a solid foundation for an analysis of this kind. Additional data on covariates is also collected from the same database. This approach contributes to the ongoing research on the educational gender gap, as well as a fresh perspective on the Norwegian debate.

Results indicate an adverse effect on students in academic track high school programs. Regression analysis estimates that the reform increased dropout rates by 1.7 – 2.7 % for boys, and 1.2 – 1.4 % for girls. I conduct several robustness tests to validate the results, in which they prove to be consistent. The framework is however unable to identify similar effects among students in vocational track programs as pre-treatment trends does not allow for suitable control groups. Early evaluations of the reform suggests that more choice has allowed for skill sorting, with stronger students displacing the weaker ones in the popular Bergen schools. A clustering of low-skills students in the second tier schools has in turn affected the educational environment. Existing literature has found boys to be more vulnerable to such inputs, letting their peer-group influence their academic performance. This might explain why we seem to observe a greater increase in dropouts among boys than for girls after the reform. Signs of similar effects are also found in other counties who implemented reforms of this kind, which substantiates the conclusions of this thesis.

The remainder of the thesis is structured as follows. Chapter 2 examines the existing literature and theoretical assessments of the educational gender gap and the effects of school choice. Chapter 3 presents the Norwegian school system to provide context for the analysis. The political environment around the reform is also discussed here. Chapter 4 describes the data on which the analysis is performed. Chapter 5 details the research design and identification strategy. Chapter 6 reports the result, while Chapter 7 explores possible explanations and policy implications. A conclusion follows in Chapter 8.

# 2 Literary review

Providing high quality education efficiently is an obvious objective for most countries. As competition grows increasingly global, high-cost countries must develop highly skilled workers in order to compete in the marketplace. The foundation for this development stem from primary and secondary education. Sub-par results from cross-country studies such as PISA, suggests that many high-development countries still have room for improvement[3]. As such, how to best organize the educational system continues to be of interest in the economic literature. A recurring topic is the benefits, or lack of such, of freedom to choose your own school, thus promoting competition and perhaps efficiency gains. The stagnation of male academic performance is a warning sign that educational policy in developed countries may not be optimal. As the magnitude of the gender gap is becoming increasingly well documented focus is shifting towards causal factors, yet conclusive evidence is scarce. In this chapter I look at the existing literature and how it relates to the case study of school choice in Hordaland. The thesis adds to a continuing debate in the literature, both on school choice and gender gaps.

## 2.1 The gender gap in education

The discrepancy in male and female academic performance has gotten the attention of both politicians and scholars. A summary of meta studies and cross-country analyses from Backe-Hansen and Walhovd (2014) concludes that girls in general do better than boys, and especially ay reading skills. The gap is smallest in mathematics and science, where some studies find that boys outperform girls (EURYDICE, 2010). Nordahl et al. (2016) find that boys score significantly lower than girls in teacher-evaluated performance, to an extent that amounts to half a school year in educational output. Interestingly the discrepancy widens with age, meaning that the girls are increasingly outperforming their counterparts as they progress through the school system. Backe-Hansen and Walhovd find no substantial difference at the start of the educational track, but by the time students reach the upper secondary level, girls on average perform better

[3] In the latest PISA study in 2015 Norway ranked 19th in math, 23rd in science and 9th in reading. For comparison, the US ranked 40th, 24th and 24th in the same categories, the UK ranked 27th, 14th and 22nd, while Sweden ranked 24th, 27th and 17th respectively (OECD, 2016).

at most skills and subjects. The difference is not huge, but has been consistent for some time, which is cause for concern. Other developed countries observe similar trends, which suggests that this is a multilateral phenomenon. For example, Autor et al. (2016) reports that in 2011 female college completion rates exceeded the male rate in 29 of 34 OECD-countries. Autor and Wasserman (2013, p.3) describes the reversal of the gender gap in the US as a "tectonic shift". In their summary, they write that "over the last three decades, the labor market trajectory of males in the U.S. has turned downward along four dimensions: skills acquisition, employment rates, occupational stature and real wage levels". Females have surpassed males by a significant margin in obtaining higher education, they are more likely to complete high school, get better grades, are less likely to be unemployed and their real wages are increasing compared to men with similar levels of education. Autor and Wasserman argue that even though a minority of men still reach the highest echelons of the labor market and accumulate wealth at a disproportionate rate compared to women, the life outcomes of the median male in the US is worsening.

A manifestation of the gender gap appears in high school dropout rates. Backe-Hansen and Walhovd (2014) find that male students are more likely to fail to complete their secondary education than girls. In particular, students with low academic achievement and those in a vocational track education seem to be most at risk, with boys outnumbering girls in both groups. Reports from Lillejord et al. (2015) and Byrhagen et al. (2006) note that grade average is an important indicator for future educational outcomes. The former finds that 99 % of students earning a grade point average (GPA) of 5.5 (out of a possible 6) or higher in middle school completed high school, while only 13 % of those earning a 2.5 or lower did the same. The research referenced also find that an increase in GPA by one grade increases the likelihood of completing high school by 30 %. This link between grades and dropouts is interesting when considering the gender gap. In my thesis I expand on these findings, and try to connect the gap in academic performance to the gap in dropout rates through the introduction of competition in the educational market. Specifically I hypothesize that the disproportionate male dropout rate might come as a result of low-performing boys failing to earn admission to their preferred school more often than girls, with the result being an increased risk of quitting.

Several other hypotheses have been presented in the literature as to why the gender gap has emerged. Broadly, they can be divided in two categories: Behavioral and cognitive differences between the genders, and social and organizational factors in disfavor of male students. The former has seen an influx of papers in later years as researchers try to explain the discrepancy by how boys and girls approach and acquire knowledge. Some data suggests that boys are more susceptible to let unstable home environments, or a low-income background translate into lower academic performance. Often cited is a paper by Bertrand and Pan (2013) that finds that boys from broken homes perform worse than students from two-parent households, and are more sensitive to poor parental inputs than girls. This can be linked to the acquisition and development of important non-cognitive skills, which tend to suffer in households with only one parent. They argue that skills like study habits, perseverance and self-control matters significantly when it comes to academic performance, while also being strongly correlated with gender. Boys are more likely to display disruptive behavior, or be diagnosed with an attention deficit disorder, resulting in lower absorption of the curriculum. This early grade behavior may lay the foundation for the diverging educational progress between boys and girls, ultimately resulting in higher dropout rates at the secondary level. Autor et al. (2016) expands by investigating if boys display the same heightened sensitivity to school inputs. By comparing siblings of opposite gender enrolled at the same school they are able to examine how the brother and sister responds to the quality of the school they attend, for example after a move. The results show that boys benefit more from being exposed to a higher quality school environment than girls, although both genders perform better when attending better schools[4]. This indicates that boys, in addition to background and home environment, are more vulnerable to poor educational input. Furthermore, a paper from Legewie and DiPrete (2012) demonstrates that boys are more sensitive to the composition of their peer group. Specifically, male peer groups vary with socioeconomic status, while female groups do not. In high quality schools the academic environment appears to be more learning oriented, shaping and channeling the 'masculine culture' among boys towards competition in school performance and achievement. In lower-quality schools, they argue that the same masculinity translates to disruptive behavior, at the cost of diminished learning. Their

[4] The paper employs a measure of school-level "gain score" detailing how much students benefit from attending that particular school in observable test scores. This measurement is done by the Florida Department of Education, from which the data is collected.

female classmates were not found to have similar variations as they conclude that "boys, in particular, benefit from school resources that create a learning-oriented peer culture" (Legewie and DiPrete 2012, p.464). If low-performing males are clustered in certain schools, these results suggest that the effect on dropout rates might be more severe for boys than for girls in the same situation. As pure school choice allows for greater segregation in abilities, we could also expect to see greater segregation between genders. If many boys are limited to second-tier schools, a lab experiment from Almås et al. (2016) might explain why these are more at risk than others. Different characteristics influence the risk of dropping out for boys and girls, where male students that reported a high degree of confidence completed their secondary education at a higher rate than others. Research also suggests that confidence is linked to academic motivation, learning and achievement (Shoemaker, 2010, Taurina, 2015)[5]. These results might be an expression of boys with lower mastery of core skills feeling less confident in their academic prowess, subsequently being at greater risk of dropping out. Girls on the other hand rely more on the long-term prospects of education, perhaps contributing to more determination and motivation than their fellows. If in fact boys let disadvantages of background, social interactions and education quality affect their academic performance to a greater degree than girls, we might understand why motivation and confidence suffers more often at advanced levels of study.

The latter category of hypotheses focus on systemic elements of education, and how they might influence genders differently. Results such as those in Nordahl et al. (2016) and Legewie and DiPrete (2012) underscore the notion that the decline of male students corresponds with a 'feminization' and 'suppressing' of masculine culture and behavior in the school system. The problem, some argue, is schools failing to engage boys by teaching to their interests and strengths, relying on principles more suited to a female preference for learning. For example, Dee (2005) shows that students perform better with teachers of the same gender, while Sikora (2014) finds that single-sex schools helps reduce gender stereotypes in post-educational career paths[6]. Since a majority of teachers at the primary and lower secondary level are female, the belief is that this

[5] Psychologists would preferably use the term 'self-efficacy' in this setting, which Shoemaker (2010, p.687) defines as "a belief in one's capability to learn or perform behaviors at designated levels".
[6] Boys showed a larger propensity for choosing life-science based occupations when coming from a single-sex school, while girls were more likely to pursue physical sciences.

favors girls as the needs and wants of male students fail to be identified. Some Norwegian studies focus on an increases emphasis on the individual responsibility of learning, which has led to less collective teaching and a more floating structure of schooling[7]. While it reflects the changing demands of the labor market, it can also be thought to favor girls as they tend to be motivated by the learning itself, while boys rely more on external motivation from the group or the teacher. On the other hand, a thorough analysis by Bakken (2008) concludes that there is little evidence that the organization of the school system creates gendered differences in performance, but it may recreate and accentuate differences already present in the class. A compelling argument is that the same gender gap appears in countries all over the world, with vast variations in how the school system is designed. They have also been persistent over time, despite recent efforts to address the issue. The hypothesis that one specific set of policies or values, whether explicit or implicit, should be the cause of the divergence therefore seems improbable. In the report they note that according to Brophy (1985) the critique of the 'feminine school' is almost a century old, while Francis and Skelton (2005) points out that the term's political motivation makes it difficult to infer what it specifically entails. Of empirical research Bakken (2008) found little that supported, or even sought out to test, whether a 'feminine school' cause boys to perform worse. The floating and vague nature of the concept may be difficult to test in an analytical setting, and the cause of why it has seen little interest among economists.

## 2.2 The effect of school choice

This thesis studies a case of increased choice in the educational market. In the application of economic theory on the provision of education, a long standing claim is that more choice will promote competition and efficiency in the school sector. Friedman (1962) is an early example in which he proposes the idea of a voucher, with which parents could choose the preferred school for their child to attend. The government would then pay the cost of the child's enrolment, regardless of public or private ownership. Friedman believed that the increased competition between schools to attract students would spur a competitive market for education, pushing private and public institutions both to improve in order to ensure adequate enrolment and funding. For instance, the competition might urge schools to invest more resources in their staff,

[7] Notably Nordahl (2007) and Øia (2007)

improve school facilities, be more open to alternative pedagogical practices, or any other measure aimed to raising the quality of schooling supplied at their respective institutions. In doing so, increasing the students' ability to choose would not only mean increased opportunities for the individual, but also improve the educational output for the system as a whole, converting to higher economic growth in the long run.

A number of previous studies aim to measure these perceived benefits from increased freedom of choice in education. If this is the case we would expect to see improvements in measurable outcomes, such as completion rates and student performance. Figlio and Hart (2014) is a recent example, where they examine if students in schools exposed to competition from private actors perform better on observable test scores. The results indicate that more competition is related to improved performance, an improvement that only occurs after choice is introduced. They also find the effect to be progressive, where the schools most at risk of losing students saw the greatest effects. Lavy (2010) finds the same reduction in dropout rates among public schools in Tel-Aviv when choice is introduced, while Angrist et. al (2002) exploits a natural experiment in the voucher lottery system of Colombia to find that recipients were more likely to have completed 8$^{th}$ grade and improved test scores. The latter's cost-benefit analysis concluded that the gains of the winners exceeded the governmental cost per voucher, increasing net welfare. A relatable case to Hordaland is the 1992 school reform in Sweden[8], where a voucher system gave access to the so-called 'independent schools'[9]. Two decades later, Lindbom (2010) reports that the overall effects have been marginal, both with regards to student performance and costs. On the other hand, a comprehensive analysis of national test scores and final marks found a significant and positive, but modest, relationship between academic performance and the availability of independent schools (Bergström and Sandström, 2001, Ahlin, 2003). This is consistent with studies from other countries where schools exposed to competition from private institutions are generally found to perform better than other schools[10]. Consequently, areas with a high degree of school choice correspond with higher test-scores and lower costs per student. These effects can

[8] Both supporters and opponents of school choice in the Norwegian public debate often use the 'Sweden example'. Norway and Sweden's school systems are in many ways founded on similar principals and structure.
[9] An independent school separates from the traditional private school in that it is not allowed to charge fees from the parents or its students, but must accept the government voucher as payment in full.
[10] Greene and Winters (2003), and Hoxby (1998, 2001) are good examples

also be found in Norwegian studies, where students exposed to school choice have been found to improve their academic performance, for instance by earning better grades[11].

Although research finds efficiency gains from allowing competition, a common objection is that more choice can lead to adverse segregational effects. When grades determine admission, a pertinent example is the sorting of students after skill, effectively creating 'A' and 'B' schools. Opponents often cite the practice of 'cream skimming', where the best schools only select students from certain preferred groups, as a reason for increased costs and poor quality in public education[12]. As Robert (2010) note, although school choice shows signs of improving both student and school performance overall, the effect is strongest for those from high status households where parents hold a more informed preference for academic quality. The consequence for policy-makers is a trade-off between efficiency and equality in the supply of education. In a seminal paper, Epple and Romano (1998) discuss how peer-effects influence students' performance. Their model suggests that more choice inevitably results in some form of sorting of students, with those with low income and ability being the most likely to remain in public school. Overall, students in private school benefit from having high-ability peers, and "because vouchers increase the premium on ability, the greatest proportionate gains from the voucher accrue to low-income, high-ability students" (Epple and Romano, 1998 p. 55). In a school choice reform, positive spill-over effects could represent a gain in schools dominated by students from homes with highly educated, high income parents, but it is unclear if the effect is large enough to outweigh a conversely negative effects on those left in weaker institutions.

Boys and minorities are examples of groups overrepresented in the weakest segments of the student population. Through the cream-skimming process of a school choice system we would expect these to be clustered in what is perceived as the second, and third tier schools. Lindbom and Almgren (2007) provides a rigorous examination of compositional effects after the Swedish reform. They find that although the overall effects were marginal, data suggested that the consequences were most prominent in

[11] See Haraldsvik (2012 and Brugård (2013)
[12] See for example Altonji et. al (2015) or Barrett and Boaz (1996).

disadvantaged areas, where there were signs of fewer students whose parents were employed or Swedish nationals, more students with low grades and fewer girls enrolled in the schools[13]. Similarly, a report from Lødding and Helland (2007) finds a distributional effect in the weaker segments of the student distribution when changing to free choice system. Those with lowest abilities and grades seemed to benefit the most from a geography-based admission principle, being more evenly distributed in the hierarchy of schools than with school choice. Guneriussen (2012) finds that the 'unpopular' schools typically have a larger concentration of minority students, who on average get lower grades than natives. When competing for admission with their grades these students will be clustered in the 'second tier' schools, which are usually located in areas with low socioeconomic status and a high share of minority residents. It is reasonable to assume that similar arguments as those on the clustering of minority students can be extended to underachieving boys. This thesis argues that when grades are determinants for school admission, the sorting process can cluster boys, who on average get lower grades, in second tier schools, where negative peer-effects and educational inputs could lead to an increased dropout rate. Common for the Swedish and Norwegian studies is the focus on ethnic and socioeconomic segregation. Few, if any, discuss the distribution of gender in the presence of school choice. This provides motivation for the analysis of this thesis, which goes in further detail on gender differences than earlier papers. In general, surprisingly little research has been conducted on Norwegian data other than descriptive summaries of statistics. Fear of racial, social and academic sorting contribute to the fact that school choice remain controversial. Among economists however, the general sentiment is that there are benefits to increased competition among suppliers of education. A 2006 survey among PhD-members of the American Economic Association revealed that 67.1 % of the asked favored a voucher system, with support increasing if the system is limited to low-income households or low-scoring schools (Whaples, 2006).

[13] Böhlmark and Lindahl (2007) finds additional evidence of modest segregational effects along socioeconomic and ethnic lines. Areas where the rate of students in private school is high, typically have a higher rate of students of a minority background enrolled in the public schools.

# 3 Institutional background

## 3.1 Main principles and organization

The Norwegian school is divided in three levels: elementary school (grades 1 -7), middle school (grades 8-10) and high school (grades VG1-VG3, i.e. 11-13), where the latter is of most interest for this thesis. Contrary to the first two, participation in this upper secondary education is voluntary, allowing for dropouts after the 10th grade[14]. However, all students in the age 16-23 has a statutory right to enrollment and schooling, assuming they have completed elementary and middle school. Grades are introduced in the 8th grade, and depending on the county form the basis on which admission to high school is decided. Although it is optional, career paths for those without a high school diploma are limited, and decreasing. As such, an objective for the Norwegian government is to ensure that more youths complete their secondary education. For many, high school education appears almost mandatory, and according to The Education Mirror for 2016 92 % of all 16 to 18-year-olds were enrolled in a high school at the start of the 2015/2016 school year (Norwegian Directory of Education and Training, 2017).

After 'The Knowledge Promotion Reform' of 2006 students starting their upper secondary education have mainly two paths to a diploma. The first is through a 'General Studies Program' (GSP), a college track education preparing them for further studies at a tertiary institution. Upon completion the student is given university and college admission certification which is required in order to qualify for higher education. Anyone seeking this must therefore attend such a GSP, which tends to be the most popular option. The schooling in these programs is mainly theoretical, providing further specialization in core subjects such as science and languages as well as granting the students the freedom to choose electives. Alternatively, students can attend a 'Vocational Studies Program' (VSP). The VSPs are two year programs, compared to GSPs three, leading to an apprenticeship within some sort of trade, lasting an additional two years. The vocational track education is usually more technical and practical in nature, where the objective is for students to be trained in a profession in which they can

[14] Dropouts during the primary education do happen, but at a miniscule rate. In 2015/16 only 192 kids failed to participate in their compulsory schooling.

enter the labor market after the four years of education. For those who in addition want the admission certification for higher education can enter supplementary studies, either after the second year or after achieving their vocational qualification. These studies are designed to make up for the theoretical schooling missing in most VSPs, and has gained popularity in recent years. Conversely, vocational education has fallen in popularity, attendance and completion rates. This has led to political focus on participation in these programs, especially among low-skilled students who tend to be more prevalent in VSPs (UNEVOC, 2013). There are a total of 12 programs to choose from at the high school level, of which three are general programs and nine vocational programs. For the purpose of this thesis I only make a distinction between the two main categories, GSPs and VSPs.

All public high schools are free and open to anyone. However, there is an ongoing debate concerning who should get priority when demand exceeds school capacity. Historically, students have enrolled at the school in the closest vicinity to their homes, as is usually the case in elementary and middle school. In the last three decades however, a growing faction of politicians have argued that students at the upper secondary level should have the right to choose for themselves which school they want to attend. As some schools are regarded as providing a higher quality of education, access to these 'good schools' should not be limited to those who happen to live near them, but rather be accessible to everyone. Deciding how access should be granted has been the basis for much controversy. While most of the Norwegian educational policy is crafted nationally by the Government and Parliament, the high school admission system is decided at the county level. Hence, systems vary and is subject to change depending on the political situation.

In general, the systems counties use can be divided into two groups. The first operates with a *free school choice* system (FSC). In this group, students are eligible for enrolment at all high schools within the county, and apply to the school which he or she wishes to attend. At schools where applications exceed capacity admission is based on the student's grade average from middle school. Thus, the most popular schools will require the best grades to be accepted. Since upper secondary education is a statutory

right, all who apply must get an offer from a school. However, those with poor academic performances in middle school may not get accepted at their first or second choice. The second group uses a geography based system, commonly called a *proximity principle* (PP). In its purest form students in PP counties are assigned admission to the school offering the program they wish to attend to which they live closest, often measured by length of commute. Freedom of choice under this system can be limited, but some allow students to change schools if there is capacity. Other counties employ a mix of the two systems. Several divide the county in 'admission regions' based on geography, with FSC within each region, while some give their students priority at their local school, but access to apply to any school they like. For the purpose of this analysis I categorize all counties who infringe on the free choice as a PP-county, including only counties where no restriction is imposed in the FSC-category.

The first FSC counties made the change from the local school principle in the late 80's and early 90's. Since then others have followed at a steady pace. A summary of high school admission policy requested by the Parliament in 2003 revealed that nine of the 19 counties employed a variant of FSC (Stortingets Utredningsseksjon, 2003). By 2016 this number have risen to 12. As the majority of counties now offer more or less free choice in education pressure is rising in the remaining seven still basing their system on PP to offer the same degree of freedom. There has also been a push to make FSC available at a national level, meaning that every student would be able to apply any high school in the country, regardless of where they live. As of the writing of this thesis a proposal from the governmental parties to implement this right is making its way through a hearing process (Hansen and Børnes, 2016)

## 3.2 Public and private schools

Private schools have traditionally been a marginal part of the Norwegian school system. At the upper secondary level privately owned schools were banned up until 2005, unless they provided a religious or pedagogical alternative to the general public education. Christian free schools and educational concepts such as Steiner and Montesorri were thus allowed. After the law change in 2005 private regular high schools were allowed, which exposed the public school system to direct competition. Although private school

attendance increased in the following years, the share of students in public education remain fairly high compared to other countries. Per UNESCO Institute for Statistics (2016) 7 % of Norwegian students in secondary education attended a private institution in 2014, compared to the OECD average of 17 % and world average of 25 %. Of the 423 Norwegian high schools 92 are privately owned, but tend to be smaller than public schools, with less than a third the average number of students (Norwegian Directory of Education and Training, 2017). Most of these are still schools with an alternative educational philosophy or religious orientation, and dependent on governmental funding. Private institutions providing the same general education and curriculum as the public schools are few and mostly concentrated in the larger cities. Oslo has the highest proportions of students in private high schools at 16 %, while Hordaland has a 15 % share. For comparison, Aust-Agder and Sogn og Fjordane, two of least populated counties, have only 6 and 4 % of students in private schools respectively.

## 3.3 Political background and environment

Administratively, the 19 counties are responsible for providing upper secondary education, while the 428 municipalities are in charge of the compulsory education. Organizing and funding the schools is viewed as one of the most important task of local government, with significant portions of the budget being used on education[15]. Most guidelines are provided from the central government, leaving little opportunity for local politicians to influence the pedagogical principles of the school. The exception is the high school admission system, regarded as an organizational matter centrally. This has made the issue a key battleground in several counties, most notably in Hordaland and Oslo. For the latter, the admission system has changed seven times since 1982 as a result of a continuous tug of war between political parties (Guneriussen, 2012).

The actors in the debate typically follow a traditional left-right axis, with the Conservative Party as the foremost proponents of FSC. Leaning on the arguments of Friedman (1962), they argue that competition can be used as a tool to promote

[15] In 2015 41.4 % of Hordaland county's budget was spent on education and training (Hordaland Fylkeskommune, 2016)

efficiency and prosperity[16]. They also emphasize the moral imperative of the issue, as it is both the students' and parents' fair right to choose the education which is best suited for their needs and preferences. The Labor Party are the most notable proximity principle advocates. Contrary to the Conservative Party, their main concern regarding school choice is the implicit establishment of first and second tier schools. In relation to results such as those in Epple and Romano (1998) they fear that grade based admissions will lead to an academic divide between those able to be accepted by the best schools, and those left behind in inferior schools. As the school system is designed to promote equality and unity across socioeconomic groups, school choice counteracts the core purpose of the 'comprehensive school'. When competing with their GPA, only the best students truly have a free choice among schools. Thus, the Labor Party argue that a proximity principle is fairer as students gather at their local school, regardless of previous achievements or academic ambitions. The level of tension on the issue varies by county. Hordaland and Oslo remain the most hotly debated counties, while the issue seems resolved in other parts of the country. Rogaland, Vestfold and Sogn og Fjordane are examples of counties where school choice has been in effect for several decades, and is today regarded as uncontroversial across the political spectrum.

## 3.4 The Hordaland reform

After regaining the majority from the Labor Party in the 2003 Hordaland county election, the center-right coalition led by the Conservative Party vowed to remove the proximity principle in favor of school choice. The reform was approved the following fall, with school choice taking effect for students beginning their high school education in August of 2005. The decision was controversial and sparked great debate in local media where both Oslo and Sweden were cited as examples of school choice reforms where student performance and satisfaction suffered as a result[17]. The students however seemed pleased and welcomed the opportunity to choose their own school. In an early evaluation from the County Parliament, a survey revealed that over 60 % were generally pleased with new system, and only 13 % displeased (AUD, 2005).

[16] See Fladset (2015) and Astrup and Røe Isaksen (2016) for remarks from the current Minister of Education from the Conservative Party, Torbjørn Røe Isaksen, on the benefits of choice. For the party's official stance on the issue, see Høyre (2013)

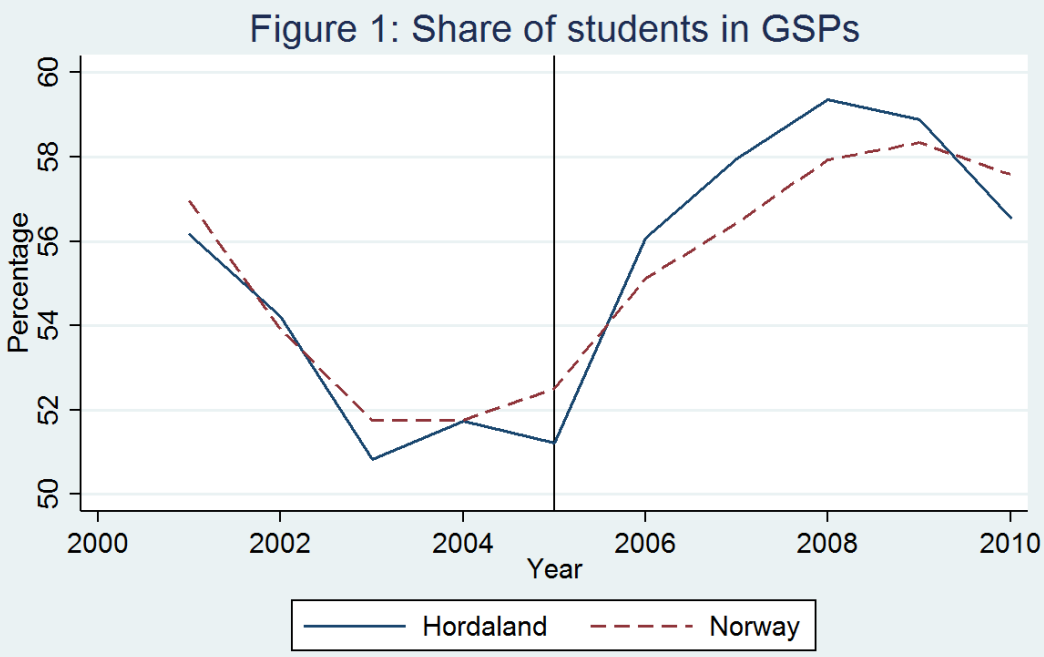
[17] For examples of media coverage of the initial reform see articles such as Holmelid and Tomasgard (2004), Holmelid and Rossland (2004), Rambøl (2004) and Madsen (2004)

At the time of the reform there were 57 high schools in Hordaland, to which all students where eligible for enrollment after the policy changed[18]. Of these, 28 were placed in the administrative center, Bergen municipality, where the most popular ones are located in the city center. By Norwegian standards, Hordaland is a large, populous county, while Bergen is the second largest city in the country, dominating an otherwise rural population. In several areas, only one or two schools are within a reasonable commute, limiting the de facto choice available for its local students. School choice is first and foremost available for students in and around Bergen city where the supply of education is highest. As such, we should expect the effect of the reform to be strongest in the most urban areas where the competition between schools and students is toughest. In fact, the Parliament evaluation found that there were competition for admission among all GSP-schools located in Bergen municipality, compared to only three in the rest of the county. It also reported that 39 % of students in Bergen, and 26 % of the county as a whole, had applied to a different school than their local one. Interestingly, the use of school choice was highest for those at the top and bottom of the grade distribution, with 35 % of those graduating with a GPA above 5 and 25 % of those below 2 not attending their local school. When asked about the importance of school choice over 60 % of the students responded that it was *very* important. In Bergen 46 % responded the same, suggesting that many students do not view school choice as a crucial issue, but choose to use it when given the opportunity[19].

An interesting trend observed in the years after the reform is the increased popularity of GSPs among students. Figure 1 shows a declining trend in the share of students choosing GSP in the first half of the decade, which is reversed into significant growth for the latter half. In Hordaland the share increases from 51.7 to 59.4 % from 2005-2008, a trend that is also present nationally. This indicates a growing tendency among adolescents to choose academic track programs, which grants access to higher education after the completion of high school. The Norwegian Directory of Education and Training (2017) report that general study programs are by far the most popular choice

[18] In 2001 there were 60, which by 2016 were reduced to 55. Of these 12 are private, one more than in 2005. Brugård (2012 note that while the number of schools in Norway have been reduced the last 20 years, it is usually the case of smaller schools merging so that the overall capacity is equal or better.
[19] Since no follow up have been conducted we do not have similar statistics on the use and satisfaction today, which might have changed significantly in years after as people adapt.

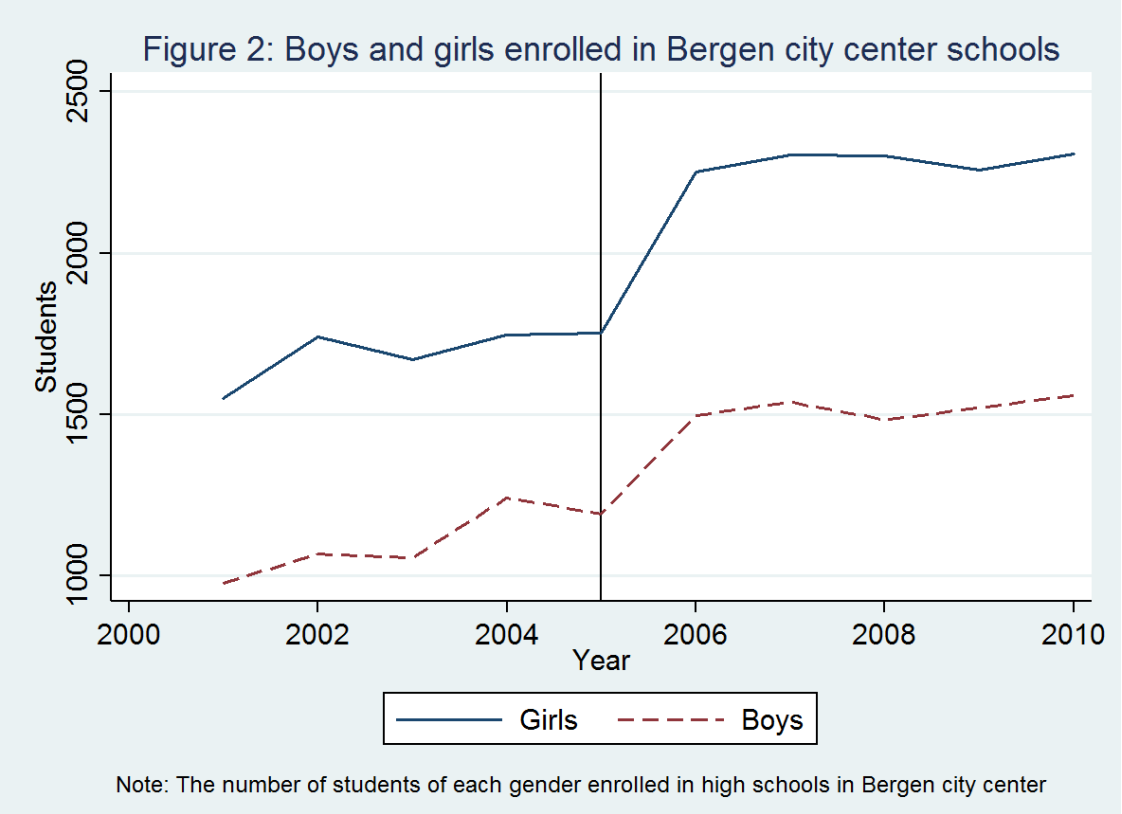
among students, and increasingly so in recent years. This implies that more students are chasing the same spots in the popular Bergen schools, inducing fiercer competition and higher GPAs necessary to get accepted to certain schools.




Note: Students attending academic track programs as a percentage of the total student mass. The share for VSP will be the inverse of that illustrated in the figure

The heightened competitiveness in schools in Bergen manifests in the distribution of boys and girls between schools. Figure 2 shows the total number of students of each gender attending the (primarily) GSP-schools in Bergen city center, illustrating how girls outnumber boys in this category. After the reform attendance for both genders increase for these schools, revealing a strong preference for the centrally located schools. This is also evident of an increase in supply as new, centrally placed schools opened in the latter half of the decade. The increase does however appear to be larger for girls than for boys. In AUD (2005), the evaluators report that the schools in the city center have the highest number of students for which the school is not their local one, a trend that is most apparent where the GPA-requirement for admission is highest. Outside of Bergen, students primarily attend the school which is geographically closest. As such, it appears that the reform allows for high-abilities student to attend the popular schools in Bergen, while other students choose schools outside the immediate city

center. Since boys are more likely to be in the lower segments of the grade distribution, the gender gap in the most popular schools is in line with what we would expect.




Note: The number of students of each gender enrolled in high schools in Bergen city center

Despite a seemingly satisfied youth population, these trends contributes to the system remaining controversial. As of 2017, a Labor-led coalition holds the majority once more after campaigning on the wish to replace FSC with a new system before the start of the school year in August. However, only minor adjustments to the current system have so far been decided. No announcements have yet been made on if, when or how school choice will be practiced in the future, other than the possibility of a later removal. The timing makes this thesis increasingly relevant, as both sides emphasize what these changes could mean in terms of student performance and dropout rates. Despite bold claims and fierce accusations, little research is available on the long-term consequences of the reform. As they prepare for another change, policy makers should have an interest in empirical analysis on the subject in order to make an informed decision.

# 4 Data

The purpose of this thesis is to examine to what extent competition for school admission can be linked to dropout rates. Motivated by existing literature, I aim to connect the research on gender differences and school choice and apply it to the case of a reform implemented in Hordaland in 2005 which introduced the ability to choose which high school to attend. The basis for this angle is part lack of research on the topic, and part availability of data. There are other measurable outcomes that warrants equal interest, but are not as readily available as dropout rates. Test scores, grades, choice of high school track, rates of higher education and early labor market outcomes are a few examples of what could be expanded on in further research. To perform the analysis I've obtained data from Statistics Norway's 'Statistical Bank', which provides detailed statistics on dropout rates, divided by county, gender and high school study program. The rates are linked to individual register data from their National Database for Education, but only available publicly in aggregated form. I have limited the analysis to students in the 19 mainland counties, meaning that data from Svalbard or students abroad is disregarded. The period of focus is 2000-2010, in which the Hordaland reform takes place midway, making it a suitable case for study. In this chapter I summarize the statistics that the analysis is built on and provide descriptive data from the sample.

## 4.1 Dropout rates

By 'dropout' Statistics Norway refer to an individual who have failed to complete their upper secondary education within five years of their initial enrollment, at which point the statutory right to schooling expires. The data is collected for all students registered at a Norwegian high school, including all teaching institutions that satisfies the conditions of the Education Act, meaning both private and public schools are included in the rates. In my sample, observations are aggregated at the county level, and expressed as percentages of the total enrollment for each cohort. Statistics Norway define these cohorts in five-year interval, where for example 2000-05 refers to dropouts among those starting high school for the first time in 2000. For simplicity, they are usually referred to by their starting year. This means that the 2010-cohort extends to 2015, making the data adequately up to date.

Table 1 details dropout rates in the sample. The dataset is split between genders and study program, in addition to the total for the cohort in question. The 12 study programs offered to high school students are divided in 'general' and 'vocational' categories[20]. The average for the period is a dropout rate of 18 %, revealing a high school completion rate lower than the OECD average (OECD, 2016a). There is however a downwards trend in the overall dropout rates, as the total decreases from 18.9 to 15.2 % from the 2000 to the 2010 cohort. This reduction is present for all genders and study programs. Hordaland see a similar trend in the overall dropout rate, but have somewhat heterogeneous developments between the different groups, which form the basis for this analysis. We also note the large discrepancy between the academic track students and vocational track students, where the former has an average dropout rate of 6.9 while the latter is closer to 30 %. In the most severe cases, dropout rates among VSP-students is approaching 50 %[21]. In addition, we can clearly see the gender gap emerging from the table. Boys have a higher dropout rate in every category, in all counties. Although girls complete their schooling at higher rates than boys do, we note that the difference between the different study tracks is generally larger than the gender gap. The lowest amount of dropouts is observed in Oslo in 2008, coincidently a county with one of the lowest shares of students in vocational programs. For contrast, the highest rate is found among male VSP-students in Finnmark in 2003 54.9 %[22].

***Table 1 - Dropout rates 2000-2010***

| | Mean | SD | Min. | Max. |
|---|---|---|---|---|
| *ALL STUDENTS* | | | | |
| Total | 18.0 | 3.7 | 11.1 | 31.5 |
| GSP | 6.9 | 2.2 | 2.4 | 15.9 |
| VSP | 28.1 | 5.2 | 19.1 | 46.8 |
| *BOYS* | | | | |
| Total | 21.6 | 4.9 | 13.4 | 40.5 |
| GSP | 8.5 | 2.9 | 2.6 | 19.5 |
| VSP | 31.2 | 6.5 | 19.2 | 54.9 |
| *GIRLS* | | | | |
| Total | 14.2 | 3.0 | 7.8 | 24.6 |
| GSP | 5.6 | 1.9 | 2.0 | 13.0 |
| VSP | 24.1 | 4.4 | 16.7 | 39.3 |

*Note: GSP: General study programs VSP: Vocational study programs*

[20] For more detailed statistics of each specific programs refer to the Education Mirror for 2016 (Norwegian Directory for Education and Training, 2017)

[21] Recently some criticism has been given to Statistics Norway definition of 'dropout' from Vogt (2017). He argues that their 5-year window is biased against vocational study programs, as these students might not finish their education until their late 20s, yet are still counted as a dropout in the official statistics. This might exaggerate the 'dropout problem', even though the completion rate has been relatively stable the last 20 years according to Vogt.

[22] Note however that this is a far less populated county than the others, which means that the limited data might skew and exacerbate the numbers.

Overall, there are not large differences between counties offering school choice and those who do not in the period 2000-2010. Table 2 shows averages for the same nine categories, and reveals that dropout rates are almost identical for several of them[23]. There is only a slight trend towards lower dropout rates in PP-counties, and less variability between these.

***Table 2 - Comparing dropout rates between FSC- and PP-counties***

| | | Mean | SD | Min. | Max. |
|---|---|---|---|---|---|
| **FSC-COUNTIES** | *ALL STUDENTS* | | | | |
| | Total | 19.0 | 5.4 | 11.7 | 31.5 |
| | GSP | 7.6 | 3.1 | 2.4 | 15.9 |
| | VSP | 29.1 | 7.4 | 19.1 | 46.8 |
| | *BOYS* | | | | |
| | Total | 23.0 | 7.2 | 13.7 | 40.5 |
| | GSP | 9.7 | 3.9 | 2.6 | 19.5 |
| | VSP | 32.2 | 9.4 | 19.9 | 54.9 |
| | *GIRLS* | | | | |
| | Total | 14.8 | 4.0 | 9.1 | 24.6 |
| | GSP | 5.9 | 2.8 | 2 | 13 |
| | VSP | 25.1 | 5.6 | 16.7 | 39.3 |
| **PP-COUNTIES** | *ALL STUDENTS* | | | | |
| | Total | 18.7 | 2.6 | 13.5 | 23.5 |
| | GSP | 6.8 | 1.7 | 3.1 | 11.7 |
| | VSP | 28.9 | 3.9 | 21.3 | 36.1 |
| | *BOYS* | | | | |
| | Total | 22.3 | 3.3 | 15.6 | 29.1 |
| | GSP | 8.2 | 2.2 | 3.6 | 13.7 |
| | VSP | 32.1 | 4.8 | 20.8 | 41.8 |
| | *GIRLS* | | | | |
| | Total | 14.9 | 2.3 | 10.4 | 22 |
| | GSP | 5.6 | 1.4 | 2.2 | 9.8 |
| | VSP | 24.9 | 3.9 | 17.2 | 36.3 |

*Note: FSC: Counties where school choice is employed PP: Counties using the proximity principle*

## 4.2 Background characteristics

Table 3 lists descriptive data on background characteristics for the counties in the sample, where Hordaland is compared to the national average. Population refers to the number of inhabitants within a given county, measured yearly. For 'National', the population count is the average of all counties. Median income measures the yearly, individual income that splits the income distribution in halves. The income data is collected by Statistics Norway from the annual tax returns, and is reported in Norwegian kroner in nominal terms. Also included is statistics on the level of education. Here, the categories refers to the percentage of the population for whom this is the

[23] Switching counties are excluded from this table

highest level of completed schooling. 'Compulsory' refers to the 10-year primary and lower secondary education, while 'High school' refers to completion of the voluntary upper secondary education. University education is split, where a 'short education' is defined as four years or less, while a 'long education' is five years and above.

***Table 3 - Background characteristics***

| | Mean | SD | Min. | Max. |
|---|---|---|---|---|
| *HORDALAND* | | | | |
| Population | 448852 | 11433 | 435219 | 469681 |
| Median income | 256191 | 41139 | 200400 | 318200 |
| Compulsory | 29.5 | 1.5 | 27.2 | 32.1 |
| High School | 44.6 | 0.8 | 43.5 | 45.5 |
| Short University | 19.9 | 1.4 | 17.8 | 21.8 |
| Long University | 6.0 | 0.9 | 4.8 | 7.4 |
| *NATIONAL* | | | | |
| Population | 242631 | 962917 | 72399 | 575475 |
| Median income | 248899 | 39907 | 179000 | 346500 |
| Compulsory | 32.6 | 4.1 | 22 | 42.4 |
| High School | 44.3 | 3.7 | 33.3 | 49.6 |
| Short University | 18.3 | 3.0 | 13.5 | 29 |
| Long University | 4.8 | 2.5 | 2.4 | 15.7 |

In terms of most of these variables, Hordaland is almost remarkably average. The most apparent discrepancy is that Hordaland is a large, populous county by Norwegian standards, with the third highest population throughout the period. Bergen might account for a somewhat higher median income, and a higher degree of inhabitants with a university education than the national average[24]. Both Hordaland and Norway in general see a general trend of increased attainment of tertiary education. In 2010, almost 30 % of inhabitants in both Hordaland and Norway overall have some sort of University schooling.

Do counties with school choice differ from other counties? Table 4 details averages for the FSC-counties and compares them to PP-counties on the same variables as Table 3. No striking difference is apparent. FSC-counties have a slightly higher income and cover a greater range of sizes, while PP-counties have a higher population on average. In regards to education, no trend is detectable, as there appears to be no systematic difference between the two groups. In lower end of the panel we see that the four

[24] McHenry (2014) discuss how college educated workers are both more mobile, and more aggressive in seeking out job markets with higher wages. A result of this is the sorting of high-skills workers into urban areas which can sustain a more comprehensive job market, and where returns to education are higher.

counties, excluding Hordaland, that changed systems in the 00's (hereby referred to as 'the switchers') are on average larger than those who did not[25]. In addition, income is higher, as well as the rate of university graduates, which is not surprising considering that the switchers contain several of the largest metropolitan areas in Norway (such as Hordaland, Akershus and Oslo). From Table 3 we see that Hordaland is relatively equal, although on the lower side of the average. The discrepancies are not striking, however, and supports the notion that the population in the different counties are relatively homogenous. This claim is in line with Guneriussen (2012) and Brugård (2013) who argue that school choice in Norway is more of an ideological issue than an evidence-based one. Which counties offer school choice is thus a question of politics, and hard to predict ex ante based on characteristics.

***Table 4 – Comparing characteristics between FSC-, PP- and switching counties***

| | Mean | SD | Min. | Max. |
|---|---|---|---|---|
| *FSC-COUNTIES* | | | | |
| Population | 179568 | 119398 | 72399 | 420574 |
| Median income | 246622 | 38956 | 183700 | 331500 |
| Compulsory | 32.6 | 4.0 | 28.2 | 42.4 |
| High School | 45.4 | 3.4 | 38.7 | 49.6 |
| Short University | 18.0 | 1.5 | 14.8 | 20.8 |
| Long University | 4.0 | 0.9 | 2.6 | 6.8 |
| *PP-COUNTIES* | | | | |
| Population | 200987 | 49978 | 127108 | 286729 |
| Median income | 242125 | 37086 | 179000 | 312700 |
| Compulsory | 34.2 | 3.4 | 27.1 | 41 |
| High School | 44.5 | 2.2 | 40.1 | 48.6 |
| Short University | 17.2 | 1.9 | 13.6 | 21.4 |
| Long University | 4.2 | 1.4 | 2.4 | 8.7 |
| *THE SWITCHERS* | | | | |
| Population | 363603 | 154217 | 182701 | 575475 |
| Median income | 263682 | 44418 | 183100 | 346500 |
| Compulsory | 30.0 | 4.8 | 22 | 38 |
| High School | 42.6 | 4.5 | 33.3 | 47.2 |
| Short University | 20.5 | 4.9 | 13.5 | 29 |
| Long University | 6.9 | 4.3 | 2.4 | 15.7 |

## 4.3 Composition of student mass

Different groups of students complete their schooling at varying rates. In addition to boys dropping out more than girls, and VSP-students more than GSP-students, Statistics Norway report that students with a minority background are less likely to graduate from

[25] Other than Hordaland in 2005, Akershus (2003), Oppland (2003) and Møre og Romsdal (2001) switched to school choice systems during the 00's. In addition, Oslo changed to PP in 2005 and back to FSC in 2008

high school within the normal time frame (Statistics Norway, 2016a). As such, the composition of the student mass can have a significant impact on the amount of dropouts in a given county. Table 5 lists the distribution of girls and boys, students in the different high school tracks and share of minority students.

***Table 5 - Distribution of gender, study program and minorities***

| | Mean | SD | Min. | Max |
|---|---|---|---|---|
| *HORDALAND* | | | | |
| Girls | 50.1 | 1.1 | 48.4 | 52.2 |
| Boys | 49.9 | 1.1 | 47.8 | 51.6 |
| GSP Share | 55.3 | 3.2 | 50.8 | 59.4 |
| VSP Share | 44.7 | 3.2 | 40.6 | 49.2 |
| Minority Share | 5.9 | 1.0 | 4.3 | 7.1 |
| *NATIONAL* | | | | |
| Girls | 50.4 | 1.4 | 46.5 | 54.4 |
| Boys | 49.6 | 1.4 | 45.6 | 53.5 |
| GSP Share | 53.9 | 5.5 | 43.0 | 72.7 |
| VSP Share | 46.4 | 5.5 | 27.3 | 57.0 |
| Minority Share | 7.8 | 6.1 | 1.8 | 35.3 |

*Note: Statistics Norway define both immigrants and children of immigrants (so-called second-generation minorities) as students with a minority background*

The genders are on average split almost 50/50 both in Hordaland and in Norway in general. Although there are some fluctuations around the time of the reform, the same trend appears nationally, and it is hard to tell whether this is a random variation or not. The share of students with a minority background is lower in Hordaland than the national average. This is partly explained by Oslo where the share is about 30 %, almost triple that of any other county. If we disregard this and Akershus county, minority students are evenly distributed among the counties, with Hordaland on an average level. The distribution of students in GSPs and VSPs is similar, but changes after 2005.

## 4.4 Shortcomings

As with any empirical analysis, this thesis is at the mercy of the quality of the data. Although Statistics Norway provide a rich variety of available data, there are some issues that could diminish the robustness of the analysis. Foremost is the level at which the data is aggregated. Ideally, I would have access to the individual register data, which would allow me to track specific cohorts before and after the reform. It would also allow for a richer set of controls on individual characteristics, which could increase the precision of the estimates. The covariates included in the analysis try to emulate the same effect, but are inherently sub-optimal for a comprehensive analysis. When data is

aggregated at the county level it also reduces the possibility of clustering standard errors. Since Norway consists of 19 counties this is also the number of clusters available. In some cases this could be too few to achieve adequate precision of the error terms[26]. Ideally we might have wanted to cluster at the municipality level, which in this case is not possible.

As data on the necessary variables have not been available below the county level, the possibility to study effects within each county is also excluded. It would be interesting, however, to do similar analyses on variations at lower levels, for example within different municipalities, or even city districts. Lindbom and Almgren (2007) emphasize the heterogeneity of the school choice effect between different neighborhoods, while Løddingand Helland (2007) find that downtown high schools are more vulnerable to the admission system than suburban schools. It is very plausible that the effect of school choice is different in rural areas than, say, Oslo and Bergen city center. More detailed geographical data would also allow me to explore the role of commute distances, linked to which students is doing the commuting, as a possible mechanism of increased dropouts. Unfortunately, this, in addition to data on dropout rates for individual schools or neighborhoods, have not been publicly available to access for a Master's student.

[26] The potential pitfall of too few clusters is further addressed in Chapter 5.2.1.

# 5 Research design

My main analysis uses a difference-in-differences approach (DID). Its' popularity among empirical scholars have surged in the last decades, partly following in the wake of the seminal paper from Card and Krueger (1994). Their analysis of a minimum wage hike in New Jersey demonstrated how exogenous policy changes could be exploited as a quasi-experiment, allowing researchers to estimate reform effects. This thesis utilize this substantial body of work, and employs a similar identification strategy. Below, I detail the theoretical foundation for DID-estimation and how it applies to the Hordaland-case.

## 5.1 The identification problem

Reform analysis aims to estimate the effect of treatment on specific groups. A typical research design involves applying such treatment to one group, and comparing the results to a non-treated control group, identifying the difference in outcomes as the treatment effect. However, if covariates that affect the dependent variable of interest also affect whether an observation is placed in the control or the treatment group it could have consequences for the results on which we base our conclusions, as we could have a selection bias problem[27]. An obvious example in this case is comparing dropout rates between students in public and private schools. If the aim is to measure the benefits of attending a private institution it would be hazardous to simply compare students in public and private schools as Böhlmark and Lindahl (2007) and Lødding and Helland (2007) show that these are not necessarily similar groups of students. In many cases, students in private schools stem from backgrounds of higher socio-economic status, and is thus expected to perform better than other students, regardless of institution. By attributing their academic performance to the private school, without controlling for background characteristics, the effect of private schooling might be skewed upwards if those attending private school already have better abilities than their counterparts, and thus would perform better in any setting. A randomized trial eliminates such bias by randomly assigning treatment status in the sample, thus isolating the effect by ensuring that all other variables and characteristics are randomly and

[27] James Heckman has provided comprehensive work on how to detect and abate selection bias in econometric studies. Notable contributions include Heckman (1979) and Heckman (1990). Demaris (2014) provides a practical overview on how Heckman's selection models can combat unmeasured confounding, which he describes as the 'principal threat' to unbiased estimation of treatment effects.

independently distributed between the two groups. Unfortunately for the econometrician random trials are seldom available, both because of the nature of the research topics studied, as well as the scope necessary for such a randomized trial in the school sector. Economic studies often rely on observable data, for which selection and confounding is hard to mitigate a priori. This is also the case for this study, where the conclusions hinges on the assumption that the control group chosen is an adequate approximation of what we would observe in the treatment group had they gone untreated.

A popular second-best solution among social scientists is relying on so-called natural experiments, in which exogenous changes in policy can be exploited as a quasi-random trial with an identifiable treatment effect. Difference-in-differences is a relevant strategy for such a case, assuming that the policy change only affects a sub-set of our observations, or at least not all at the same time. Assuming further that the assignment of treatment is (quasi) random, so that there are no systematic process determining which counties implement school choice at which time (treatment status appears 'as if' random), a suitable non-treated control group allow for the identification of effects. Fuchs-Schündeln and Hassan (2016) discuss the advantages and challenges of the popularity of such natural experiments in economic research[28]. They argue that even though studies of this kind have been instrumental in developing compelling evidence for many economic hypotheses with policy implications, it is not without faults. "The fundamental challenge" they write, "is to argue that the historical episode in question provides the quasi-random variation that is necessary to identify causal effects" (Fuchs-Schündeln and Hassan, 2016 p. 991). To substantiate such an argument, they underscore the need for corroborative evidence and supporting analysis, especially to mitigate concerns regarding the identifying assumptions. Bertrand et al. (2004) questions how much faith we can put in DID-estimates. Their main concern is that such analyses often fail to address inconsistencies in the estimation of standard errors, leading to false significance in the results. To address the issue they stress the need for placebo and robustness testing of both estimates and error terms in order to increase inferential validity. Both concerns are noted and addressed in Chapters 6 and 7.

[28] They define a natural experiment as "historical episodes that provide observable, quasi-random variation in treatment subject to a plausible identifying assumption" (Fuchs-Schündeln and Hassan, 2016 p. 925). The policy change in Hordaland in 2005 fit this description reasonably well.

## 5.2 The difference-in-differences method

Consider an outcome $Y_{ict}$, observed for student group *i*, in county *c*, at time *t*. In this case the outcome corresponds to dropout rates for the given group and *t = year*. Treatment status is assigned with the dummy *D*, with *school choice* being the treatment in question.

$$D_c = \{0,1\}$$
$$\rightarrow Y_{0c} = Outcome\ for\ county\ c \mid D = 0$$
$$\rightarrow Y_{1c} = Outcome\ for\ county\ c \mid D = 1$$

All units could potentially get treatment, but we can only observe them in one state after the treatment has occurred. This implies that $Y_{0c}$ gives the outcome for county *c* if not treated and $Y_{1c}$ is the outcome if treated. We are also interested in the unobserved, counterfactual outcomes. Behind every $Y_{1c}$ there is a potential $Y_{0c}$ that is not realized. Comparing dropout rates in Hordaland before and after the reform is not sufficient. The causal effect lies in the difference between the observable outcomes after treatment, and outcomes that would have been observed had treatment not occurred. The equation of interest is therefore

$$Effect = E(Y_{1ict}|D_i = 1) - E(Y_{1ict}|D_i = 0) \quad (1)$$

which is obviously impossible, since an observation cannot be treated and at the same time *not* treated. A proxy is needed for the counterfactual outcome. Using DID, finding such a proxy consists of identifying a comparable control group to the treated. Ideally, this control group will have a similar distribution of characteristics, so that

$$E(Y_{0ict} \mid \boldsymbol{X}_{ict}, D_{ct}, t) = E(Y_{0ict} \mid \boldsymbol{X}_{ict}, t) \quad (2)$$

implying that treatment status is random, conditional on other covariates (Angrist and Pischke, 2008). Finding a suitable proxy is a key task of any empirical study aiming to use DID. Geographical variations is a popular choice, and the strategy of this thesis' analysis[29]. Generally, we want to compare the treatment group to those who display a similar trend ex ante, but do not receive treatment so that we can estimate (3):

$$DID = E\left(Y_{1ic,post} - Y_{1ic,pre}\middle|D_i = 1\right) - E(Y_{0ic,post} - Y_{0ic,pre}|D_i = 0) \quad (3)$$

[29] This strategy was also used by Card and Krueger (1994), who compared the labor market in New Jersey with neighbor state Pennsylvania which did not increase the minimum wage.

This equation measures the difference between pre-treatment and post-treatment observations for both groups. The difference between these two differences is the effect we are looking for.

The identifying assumption in this approach is that of a 'parallel trend'. In the absence of treatment, the DID-framework assumes that

$$E(Y_{0ict} \mid c, t) = \gamma_c + \lambda_t \quad (4)$$

meaning that the observed outcome is a sum of county specific trends and year effects present among all observations. This implies that the potential outcome of a cohort should be unrelated to the timing of the policy change. Without intervention, the trends should be equal between the treated and the control, though not necessarily in levels.

$$E\left(Y_{0ic,post} - Y_{0ic,pre} \middle| D_i = 1\right) = E(Y_{0ic,post} - Y_{0ic,pre} | D_i = 0) \quad (5)$$

If treatment has effect, Hordaland will deviate from these trends compared to the control group. To identify such an effect, equation (6) is estimated.

$$Y_{ict} = \alpha + \beta D_c + \lambda Post + \delta D_c * Post + \varepsilon_{ict} \quad (6)$$

In this equation *D* is treatment status, *Post = 1* in periods after the reform, with the interaction being the DID-estimator. However, as this estimator only makes the distinction between pre- and post-treatment periods, limited control for overall time trends common for all observations is achieved. When data is available for several periods both before and after, a vector of dummies for each period of time such trends are controlled, leading to more precise estimates of treatment effects. Additionally, one might include a vector of county specific dummies, whose inclusion control for mean differences in dropout rates between counties. In such cases, the estimated equation is

$$Y_{ict} = \alpha + \beta D_c + \sum_{t=1}^{T} \lambda_t T + \delta D_c * Post + \sum_{c=1}^{C} \gamma_c C + \varepsilon_{ict} \quad (7)$$

where **C** and **T** are the vectors for county and year dummies[30]. In some cases an interaction between the two is employed as well, in addition to additional controls for covariates who vary between counties and over time. Several specifications are tested and reported.

[30] This specification is inspired by the one used in Autor (2003).

## 5.3 Issues with standard errors

An important criterion for our confidence in the regression estimates is correct treatment of the standard errors. While the implementation of heteroskedastic-robust errors is almost routine in modern statistical software, they can be "misleading when the asymptotic approximation that justifies these estimates are not very good" (Angrist and Pischke, 2008 p. 293)[31]. In basic cross-sectional analysis we assume that observations represent a random draw from a population, and that they are independent from other observations. However, this will often not be the case, and failure to correct for bias represents a threat to the validity of the inference. Angrist and Pischke (2008) note that the most important form of such correlation arises in the presence of grouping in the data. An example in this case is the dropout rate observed within each county. Since different cohorts of students are exposed to the same environmental inputs we might expect their observed outcomes to be correlated. Another common issue is serial-correlation in observations. When employing time series, an observation one year will often correlate with observation the year before or after. This is especially the case when operating in a DID-framework where the dummy variables are obvious examples of strong serial correlation. As such, researchers should take measures to prevent potential bias in their estimations. Below I detail two approaches to correct issues of the error terms, both of which are included in the robustness tests in Chapter 6.

### 5.3.1 Clustering errors

Autor (2003) provides an example of how grouping of observations might affect a DID-analysis. In his use of data from each state in the US it will be reasonable to suspect that the error term within each state is not independent, but could be serial correlated. If there is correlation *within* each category, but independent *between* them it can be wise to correct by clustering standard errors[32]. Cameron and Miller (2015) note that failure to cluster could lead normal OLS to overestimate the precision of the estimates, and underestimate standard errors[33]. In their illustration of the problem they consider the simple OLS case with one regressor (while assuming $\alpha = 0$ for simplicity)

[31] Angrist and Pischke do however note that robust standard errors improve the performance of estimators as they are asymptotically valid in the case of heteroscedastic errors, which is common in the practical implementation of regression models.
[32] The importance of addressing clustering in a DID-framework is also stressed in Bertrand et. al (2004).
[33] For more in-depth mathematical presentations of the cluster-robust standard error solution, refer to Cameron and Miller (2015), Cameron et. al. (2008), or White (1984).

$$y_c = \beta x_c + u_c, c = 1 \dots N \quad (8)$$

Under the normal Gauss-Markov conditions for linear regression we assume that $E[u_c] = 0$. If so is the case, the OLS estimator $\hat{\beta}$ can be expressed as $\sum_c x_c y_c / \sum_c x_c^2$. The residual of the estimate is then $\hat{\beta} - \beta = \sum_c x_c u_c / \sum_c x_c^2$. This implies that the variance of $\hat{\beta}$ is equal to the expected value of the squared residual.

$$V(\hat{\beta}) = E\left[(\hat{\beta} - \beta)^2\right] = V[\sum_c x_c u_c]/[\sum_c x_c^2]^2 \quad (9)$$

In the case of uncorrelated error terms between counties, $V[\sum_c x_c u_c] = \sum_c x_c^2 V[u_c]$. Assuming further that the errors are homoscedastic, so that $V[u_c] = \sigma^2$, we get the familiar result of (9) simplifying to $V[\hat{\beta}] = \frac{\sigma^2}{\sum_c x_c^2}$. If, however, errors are correlated, we get bias in the variance estimates. Assume we have observations *c* and *c'*. In the correlating case, the variance for *c* will be given by

$$V[\Sigma_c x_c u_c] = \Sigma_c \Sigma_{c'} Cov[x_c u_c, x_{c'} u_{c'}] = \Sigma_c \Sigma_{c'} x_c x_{c'} E[u_c u_{c'}]$$

$$\xrightarrow{yields} V_{cor}(\hat{\beta}) = [\sum_c \sum_{c'} x_c x_{c'} E[u_c u_{c'}]] / [\sum_c x_c^2]^2 \quad (10)$$

For clustered errors, a rewrite of (10) can be useful. We assume that $E[u_c u_{c'}] = 0$, unless *c* and *c'* belong in the same cluster. Hence, we write (10) as

$$V_{clu}(\hat{\beta}) = [\sum_c \sum_{c'} x_c x_{c'} E[u_c u_{c'}] \mid (c \; and \; c' is \; in \; same \; cluster)] / [\sum_c x_c^2]^2 \quad (11)$$

We will typically find that $V_{clu}(\hat{\beta}) > V(\hat{\beta})$ as un-clustered errors tends to have a downwards bias (Cameron and Miller, 2015 p. 321). A critical consequence is the tendency to over-reject null-hypotheses under a normal t-distribution test for significance when we fail to address within-cluster correlation[34]. By estimating (11) rather than (9) we obtain cluster-robust (and heteroscedastic-robust) standard errors. Cameron and Miller suggest clustering on the level at which you believe the observations to be independent, which suggests that time units are unfitting. In the case of this thesis, clustering at the county level seems natural. Chapter 4 demonstrates how there are some general differences in dropout rates between counties, which could suggest that the dropout rate for different cohorts within the same county is correlated. There is however little to suggest that error terms are correlated between counties.

[34] In a t-test, the critical value for rejection of a null-hypothesis at the 5 % significance level is typically $\hat{\beta} \pm 1.96 \; x \; standard \; error$, which underscores the importance of obtaining precise error terms.

A second concern when clustering errors is the number of clusters. Cameron and Miller proclaim that "more is always better" to ensure that the asymptotic properties are realized, and that there are no definitive answers on how few is too few. A problem is the tendency of OLS-estimators to 'over-fit' data when using too few clusters, with narrow confidence intervals and over-rejection of null-hypotheses as a consequence. Angrist and Pischke (2008) note that this can be a result of the serial correlated shocks being underestimated, meaning that inference on estimated coefficients is problematic. Consider the standard Wald t-statistic $w = \frac{\hat{\beta}-\beta}{s_{\hat{\beta}}}$ where $s_{\hat{\beta}}$ is the square root of $V_{Clu}(\hat{\beta})$ from (11). Assuming there are *G* clusters, $w \sim N(0,1)$ only when $G \to \infty$. In the case of low *G*, asymptotics are not yet realized, which could mean that the variance has a downwards bias (Cameron and Miller, 2015 p. 340). The current consensus of 50 clusters for the typical state-year panel data of DID-analyses have been shown to perform reasonably well, but the results become more unclear as the clusters decrease towards zero. Bertrand et. al (2004) and Cameron et. al (2008) show that tendencies of over-rejection appear when clusters drop below 30, and increases for lower numbers of clusters. There are however no 'cut-off' at which the number of clusters become too low, and Cameron and Miller stress that it must be considered on a model-to-model basis. Hence, there is not necessarily a problem of using 19 clusters, as is the case of this thesis, but that researchers should be aware of the potential pitfall.

### 5.3.2 Bootstrapping

The standard parametric assumptions of statistical inference postulate that a sample drawn from a population follows a known probability distribution. By repeatedly drawing samples from the same population, the parametric model assumes that the statistic of interest, like the coefficient, will be the same every time. However, since the sample will vary with each draw, so will the statistic, giving rise to the sampling distribution. In cases where the assumptions about the sampling distribution is questionable, for example when errors are not normally distributed, a bootstrapping procedure might improve performance of the estimator.

The aim is to simulate the possible randomness underlying the observations. In a basic regression model the only random element is the error term, which is often the basis for

such bootstrapping. In practical terms, consider our sample *N*. In a bootstrap we treat *N* as the population and repeatedly draw from it (with replacement), constructing a sampling distribution in the process. Angrist and Pischke (2008) note that, intuitively, this provides a reasonable approximation of the distribution we're after. Using this approximation we can estimate the properties of an estimator, like its variance. Because the true population is unknown, the true error term of the sample is uncertain. However, when we treat *N* as the population, the 'true' error is measurable because the population is known. This means that we approximate the standard error of the true distribution with the errors of the re-estimates of the fitted model. Thus we can assess the quality of our inference on the resampled data. It's validity for the true population is conditional on the sampling distribution obtained from resampling *N* being a reasonable approximation. If implemented correctly, bootstrapping can therefore improve inference, for example by reducing bias in the normal, robust standard errors. Adèr et al. (2008) suggests that bootstrapping can be especially useful when the sample size is small, which we might suspect could be the case here. In Chapter 6 I employ what is commonly known as a non-parametric bootstrap, where you repeatedly draw pairs of the dependent variable and the regressor from *N*, with results posted in Table 9.

## 5.4 The synthetic control method

If adequate control groups are not available, a synthetic one might be constructed. This method was pioneered by Abadie and Gardeazabal (2003) who questioned the suitability of more or less arbitrary control groups as the proxy for the counterfactuals of the treated. They proposed an approach where instead a usable control is designed based on a 'data-driven selection procedure'[35]. By employing a weighted average of observable control units, a hypothetical group is constructed to best approximate the treatment group in the period before treatment occurs. The control variables utilized are chosen based on their relative similarity to the treatment group, and relevance for determining pre-treatment outcomes. When implemented correctly, the authors argue that such a synthetic group can achieve a better extrapolation of counterfactual outcomes than observed groups of untreated.

[35] The design of the method, as well as its practical application for statistical software, is further discussed in Abadie et. al (2011).

In the case of the Hordaland reform we observe $c = 1,\ldots,19$ counties in the period 2000-2010. For ease of notation, refer to the time periods as $t = 1,\ldots,T$ and assume that *Hordaland* = $c = 1$. Treatment is introduced at time period $T_0+1$, so that we have $1,2,\ldots,T_0$ periods to construct the synthetic group from, and $T_0+1$, $T_0+2,\ldots,T$ post-treatment periods. Define $U_c$ as a vector of the observed characteristics for each county[36]. In addition, the vector $K = (k1,\ldots,k_{T0})'$ contains linear combinations of outcomes in the years 2000-2004, so that $\bar{Y}_c^K = \Sigma_{s=1}^{T_0} k_s Y_{cs}$, where *s* refers to pre-treatment time periods. Assume we use *M* pre-treatment outcomes, where $M \leq T_0$[37]. With these controls, $j = 2,\ldots,19$ donor counties, and $s = 1,2,\ldots T_0$ pre-treatment periods, a synthetic control group can be constructed. The process consists of choosing a vector of weights, $W = (w_2,\ldots,w_{19})'$ where $w_c \geq 0$ for all donor counties so that $\Sigma_{c=2}^{19} w_c = 1$. Obviously, there are many combinations of weights that satisfies this condition. The objective of the method is hence to choose the ideal set of weights *W** that is the best approximation of the treated group. To achieve this, combine the characteristics of Hordaland in a *(k x 1)* matrix $X_1 = (U_1', \bar{Y}_1^{K_1}, \ldots, \bar{Y}_1^{K_M})'$, and those of the control units in a *(k x 18)* matrix, where for the *c*-th row $X_0 = (U_c', \bar{Y}_c^{K_1}, \ldots, \bar{Y}_c^{K_M})'$. The optimal synthetic control is then that whose vector *W** minimizes the difference between the treated and the control, formally expressed as $\|X_1 - X_0 W\|$. To minimize the mean square error, optimal weights is obtained by solving

$$\|X_1 - X_0 W\| V = \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \tag{11}$$

In (11), *V* refers to a *(k x k)* matrix containing different weights for the variables in $X_1$ and $X_0$, where the optimal choice of *V* identifies *W**[38]. The resulting synthetic group is the optimal combination of covariates and pre-treatment outcomes within the limits of the available data. By doing so, the initial equation of interest, (1), can be rewritten to

$$\widehat{Effect} = (Y_{1t}|D_i = 1) - (\Sigma_{c=2}^{18} w_c^* Y_{ct}|D_i = 0) \tag{12}$$

[36] Refer to Chapter 4 for details.
[37] Adding such outcomes is similar to controlling for county specific effects in section 5.2
[38] A suggested procedure for choosing the optimal *V**, which is implemented as default in Stata, is described in Abadie and Gardeazabal (2003), and Abadie et. al (2010).

In my analysis, I construct a hypothetical Hordaland based on the covariates described in Chapter 4. Using background characteristics from PP-counties, as well as the composition of the student mass I design a control group for each of the four students group on which the focus of my analysis lay. This includes median income, the share of minority students, the share of vocational students, the share in private schools and the level of education in the population. All of these can be assumed to be predictors of the dropout rate in a given county, which makes them suitable variables for this method. The observed dropout rates from the last three years leading up to the reform is also included for increased precision. Table 6 reports the estimated values for the covariates of the synthetic group and compare them to Hordaland[39]. It appears as the synthetic GSP-groups provide better approximations than the VSP-counterparts, although both are reasonably close to the factual treated group. When comparing the pre-treatment dropout rates, which differed quite a lot for VSPs, we see from the final three rows that the estimated dropouts for the synthetic VSPs are closer to treated ones. They are however not perfect, with a divergence of several percent appearing closer to the year of the reform. For GSPs, the dropout rates are better fitted, and almost identical for the girls. Two covariates distinguish themselves as explanatory variables for which Hordaland differs from other counties. In Row 2 and 4 we see that no comparable donors are found for the share of minority students or the share of students in private school. For the former, Hordaland stands out with an unusually low rate compared to other counties, while for the latter we see that private schools holds a significantly larger share of the educational market. Similar discrepancies were found using the full sample. If these are crucial determinants of dropout rates this could be cause for concern for the validity of the results. On the other hand, the fit of pre-treatment trends, at least for GSPs, is encouraging.

[39] The practical implementation of the method was achieved by using the *Synth* Stata-package created by Abadie et. al (2011).

***Table 6: The suitability of the synthetic control group***

| **Donors: PP-counties** | (1) Boys GSP | | (2) Boys VSP | | (3) Girls GSP | | (4) Girls VSP | |
|---|---|---|---|---|---|---|---|---|
| | *Treated* | *Synthetic* | *Treated* | *Synthetic* | *Treated* | *Synthetic* | *Treated* | *Synthetic* |
| Median income | 225775 | 220400 | 225775 | 206981 | 225775 | 220090 | 225775 | 225427 |
| Share of minority students | 4.8 | 6.3 | 4.8 | 5.7 | 4.8 | 6.2 | 4.8 | 6.7 |
| Share in vocational programs | 46.8 | 47.3 | 46.8 | 51.4 | 46.8 | 47.2 | 46.8 | 46.8 |
| Share in private school | 8.3 | 5.5 | 8.3 | 4.2 | 8.3 | 5.8 | 8.3 | 4.7 |
| Share with compulsory school | 30.6 | 31.8 | 30.6 | 31.8 | 30.6 | 31.7 | 30.6 | 33.3 |
| Share with High School education | 45.3 | 45.2 | 45.3 | 48.2 | 45.3 | 45.0 | 45.3 | 44.0 |
| Share with short College education | 18.8 | 17.6 | 18.8 | 16.7 | 18.8 | 17.7 | 18.8 | 17.4 |
| Share with long College education | 5.4 | 5.4 | 5.4 | 3.4 | 5.4 | 5.6 | 5.4 | 5.3 |
| Dropouts (2004) | 7.5 | 7.9 | 23.9 | 29.5 | 5.2 | 5.2 | 22 | 23.9 |
| Dropouts (2003) | 8.9 | 8.5 | 25.8 | 29.3 | 4.7 | 4.7 | 19.9 | 22.2 |
| Dropouts (2002) | 8.6 | 9.0 | 26.3 | 27.9 | 5 | 5.3 | 21.4 | 21.5 |

*Note: A comparison between the factual data for Hordaland, and the estimated data for the synthetic control utilized.*
*All numbers except 'Median Income' represent percentages. The former is given in total number of Norwegian kroner.*

# 6 Results

This chapter discusses the results from the regression analysis described in chapter 5. First I explore the assumption of parallel trends by looking at the graphical evidence. I then discuss how the trends in dropout rates in Hordaland changed noticeably from other counties in the years following the reform. Regression results from the difference-in-differences estimation follow in section 6.2. To validate, I put these results through a series of robustness tests. This includes exploring the possibility of placebo effects, as well as the timing of trend deviations. Lastly, I discuss whether the results from Hordaland can be applicable in a general context.

## 6.1 The suitability of the control groups

The identification of causal effects in comparative analyses like DID hinges on the comparability of the control group. When using quasi-random natural experiments, the critical assumption is that of a parallel trend between the treated and the control in the periods leading up to the treatment (expressed in equation (5) above). If this condition is not satisfied, our assertion that the control group provides an adequate proxy for the unobserved counterfactual of the treated is at best questionable. In the analysis I employ three different controls, with an increasing level of precision. The first is comparing Hordaland to the national trend, using the full data sample as the control group. This includes both counties with and without school choice systems, in addition to the switchers. As the discussion in Chapter 4 illustrated, Hordaland is similar to national averages on many of the covariates which we can assume are predictive of dropout rates. However, using this specification we assume that there is an overall national trend, common among all counties, from which Hordaland deviates in the case of treatment effects. A better approach might be comparing Hordaland to those who continue using the proximity principle throughout the entire period (the PP-counties). As these counties never receive treatment, a deviation in trend post-2005 could identify effects on Hordaland. The third control employed is the synthetic method detailed in Chapter 5. This might represent the best fitted pre-treatment trends, but comes with other complications, which are discussed in 6.2. To explore the common trend assumption, graphical analysis is typically used (Angrist and Pischke, 2008).

### 6.1.1 Graphical analysis of dropout trends

Throughout the 2000's, dropout rates were declining. Figure 3, Panel A shows a positive development for both Hordaland and Norway as a whole. However, we note that the dropout rate in Hordaland peaks in 2005 at the implementation of the reform, deviating from the overall trend. Keep in mind that the dropout rate of this cohort is measured in 2010, meaning that the peak occurs for the first batch of students starting their high school education after the reform is in effect. While the national rate exceeds Hordaland for the entire period, they converge towards the end, with the difference between them halved in the span of ten years.

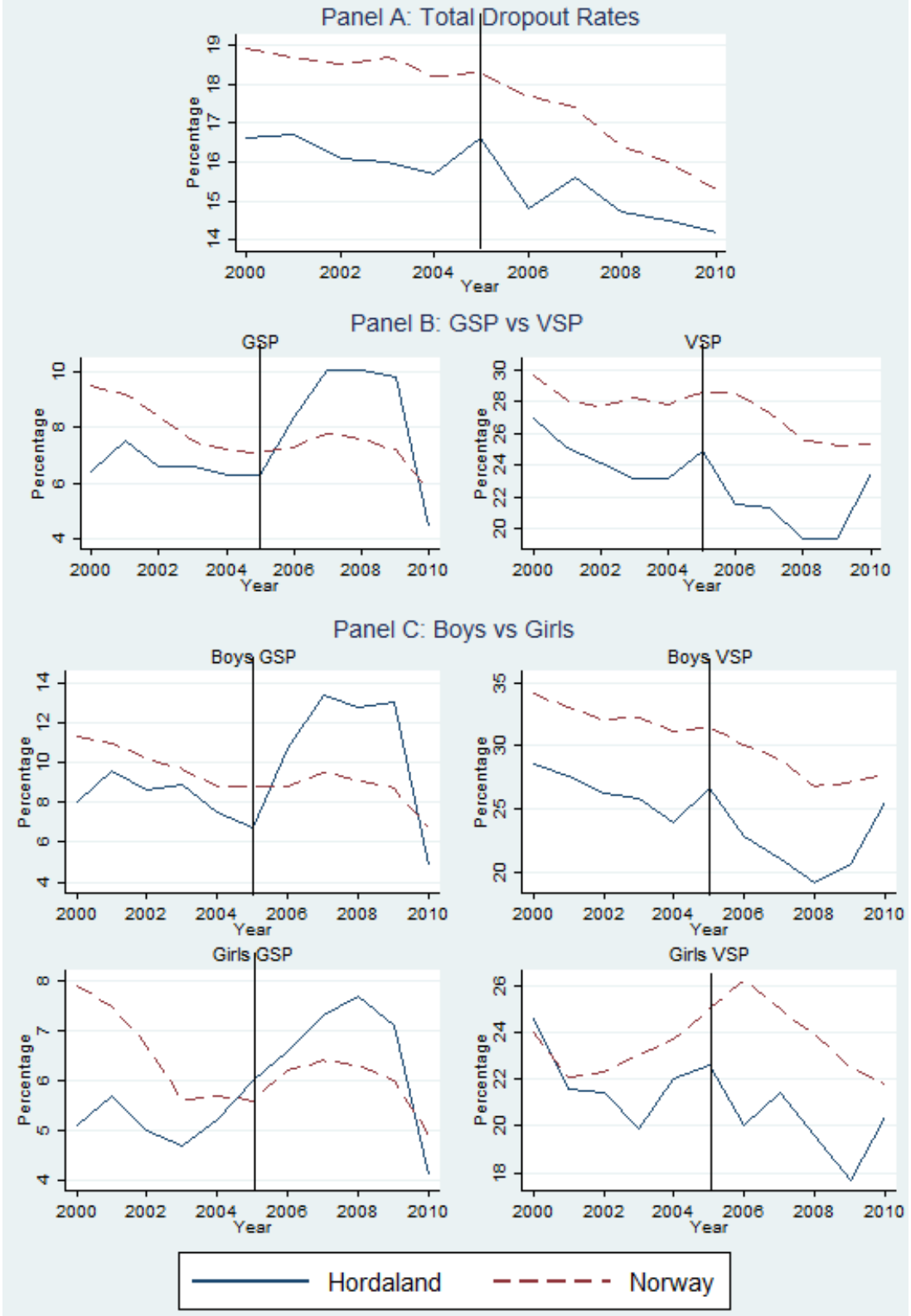
In Panel B I illustrate the difference between GSP- and VSP-students. As expected, VSP-students drop out at a far higher rate than their counterparts. In Hordaland, both groups drop out less than the national rate at the start of the period. Contrary to the rest of the country though, there is a sharp increase in dropouts among students in the academic track after 2005, with a corresponding decrease among students in vocational tracks. The VSP-rate actually peaks in 2005, but then declines steadily in the following years. These results are interesting as it could indicate that the different groups respond differently to increased choice. The increase in dropouts among GSP-students is striking, and seem to be the driving factor behind the spike in the overall rates.

The trend is more pronounced when separating the genders (Panel C). In Hordaland, both boys and girls in academic track education see an increase in dropouts after the reform. The effect is demonstrably larger for boys though, where the rate increases from 6.7 to 10.7 % from the 2005 to the 2006 cohort, and peaks in 2007 at 13.4 %. In other words, two years removed from the reform we observe a dropout rate almost double that from prior cohorts. The effect on girls is strong as well, though less substantial than for boys. From 2005 to the peak in 2008, the dropout rate for female GSP-students increase from 6 to 7.7 %, though the increasing trend seem to begin a few years prior to the reform. Conversely, we observe a decline in VSP-dropouts, for both genders. By 2008, the rate has gone down by 7.5 % for boys and 3 % for girls. An interesting point is observed in the difference between the study tracks for male students. Initially at 20 %

at the introduction of the reform, the program gap is reduced to only 6.4 % in 2008, the smallest margin of any county at any time in the sample.

Similar trends are not observed at the national level. In Panel B we see that the national rate have tendencies of the same development as in Hordaland, though much more modest. Where the trend in Hordaland changes sharply in the second half of the period, the national rate have small variations from year to year. The gender-specific panel show that the male rate for GSP is relatively stable, while the rate for VSP declines 6.4 % over the period. While the former shows a definitive deviation in trend for Hordaland, the latter seem to be more in accord with the national rate. The sudden change post-reform is not as apparent for VSP-males as some of the other groups. Similar to their male counterparts, girls in general studies programs have an increased dropout rate after 2005, similar too, though more modest, than Hordaland. The girls in vocational studies see an increase in the first half of the period, with a corresponding decline in the second half. In comparison, the Hordaland time series seem much more variable, perhaps a sign of limited data as this is by far the smallest group. We should note that there is reason to be concerned about the common trend assumption for some of the groups. From Panel C Column 2, it seems that comparing Hordaland to the national sample may not provide an adequate control group, especially for the girls. Similarly, the pre-treatment trend for girls in GSPs is not ideal. However, it is more so for the boys in both cases, for whom compelling changes in trends are observed in the wake of the reform.

# Figure 3: Comparing dropout rates




Note: Time series of percentage dropouts, reported for Hordaland and Norway as a whole
GSP: General Study Programs
VSP: Vocational Study Programs

### 6.1.2 Graphical analysis of the synthetic control

To abate possible issues with the common trend assumption, comparing the Hordaland to the synthetic control group might shed more light on what happened after the reform. When implemented correctly the synthetic control gives the best approximation of what we could expect from Hordaland in the years 2005-2010, had they not switched to a school choice system. The estimated trend of 'Synthetic Hordaland' is illustrated in Figure 4. As discussed in 5.2.2., the panels demonstrate that some control groups are better fitted than others, with perhaps 'Boys VSP' being the least matching. For this group it is easy to spot deviations from the estimated trend. The best control groups are designed for the GSP groups, where pre-reform trends are generally parallel. For both boys and girls we see that the actual dropout rates observed in Hordaland exceed those estimated for the synthetic control. This implies, as above, that the reform worsened dropout rates for these groups, with the boys taking the hardest hit. In the latter case, the estimated trend is relatively stable, while observed rates are not at all. For female VSP-students we see a substantial reduction in dropouts compared to the synthetic group. As in Figure 3, the interpretation for the total dropout rates remain inconclusive. Although, there are some spikes and lows in the observed rate, the overall trend seem to match the synthetic group. It is perhaps, reasonable to assume that when the effect could be different for the different study tracks that the overall net effect is ambiguous. Overall, Figure 3 and 4 suggests that the change in post-reform trends are most apparent for GSP-students. Those in vocational tracks lack suitable control groups which would allow for identification of treatment effects. This issue is not abated by the implementation of synthetic control groups.

# Figure 4: Synthetic Control


Note: Time series comparison of Hordaland and the synthetic control
Dropout percentages reported

## 6.2 Basic regression results

Here, the results from the DID-analysis discussed in chapter 5 are reported. In line with the issues discussed above, estimations for VSPs and the overall rates did not yield valid results, failing multiple robustness tests. The framework could not identify the presence, or lack, of effects in a way that would lead to meaningful inference. Hence, the study focus on GSP-students. A concern in this analysis is the potential for selection from VSP to GSP after the reform. It may not be unreasonable to assume that some students who previously chose *not* to attend an academic track program, perhaps because they didn't care for their neighborhood school, are more likely to apply to GSP-schools after school choice is introduced. If so, the composition of the student mass post-reform might be skewed, which could exacerbate the effects of the reform if these students are more likely to drop out (or vice versa). Figure 1 illustrated a sharp increase in GSP-attendance in the latter half of the 00's. However, the same trend was apparent nationally, which indicates an overall shift in preferences not linked to the reform. To explore, I carried out a preliminary test where the reform effect on the share of students in academic programs was estimated using a similar DID-framework as the main analysis. No significance was found in the test, with an estimated p-value of 0.362[40]. Nevertheless, the concern should not be put to rest conclusively, but urge us to remain cautious of the inference of the analysis.

Table 7 lists the baseline results. In the first estimations, no additional controls are used other than those of a standard DID-specification, as formulated in (6). However, I employ some tweaking in the level of trend control, and utilize three different variations of control groups. Panel A compares Hordaland to the national rate, where the coefficients listed refers to the difference-in-differences estimator (*post x treatment*). In Column (1) the specification simply makes the distinction between pre-treatment and post-treatment periods. The first row for this column reports an estimated coefficient of 2.749 for boys in general study programs, which is significant at the 10 % level (with a p-value of 0.064). This implies that the introduction of school choice raised dropout rates for this group by multiple percent compared to the national trend.

[40] Estimated treatment effect on share of GSP-students:
$\hat{\beta}$ = 1.60 SE = 1.75 P-value = 0.362  95 % CI = [-1.86 , 5.06]

## *Table 7: Estimated impact of the reform*

**Panel A: Full sample**

| Post x Treatment | (1) | (2) | (3) |
|---|---|---|---|
| Boys | 2.749* | 2.749** | 1.749 |
| | (1.470) | (1.346) | (3.188) |
| Girls | 1.229** | 1.229*** | 1.436* |
| | (0.578) | (0.464) | (0.790) |
| County and year dummies | No | Yes | Yes |
| County x Year trends | No | No | Yes |
| Test for difference (P > χ2) | 0.134 | 0.107 | 0.895 |
| Observations | 209 | 209 | 209 |

**Panel B: PP-counties only**

| Post x Treatment | (1) | (2) | (3) |
|---|---|---|---|
| Boys | 2.802* | 2.802* | 1.794 |
| | (1.494) | (1.411) | (3.230) |
| Girls | 1.228** | 1.228** | 1.464* |
| | (0.594) | (0.474) | (0.805) |
| County and year dummies | No | Yes | Yes |
| County x year trends | No | No | Yes |
| Test for difference (P > χ2) | 0.128 | 0.134 | 0.895 |
| Observations | 110 | 110 | 110 |

**Panel C: Synthetic control**

| Post x Treatment | (1) | (2) | (3) |
|---|---|---|---|
| Boys | 2.500 | 2.500 | 2.418 |
| | (1.586) | (1.463) | (3.696) |
| Girls | 0.913 | 0.913 | 1.621 |
| | (0.611) | (0.619) | (1.173) |
| County and year dummies | No | Yes | Yes |
| County x Year trends | No | No | Yes |
| Test for difference (P > χ2) | 0.131 | 0.014 | 0.656 |
| Observations | 22 | 22 | 22 |

*Note: Robust standard errors reported in parentheses.*
*The χ2-test measures if the coefficient for boys and girls are significantly different.*
*1 star = significant at the 10 % level, 2 stars = 5 %, 3 stars = 1 %*

Similarly in Row 2, the estimated coefficient for their female counterparts is 1.229, which is a weaker effect than the boys. The estimates for the girls is significant at the 5 % level. In general, these results imply that academic track students responded negatively to increased choice and competition, and more so for boys than for girls. However, when testing for significant differences in the estimates for boys and girls, we cannot reject the null hypothesis of no difference, even at the 10 % level (Row 5). Therefore we cannot safely rule out the possibility that the higher estimates for boys are random variations.

Column (2) estimates the same model using vectors of county- and year-specific dummies. This allows for control of mean differences in dropouts between counties, as well as overall year effects common among all observations. Using these controls do not change results drastically, suggesting that the initial specification is a reasonable approximation. Noteworthy is the fact that by employing this specification the precision increases. The estimates for boys and girls are significant at the 5 % and 1 % level respectively. This could indicate that these dummies help reduce noise from the time series, better identifying treatment effects.

Column (3) employs both the dummies from Column (2), and dummies for county x time interactions, controlling for county-specific time trends as well. Using this specification the estimated coefficients for male GSP-students the coefficient is reduced to 1.749. For the girls in academic track studies, however, the effect is stronger than for Columns (1)-(2) by about 0.2 percent. Standard errors greatly increases in this model, limiting the girls' coefficient to significance at the 10 % level. For the boys, the error term more than doubles, and no significance is consequently found. Thus, when including county-specific trends the effect of school choice reform on dropout rates cannot be measured with the same precision. A similar modelling issue is encountered by Besley and Burgess (2004), though on an unrelated issue. They argue that this could suggest that observations who display similar patterns in the policy of interest also have similar long-term trends. Thus, it might be school choice reforms driving the growth of these trends. On the other hand, it could also imply that there is difficulty in isolating the effect of the reform itself from other factors that might influence both the dropout

rates and whether school choice is allowed. In Besley and Burgess' case the DID-coefficient drops to zero, which indicates that no effect could be identified. This is not the case here, where a reasonably sized effect is estimated, but it cannot be done accurately. Hence we cannot exclude the possibility of the result being due to random shocks. A sample of 19 counties and 11 year might not be enough to achieve an asymptotic distribution in the presence of such county specific shocks[41].

Panel B narrows the control group to counties that employed a proximity principle throughout the entire decade, consequently reducing the number of control counties to nine[42]. Columns (1), (2) and (3) employs the same specification as for Panel A. From Table 7 we see that results do not differ greatly. In Column (1) we find the same significant effect as in Panel A, with a slightly higher coefficient for the boys. Column (2) posts estimates with a minor increase in standard errors, while we find similar issues as for Panel A in Column (3). Significant differences between the genders are not found in Panel B either, with p-values for Columns (1) and (2) at ~ 0.13. Overall there is not much difference in whether we use the full sample of all 19 counties, or limiting the control group to only PP-counties. Since the full sample is an adequate approximation and provides a larger sample size this specification is preferred in subsequent testing.

In the final panel, I estimate the model using the synthetic control group constructed based on covariates. Since this control is a weighted combination of the most fitting PP-counties, Hordaland is only compared to one other county. As such, the number of observations is reduced to 22 (one for each year, for each county). Panel C reveal that none of the estimations are significant using this approach. We do however see that the coefficients estimated are relatively similar to Panels A and B, but the standard errors are considerably larger, meaning that with cannot safely reject the null hypothesis of no effect. In this case, we could suspect the lack of precision in the estimates to stem from the limited number of observations. For example, Harrell Jr (2015) suggests that to expect a reasonable identification of effects, an model should contain 10-20 observations for each parameter estimated. The estimation in Panel C barely meet this

[41] Angrist and Pischke (2008) further details how such shocks can be problematic for DID inference.
[42] In this case: Østfold, Hedmark, Buskerud, Telemark, Vest-Agder, Sør-Trøndelag, Nord-Trøndelag, Nordland and Troms.

criterion, and tells us little about the effect that I aim to measure. Though the size of the estimated effect could be interpreted as encouraging, the results in this panel cannot be regarded as evidence in either direction.

## 6.3 Robustness tests

In this section, I provide a number of tests to substantiate the results in 6.2. If the results remain consistent with what is reported above, it may increase our confidence in the link proposed between school choice and dropout rates.

### 6.3.1 Additional controls

Firstly, I add additional controls to the basic regression analysis. By adding a vector of background characteristics we allow for more precision in the estimates, reducing the chance of confounding in the results. Table 8 lists the results with additional controls. In this specification, I've chosen to control for several of the background characteristics discussed in Chapter 4. This entails the inclusion of the percentage share of students with a minority background (Row 3), the share of students attending a private school (Row 4), the share of students participating in a vocational track program (Row 5), and the level of education in the population (Row 6-9). In addition, I've included the log of median income (Row 2) to control for changes in the overall wealth level in the county. The estimation is carried out using the same trend control as Column (3) of Table 7, meaning that time and county dummies plus the interaction is included. Columns (1) and (3) lists the baseline results from the previous estimation, while Column (2) and (4) reports estimates with additional controls for boys and girls respectively. The estimates remain consistent with the results from 6.2, with only a slight reduction in the coefficients of interest. Standard errors are reduced compared to Table 7, implying that by adding these controls we increase the precision of the estimates. The errors for boys are still fairly large, and it is possible that there are other confounding variables that are not included in this test. However, as before the coefficient for boys is found to be higher than for girls. Considering the theoretical assessment of school choice discussed in the literary review, this is in line with what we might expect. In general, it is a positive sign that the results from this test do not differ greatly from the results in 6.2.

***Table 8: Additional controls[43]***

| **Boys** | (1) | (2) | **Girls** | (3) | (4) |
|---|---|---|---|---|---|
| Post x Treatment | 1.749 | 1.663 | | 1.436* | 1.139* |
| | (3.188) | (2.268) | | (0.790) | (0.681) |
| Log of median income | | 56.596* | | | 36.776* |
| | | (29.744) | | | (19.490) |
| Share of minority students | | 0.297 | | | 0.259* |
| | | (0.208) | | | (0.133) |
| Share in private school | | 0.201 | | | -0.031 |
| | | (0.178) | | | (0.140) |
| Share in vocational programs | | -0.375*** | | | -0.329*** |
| | | (0.122) | | | (0.070) |
| Share with compulsory school | | 2.144 | | | -1.888 |
| | | (2.891) | | | (1.806) |
| Share with High School education | | -2.606 | | | -1.343 |
| | | (2.737) | | | (1.762) |
| Share with short College education | | 3.806 | | | 0.825 |
| | | (2.853) | | | (1.671) |
| Share with long College education | | 0.928 | | | -1.404 |
| | | (3.381) | | | (2.195) |
| County and year dummies | Yes | Yes | | Yes | Yes |
| County x Year trends | Yes | Yes | | Yes | Yes |
| Observations | 209 | 190 | | 209 | 190 |

*Note: DID-coefficient is estimated with county and year dummies, and time trends. Robust errors in parentheses.*
*As some of the covariates only had data from 2001 onwards, this estimation has 19 fewer observations*
*1 star = significant at 10 % level, 2 stars = 5 %, 3 stars = 1 %*

With regards to the covariates there are some interesting results. For instance, Row 3 show a positive correlation between the share of minority students and the dropout rates. This result is to be expected considering the studies discussed in the literary review where minority students, on average, were found to perform worse than native students (Lindbom, 2010). Hordaland's low share of minority students (4.2 % at the time of the reform, compared to 10 % nationally) might partly explain why dropout rates in general were lower than the national average. However, the effect is imprecisely measured. Interestingly, we also observe no significant effect from the share of students

[43] Only the test employing the full sample is reported in Table 8. A similar test using the PP-county specification did not differ in results.

in private schools. As previous studies have found, this group tend to outperform public school students, and as such should warrant a lower dropout rate, all else equal. This is not the case in this sample, and neither when looking specifically at Hordaland, which is somewhat surprising. It could be an indication of a lesser degree of academic segregation in Norwegian private schools than in other countries, partly explained by the fact that the majority of private institutions remain religious and pedagogical alternatives, and not direct competitors to public schooling per se. On the other hand, the amount of students in vocational tracks seem to have a positive effect on GSP-students, reducing the dropout rate by -0.375 for boys and -0.329 for girls respectively. A central hypothesis in this thesis is that the competition spurring from school choice is disadvantageous towards academic tracks which are the most popular and thus faces the most competitive environment. If this is the case an increase in the share vocational track students should serve to decrease competition as fewer students compete for the same spots in GSPs, and in return reduce dropouts.

### 6.3.2 Robustness of error terms

In this test I employ the different strategies for correct estimation of the standard errors, detailed in Chapter 5. All three specifications from Table 7 are run, using the full sample as control. In Panel A the previously reported results from the baseline estimation are restated for comparison. Panel B displays results from regressions using clustering at the county level, which according to the discussion in 5.3.1. should be a natural level at which to cluster. By allowing for within-cluster correlation we observe that all estimations are found to be strongly significant, even for very high levels of confidence. At face value this might seem reassuring, but there are some troubling signs when using this strategy. Most notably, standard errors are drastically lowered in Panel B where clusters are used. This is opposite of what should be expected beforehand, and might suggest that the model is not suitable for clustering. An obvious suspect is that the number of clusters is too low. Cameron and Miller (2015) point out that this can be overcome by having many observations per cluster. However, this might not be the case here either. With few clusters and limited observations, asymptotics have not kicked in, which could lead to the estimated variance, $V_{clu}(\hat{\beta})$, being downwards-biased (Cameron and Miller, 2015 p. 340).

***Table 9: Testing different standard error-strategies***

**Panel A: Baseline**

| Post x Treatment | (1) | (2) | (3) |
|---|---|---|---|
| Boys | 2.749* | 2.749** | 1.749 |
| | (1.470) | (1.346) | (3.188) |
| Girls | 1.229** | 1.229*** | 1.436* |
| | (0.578) | (0.464) | (0.790) |
| County and year dummies | No | Yes | Yes |
| County x Year trends | No | No | Yes |
| Observations | 209 | 209 | 209 |

**Panel B: Clustering**

| Post x Treatment | (1) | (2) | (3) |
|---|---|---|---|
| Boys | 2.749*** | 2.779*** | 1.741*** |
| | (0.311) | (0.316) | (0.474) |
| Girls | 1.229*** | 1.275*** | 1.431*** |
| | (0.234) | (0.242) | (0.409) |
| County and year dummies | No | Yes | Yes |
| County x year trends | No | No | Yes |
| Observations | 209 | 209 | 209 |

**Panel C: Bootstrap**

| Post x Treatment | (1) | (2) | (3) |
|---|---|---|---|
| Boys | 2.749* | 2.749* | 1.749 |
| | (1.583) | (1.429) | (4.646) |
| Girls | 1.229* | 1.229** | 1.436 |
| | (0.636) | (0.515) | (1.370) |
| County and year dummies | No | Yes | Yes |
| County x Year trends | No | No | Yes |
| Observations | 209 | 209 | 209 |

*Note: Standard errors in parentheses.*
*1 star = significant at 10 % level, 2 stars = 5 %, 3 stars = 1 %*

They go on to discuss that when employing too few clusters, the OLS estimator could resort to 'over-fitting' of the model, systematically estimating errors too close to zero compared to the true error term. In Table 7 Column (3) we saw that including county specific trends led to sharp increases in the error terms, especially for boys. Results

from Panel B of Table 9 indicate that clustering the error terms leads the model to over-fit this variability, which in turn could mean that the standard errors are greatly underestimated. It could also be put into question whether the county is an adequate level to cluster over. Effects might differ significantly in different parts of each county, specifically in the urban vs rural dimension. It might be unreasonable to assume within-correlation for a county as a whole, if the correlation is in fact between smaller units. You could also argue that the municipalities containing large cities might have more in common with each other, than the more rural municipalities in the same county. A better option, had it been available, could seemingly have been to cluster over municipality, or even district, instead. The result is that the seemingly significant result from the cluster model should be interpreted with caution, and hardly as an improvement of the baseline results.

Panel C report results using the bootstrap procedure outlined in section 5.3.2. Since this strategy involves performing an, obviously, finite number of simulations, and important question is how many simulations to run. In Efron and Tibshirani (1993) they argue that once the number of repetitions exceed 200 you start approaching the same statistics as infinity. Wilcox (2010), on the other hand, suggest that 599 is the magical number, and recommended for general use. Cameron and Miller (2015) vary between 1000 and 4000 repetitions in their simulations. The main concern is to run enough for the asymptotic properties to be realized. To ensure this I ran 1500 repetitions, leading to the results in Table 9[44]. We note that standard errors are higher for this strategy than for the baseline, in line with the expectation. For Columns (1) and (2), however, the difference between the two is small. This could imply that the initial estimations are a reasonable approximation of the true model. In some cases the small increase in standard errors barely pushes the p-values below common significance thresholds (for example below the 5 % significance level, notably for girls in Column (1) and boys in Column (2)). The fact that the results are very similar is reassuring though. In Column (3) we see that bootstrapping further increases the already large standard errors for the county-time interaction specification. As a result, the coefficient for girls is not significant at the 10 % level as in the baseline results in Panel A. This column underlines the issues of this

[44] Regressions with both fewer and more repetitions were run, with no discernible difference in the results

specification discussed in the sections above. It also demonstrates that red flags should be raised concerning the clustered strategy. In general the bootstrapping results suggest we should remain cautious, but not discouraged by the robustness of the baseline estimations.

### 6.3.3 Placebo testing

A threat to the identification of causal effects is the presence of anticipatory effects. In the Hordaland case that could mean inhabitants predicting the reform taking place and adjusting their behavior accordingly. For example, there might be some inter-county mobility as students and parents adjust to their preferences. Although moving in anticipation of increased school choice might seem drastic, we cannot safely rule it out on good faith. By employing a simple placebo we can test for pre-treatment effects by introducing the treatment at an earlier time. In doing so we should expect to not find significant effects if we believe our previous estimates are correct. I carry out such a test by limiting the period of focus the five years leading up to the reform, years 2000-2005. Treatment is introduced in 2003, using the full sample as the control. Results are reported in Table 10.

***Table 10: Results from placebo test***

| Post x Treatment | (1) | (2) | (3) |
|---|---|---|---|
| Boys | -0.193 | -0.193 | -0.380 |
| | (0.872) | (0.802) | (1.661) |
| Girls | 0.370 | 0.370 | -0.855 |
| | (0.519) | (0.481) | (0.797) |
| County and year dummies | No | Yes | Yes |
| County x Year trends | No | No | Yes |
| Observations | 114 | 114 | 114 |

*Note: Robust errors in parentheses*
*1 star = significant at 10 % level, 2 stars = 5 %, 3 stars = 1 %*

This test was performed using the same three specifications as before. As we see, no coefficient were found to be significant in any case, which is reassuring. For the boys coefficient is found to be negative, which is also the case for girls when using the county-specific trends. Additional tests using 2002 and 2004 as the placebo yielded similar results. This should not reduce our faith in the estimated effect of the reform.

### 6.3.4 The timing of treatment effects

Pischke (2005) provides a useful procedure for testing for the timing of effects by employing the Granger test approach of Autor (2003). He proposes to estimate the following equation

$$Y_{ict} = \gamma_c + \lambda_t + \sum_{j=-m}^{q} \beta_j D_{ct}(t = k + j) + \boldsymbol{X}_{ct}\delta + \varepsilon_{ict} \qquad (7)$$

where $\gamma_c$ and $\lambda_t$ refer to county specific trends, and year effects present among all observations, while $\mathbf{X}_{ct}$ is an optional vector of background characteristics. The variables of interest are the dummies $D_{ct}$ which denote 'leads' and 'lags', time periods immediately before and after the treatment. Assume the reform occurs in period *k*. By adding *m* leads and *q* lags we can run a regression on (7), obtaining the coefficient $\beta_j$ for the *j*th period. In the absence of anticipatory effects we should expect to find that pre-treatment coefficients to be zero, so that $\beta j = 0 \ \forall \ j < 0$. Ideally, we also want to observe a non-zero $\beta_j$ for $j > 0$, since the initial results indicated an effect. Table 11 reports the results from this test.

***Table 11: Timing of treatment effects***

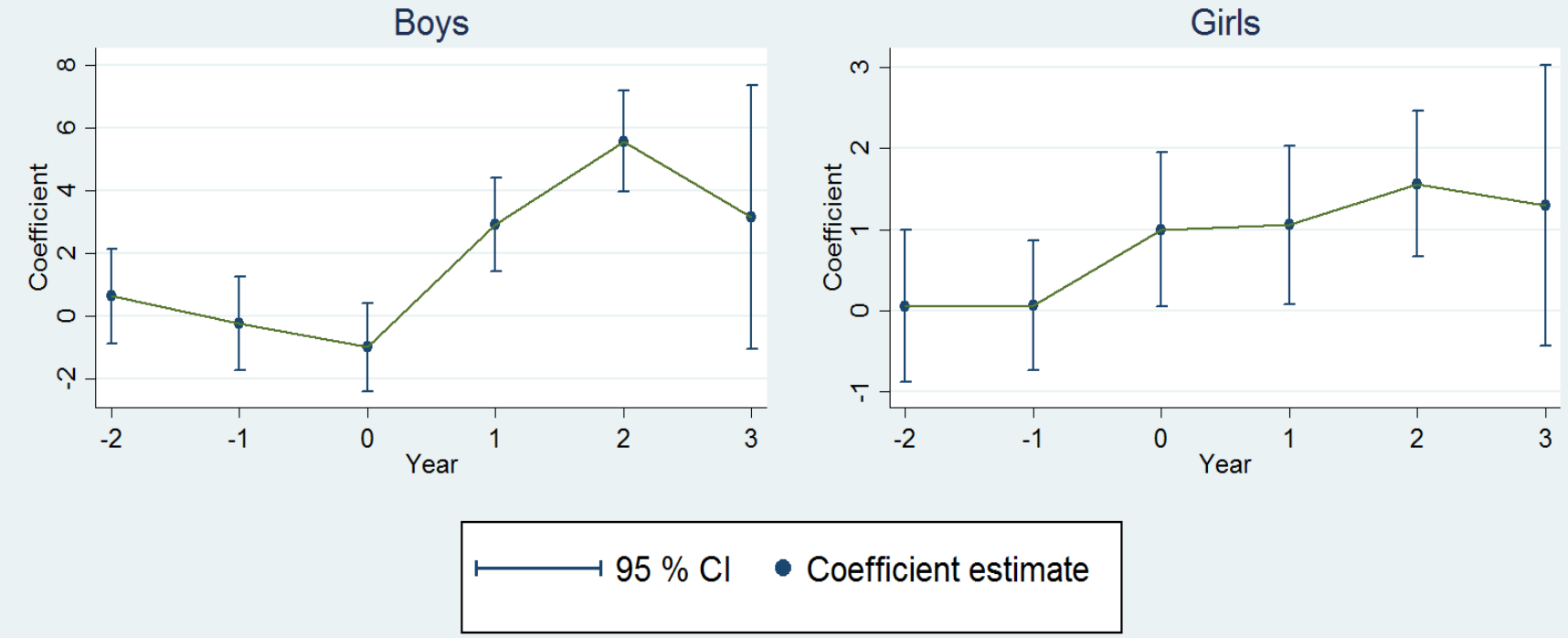
| **Leads and lags** | *Boys* | *Girls* |
|---|---|---|
| Reform $_{t-2}$ | 0.639 | 0.054 |
| | (0.758) | (0.469) |
| Reform $_{t-1}$ | -0.233 | 0.059 |
| | (0.745) | (0.403) |
| Reform $_{t0}$ | -0.983 | 0.998** |
| | (0.703) | (0.475) |
| Reform $_{t+1}$ | 2.928*** | 1.054** |
| | (0.745) | (0.490) |
| Reform $_{t+2}$ | 5.567*** | 1.565*** |
| | (0.801) | (0.452) |
| Reform $_{t+3}$ | 3.157 | 1.298 |
| | (2.104) | (0.867) |
| Observations | 209 | 209 |

*Note: Robust errors in parentheses*
*1 star = significant at 10 % level, 2 stars = 5 %, 3 stars = 1 %*

Estimation is carried out on the full sample using the same model as in Autor (2003) meaning that county and time dummies, but not additional covariates, are included. The leads and lags are equal to 1 in only one period each for the treatment group. The

exception to this is lag 3, which is 1 for years >=2008. As the initial placebo test above, the Granger test returns some reassuring results. For both boys and girls, the treatment effect appears when we would expect it, and increases in strength throughout the period. In Figure 6, the timing of treatment effects for GSP students are illustrated. As we see, the initial coefficient for boys is negative, before increasing rapidly in the following years. Some dynamics in the treatment effect is to be expected, and might be indicative of an adaptation process among students. The effect is strongest two years removed from the reform, for both genders. It remains positive for all lags, but increases in variance for Lag 3. Overall, the results from these increases our faith in the notion that the estimates for GSP-students are robust.

# Figure 5: Timing of Effect for GSP-students




Note: Estimates for leads and lags of the reform. 95 % confidence intervalls included

### 6.3.5 External validity

The sharp deviations in trends observed in Hordaland after the reform are not matched at the national level. An interesting question is whether this is a singular case, or if there is some general effect of switching from a PP- to a FSC-system. If so, we should expect similar effects to be found among other switching counties. To explore such a hypothesis I carry out a similar DID-estimation for other reforming counties, with results reported in Table 12. Here I estimate the effect of the change to FSC for three of the Switchers preceding Hordaland[45]. The specification is similar to that of Table 7, where county and year dummies are included, plus controls for county specific trends.

Results from Rows 1-4 show that the estimations are imprecise in many cases, largely because of limited data and narrow pre-treatment windows. They do however point in the direction of a pattern of expected consequences from making the switch. In Akershus, Column (1) show similar effects as those observed in Hordaland. The boys in academic track programs are estimated to have a highly significant increase in dropouts from the reform. For the girls, only a small effect is estimated, which is not significant. No significance is neither found in Oppland, though the sign for both groups is positive, which we would expect in the case of a general effect. The effect is also estimated to be smaller for this county than Akershus. For Oslo the estimation is done in two installments. This is done to measure the effect of both the PP-reform in 2005 and the FSC-reform in 2008, as they underwent two changes during the period. Make especially note of Row 3. If school choice increases dropout rates, we should observe that the reverse case in Oslo in 2005 would lower them. Interestingly, the estimates show a reduction in dropouts for the PP-reform for male students, while no effect is found for the girls. However, a negative effect is also found in the estimation for the FSC-reform in 2008, the FSC-reform. This is the only that result that is contrary to what we might expect, but we do note a substantial standard error. For the girls a coefficient in line with expectations and similar to the other cases is found, but with high standard errors as well. In general, the data shows that the trend for girls in Oslo follows the national trend closely, which would suggest few effects identifiable from the reform.

[45] Since Møre og Romsdal made the switch in 2001, the data does not allow for analysis of pre-treatment trends. Hence, this county is excluded in this analysis and test.

***Table 12: DID-estimation for other switching counties***

| | Boys | Girls |
|---|---|---|
| Akershus | 2.644** | 0.411 |
| | (1.092) | (0.599) |
| Oppland | 0.727 | 0.202 |
| | (1.854) | (0.897) |
| Oslo $_{2005}$ | -1.573 | -0.010 |
| | (1.521) | (0.572) |
| Oslo $_{2008}$ | -1.610 | 0.632 |
| | (2.503) | (0.878) |
| Combined | 1.377 | 0.632* |
| | (0.868) | (0.382) |
| Test difference (P > $\chi$2) | | 0.230 |
| Observations | 209 | 209 |

*Note: Robust errors in parentheses*
*1 star = significant at 10 % level, 2 stars = 5 %, 3 stars = 1 %*

In Row 4 I employ a model where the effect of introducing school choice is estimated using the three counties plus Hordaland as treatment groups for whom the treatment occurs at different times, using the same controls as before[46]. The effect found for male GSP-students is an estimated increase in dropout rates of 1.38 % after a reform of this kind. We should take in to account that there is some imprecision to this result, with a p-value of 0.11, though it is consistent both in size and direction with the other results of this thesis. Effects are also found for the girls, though to a lesser degree than the boys, which are significant at the 10 % level. This is in line with what we observe in Hordaland, where the strongest negative effect appears to be on the boys. However, as before, the gender difference is not statistically significant (see Row 6), with a higher p-value than that for the baseline results of Table 7. Both separate and combined we see indications that similar effects can be found in the other cases, pointing in the direction of a general effect. However, the scope of this test is too small and superficial to arrive at any conclusions.

Hordaland's comparability to the other counties might explain some of the differences in the results. For example, Oppland separates from the other Switchers by having a

[46] This approach is similar to that of Besley and Burgess (2004)

smaller, more rural population. There are no city at the level of Bergen and Oslo, which suggests that the effects of school choice might be different in these counties than others[47]. This might explain why we only find small effects for this observation. Hordaland, Akershus and Oslo are more similar in size and population, in addition to containing large metropolitan areas. On the other hand, their inhabitants differ compositionally. For example, Akershus and Oslo have a much more heterogeneous population, both in terms of ethnicity and socioeconomic status. It is therefore not obvious that the segregational effects of school choice is equal in the three counties. It is possible that the adverse effects of school choice is stronger in areas where the segregation is already stronger, perhaps implied by the relatively stronger effect found on dropout rates among male GSP-students in Akershus than in Hordaland. Such a question should garner interest for further analysis.

[47] Section 3.4 stressed how urban and rural areas are affected differently

# 7 Discussion

Chapter 6 suggests a possible link between students in general study programs dropping out and the school choice reform. Why could this be the case? The following Chapter looks at possible mechanisms that could explain such results, and discuss how these relate to existing literature on the subject. Alternative explanations are also explored, especially the possible confounding effect of the legalization of private schools. Lastly, the policy implications of adverse effects are explored.

## 7.1 Mechanisms

In general, a school choice system will result in some form for skill-sorting process. The most popular schools will be those who are perceived as providing the best education, attracting the students with the highest grades and abilities. These students will subsequently benefit from having high-ability peers, with a conversely negative effect on those in less popular schools (Epple and Romano, 1998). Through this self-sorting, the market perception might become a self-fulfilling prophecy, where the most *popular* schools become the *best* schools by getting the best students and teachers. The central hypothesis of this thesis was that increased levels of competition in the educational market will affect boys and girls differently. The results of the DID-analysis show that both genders responded negatively to the reform. The estimated effect is strongest for the boys, though this difference is not found to be statistically significant. However, the fact that the coefficient is consistently estimated to be larger than that for the girls suggest that the treatment effect is perhaps larger for boys.

The evaluation reported in AUD (2005) indicated that the school choice reform led to a process where the strongest students outside Bergen applied to the popular schools in the city center, while the weaker students have to settle for more rurally located schools. 11.2 % of students who had their neighborhood school as their top choice did not earn admission, but was referred to their other choices. Of these, students in the bottom half of the grade distribution were severely overrepresented, and over 50 % of them living in central Bergen (AUD, 2005 p. 16). For students who preferred other schools than their local one, about ¼ did not get their top choice. In this group, students in the second-to-

best tier (4.0 – 4.9 GPA range) were the majority. Both these groups should be expected to be vulnerable to drop out. As boys are especially overrepresented among low-achieving students, these would be expected to be in the majority in the second-tier schools. Autor et. al (2016) noted how boys respond more to poor school inputs, increasing their risk of dropping out. Furthermore, Legewie and DiPrete (2012) argued that since boys are more susceptible to the inputs of their peer-groups, they are more vulnerable to let such clustering affect their academic performance. As the best students leave for the most popular schools, an adverse selection of peer groups form in the less popular schools. The report also features feedback from the teachers in various districts on the perceived quality of the educational environment at their school. Following the reform, the city center schools have been characterized by an increasingly homogeneous group of students with very high academic standards. Some teachers reported that the students are 'breathing down their neck' academically, pushing for better and more advanced curriculum. In schools outside the immediate city center, teachers report a worsening in class environment. They attribute this to the departure of the students maintaining the academic standard in class, leaving a higher percentage of students with low motivation and low skills behind.

These reports suggests that the effects of the reform is strongest for the best and the weakest students, in opposite directions[48]. It is reasonable to assume that a large part of the increase in dropouts comes from weaker students being deferred to a less preferred choice, where the educational quality is lower. The lack of motivation is also apparent in the feedback from students who were not admitted to their top choice. In AUD (2005, p. 22) when asked why they were dissatisfied with the school choice system, many students responded that their current school was only their second or third choice, and that they "didn't even want to go to this school". The most common objection among the dissatisfied students was however the length of commute, with almost 50 % reporting this as their main issue. A central claim from opponents of school choice in Hordaland is that the weakest students are forced to endure long commutes because the spots at their local school are taken by stronger students. Especially those in Bergen city center are vulnerable to such displacement, having to settle for schools further away

[48] Teachers in mid-tier schools reported no significant change in their class environment.

from home. They argue that this puts extra strain on those already at risk of quitting, increasing the likelihood that dropout rates will increase. Burdick-Will (2015) finds that it is students from disadvantaged neighborhoods who tend to have the longest commute, as students from backgrounds of higher social status often live near popular, high quality schools. She points out that the privilege to choose is equally the privilege not to *have* to choose, but being able to stay in your local community, maintaining established relations. Bierhaum and Barajas (2017) on the other hand, argues that the burden of increased travel distance is a common criticism against school choice systems, which serves to exacerbate, rather than reduce inequality among students. As this thesis points out, the de facto choice for the weakest students is limited, at least when considering the contested schools in and around Bergen. For students located near the city center the likelihood of getting accepted to a school close to home decreases as the GPA decreases. The weakest students applying to GSP-schools are thus most at risk of being placed in a school to which they have a long commute. This will be the case for both genders, but because boys are more prevalent in this segment they will outnumber the girls. The increased travel distance, combined with the lack of motivation from not getting admitted to their top choice and the adverse selection of peer groups provides a plausible hypothesis for why increased dropout rates are observed after the reform in Hordaland, and why the effect appears to be stronger for boys than for girls. With a more detailed data source, preferably at the individual level, on grades, location, school application, background etc., such a hypothesis could be tested and substantiated by empirical analysis. Unfortunately the available data and scope for this thesis does not allow for such analysis, but should be a topic of interest for future research.

## 7.2 Alternative explanations

There are severable variables that might influence dropout rates. For example, the income and level of education for parents are found to be positively correlated with a child's academic abilities[49]. Thus, we would expect counties with a high degree of highly educated to have a lower rate of dropouts, all else equal. If large changes took

[49] Reardon (2011) discusses recent developments in the achievement gap between children of high-income and low-income households.

place around the time of the reform it might contradict the hypothesis that school choice has an effect on dropout rates.

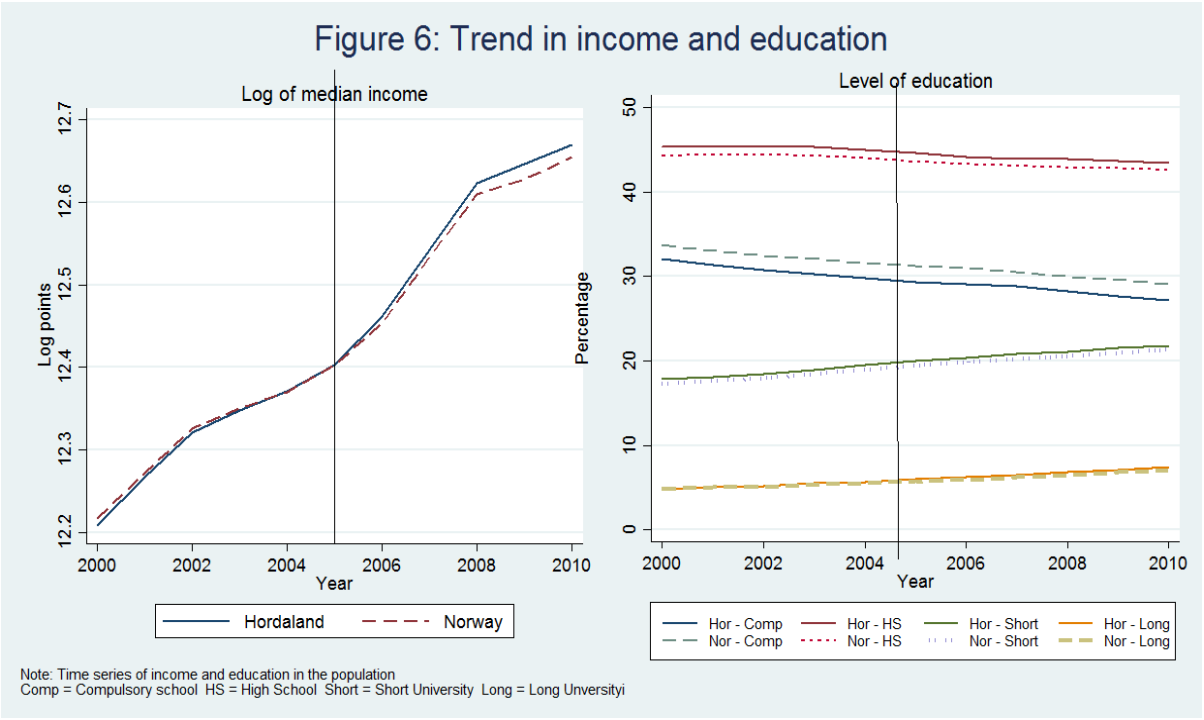



Figure 6 illustrate the development in income and education in the population during the decade in question. The level of education is relatively stable throughout the period. The significant trend is a slow reduction in the share of the population who only have completed compulsory education, and a steady increase of those with a university education. These changes are likely related to the overall trend of increased attainment of education. We observe no changes around the time of the reform. On the other hand, the growth in median income seem to increase in pace around 2005. A similar change of pace is, however, present for Norway as a whole, which indicate that this is the result of a general improvement in wealth in the second half of the 00's and not specific for Hordaland.

Another factor that could influence the dropout rate is the amount of minority students in the schools. From 2001 to 2010 this share rose from 2.8 to 6.2 % in Hordaland, which represents more than a doubling. However, it is still below the national rate, which in comparison rose from 7.2 to 13.4 % in the same period. If we disregard Oslo and Akershus county, minority students are evenly distributed among the counties, with

Hordaland on an average level. In both cases the majority of the growth happens at the end of the period, which does not correspond with the timing of the increase in dropouts.

The other major policy change in the education sector in 2005 was the legalization of private institutions which do not offer a pedagogical or religious alternatives. This allowed private actors to supply education in direct competition with the public sector. Despite this, the overall share of students choosing a private education remained modest in Norway, with an increase from 5 % in 2005 to 7.3 % in 2010. The private schools remain few in number and are mostly concentrated in the larger cities. Per 2016, Oslo has the highest proportions of students in private high schools at 16 %, while Hordaland has a 15 % share. The majority of these schools are located in, and around, Bergen city center. After 2005, the city saw a sharp increase in private school attendance, leading to one of the highest shares in the country. This is illustrated in Figure 7[50]. In 2010 over 40 % of Bergen girls and a quarter of Bergen boys were in a private school. The share has been increasing in recent years as well, and in 2015 almost half of all students in upper secondary education in downtown Bergen were in a private school, with the girls increasingly outnumbering the boys (Statistics Norway, 2016c). These numbers are remarkably high by Norwegian standards, and separates the situation in Bergen from that in many other cities.

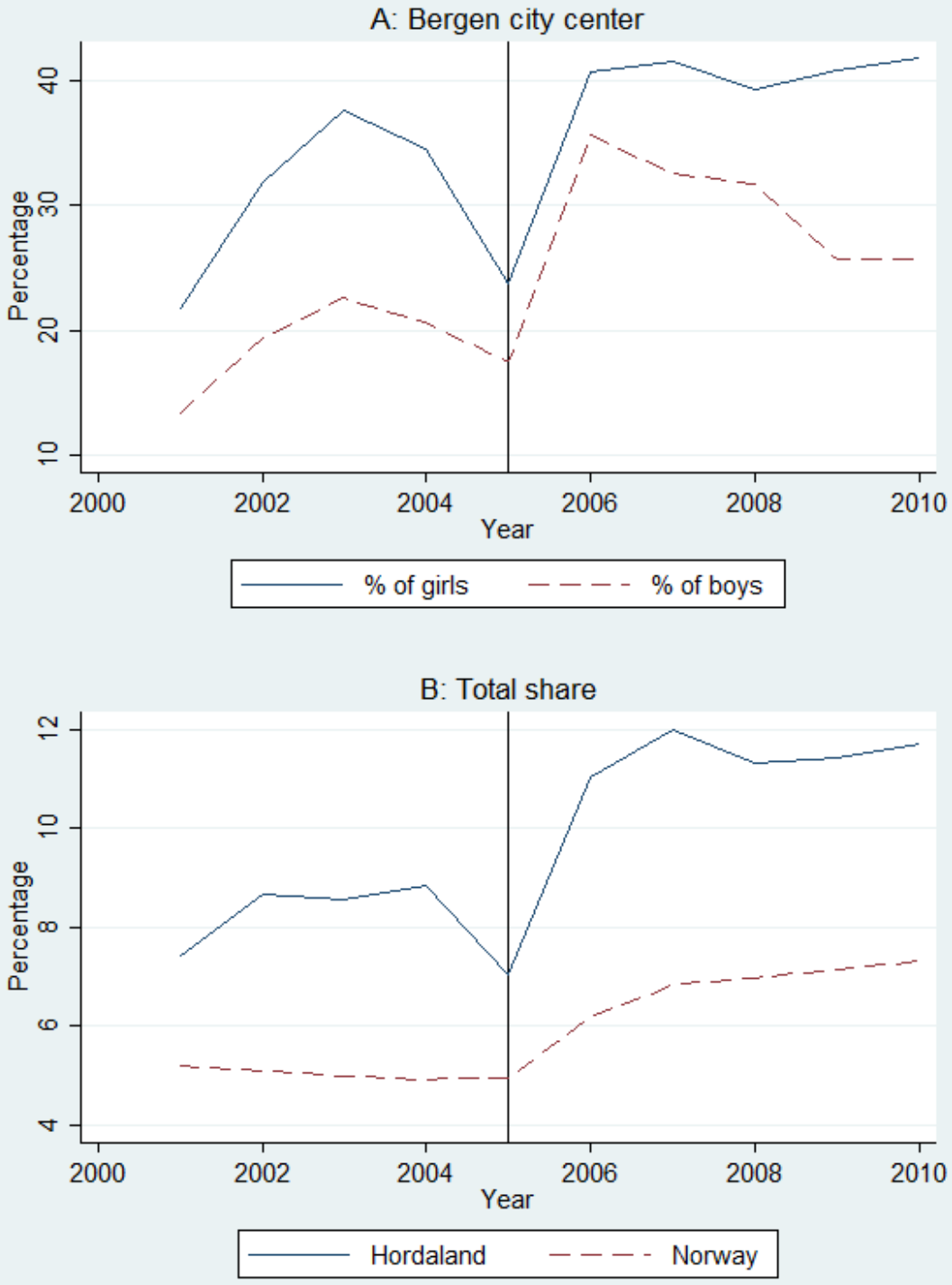
In the literary review, some results suggest that private schools increase performance, both for the student and the school sector in general. Thus, we might expect to see lower rates of dropouts in counties where there is a larger degree of students in these schools. However, in Hordaland we observe an increase in enrollment in private schools simultaneously as dropout rates increase among GSP-students. In line with the theoretical assessments of school choice, we can assume that two mechanisms are in effect. Firstly, the increased competition from private actors should improve effort among public schools, spurring efficiency gains and improved quality of education

[50] I've categorized the following schools as located in Bergen city center: *Private* – Akademiet, Bergen Private Gymnas, Danielsen Intensivgymnas, Danielsen videregående skole, Sonans and St. Paul. *Public* – Amalie Skram, Bergen Katedralskole, Bergen Maritime, Bergen Tekniske Fagskole, Bergens Handelsgymnasium, Bjørgvin, Kyrre and Tanks.

overall. All else equal, studies like Figlio and Hart (2010) suggest that this should lower dropout rates. The uncharacteristically high take-up of private education indicate that these schools are desirable among Hordaland students, and are at least perceived as high quality schools in the market. If they are in fact better educators than the public school, and a large portion of students attends these schools, we should expect performances to improve further. However, the data on which this thesis is based includes combined numbers for private and public schools. As we observe the dropout rates among GSP-students increase sharply post-reform it seems implausible that there are significant gains from the high share of private school students. At the very least, the net effect for the general study programs (which is primarily what the private schools offer) is negative.

As discussed above, there is a second mechanism is at play through the sorting process of the school choice system. If the private schools are perceived as better, these will be preferred by the strongest students. If so is the case, we should expect to find clustering of high ability students in private schools, and low ability students in public schools. Figure 7 shows that girls increasingly outnumber boys in private schools. As boys outnumber girls in (perceived) lesser-quality public schools, dropout rates might rise through the adverse selection of peer groups. This implies that the sharp increase in private school attendance might accentuate the mechanisms described in 7.1, not contradict them. In the absence of the school choice reform, a skill-sorting process between private and public education might still appear, with adverse effects on those left in a public institution. If so is the case, this provides a plausible explanation for why similar effects as those observed in Hordaland are not as dramatic in other switching counties, because they have not experienced a similar increase in the private educational market.

# Figure 7: Share in private schools




Note: Panel A - The percentage of boys and girls attending private school in Bergen city center
Panel B - The total share of private school students, as % of the total student mass

## 7.3 Policy implications

School choice continues to be controversial. The Norwegian debate on educational policy is primarily focused on reducing dropouts. Results indicating that school choice increases dropouts could therefore be taken as argument in favor of adjustments to the system. While opponents hope for the reintroduction of the proximity principle, signals from the newly elected Labor Party indicate that the current system will continue for now, with some minor changes[51].

A County Parliament assessment of the admission system makes a note of the objective to promote diversity in the student mass at each school, and that FSC has not been successful in doing so (Haugsdal, 2016 p. 2). In order to achieve a more balanced distribution of students, some suggest that a mix of FSC and PP could be employed. Examples from other counties include giving the students priority at their neighborhood school, while maintaining the option to apply to others. Admission among external applicants will be decided after all priority students have been allocated. Supporters argue that such a system will eliminate the potential risk factors of long commutes and weaker students being forced to attend schools they do not prefer by guaranteeing them at spot in their own community. On the other hand, objectors point out that it could exacerbate the issues of school choice, as the spots open to outside applicants will be in short supply. The GPA needed to be able to get accepted to a school that is not local will be even higher, effectively ensuring that school choice is only a choice for the very best students, or those who happen to live near them. Haugsdal (2016) also note that prior to the reform in 2005 there were problems in ensuring that the local schools had capacity to accommodate all neighboring students. Thus, there were cases where students were moved to other schools, or there had to be some form of selection process based on the grade distribution. When considering alternative systems one has to account for such challenges, specifically concerning how many students will have to commute, or how students who would prefer their neighborhood school, but are displaced by other priority students, will respond. Haugsdal considers it likely that the

[51] With the new stipulations, students facing an 'unreasonable commute' will be given a discretionary assessment for admission to their neighborhood school. Students will also be given the right to continue at their current schools for VG2 and VG3, if they wish to do so. See Krane Hansen (2016)

academically weakest students will be the ones having to settle for other schools. The main issue, as the County Parliament sees it, is limited capacity. Specifically in Bergen, demand exceeds supply to great degrees in several schools. AUD (2005) also found that the majority of students who had their local school as the top choice, but did not earn admittance, were living in Bergen city. An increase in capacity could mitigate the problems by allowing more of these students to attend a school closer to home. We could also expect an increase in supply to lower the GPA required at other schools[52], improving the chances of the second-to-best students who were overrepresented among those applying to schools outside their neighborhood, but not getting admitted. Improving the likelihood that more students are able to attend their preferred school could prove advantageous towards preventing negative outcomes.

As a result of the disproportionate amount of male dropouts, reducing dropout rates will inevitably involve reducing the gender gap. However, it is not obvious that this should be cause for policy intervention. Pekkarinen (2012) raises a question of whether the boys are declining, or simply stalling, allowing girls to make up for the bias of previous decades[53]. There are however some arguments in favor of targeting boys in particular. The literature show that boys have a more elastic response to external inputs, and are thus more vulnerable to the effects of a school choice system. Policy that works in their disfavor could therefore have a greater impact on outcomes like dropout rates than in the reverse case. On the other hand, Pekkarinen argues that because of their overrepresentation at the bottom of the grade distribution, boys might simply be a proxy for 'low performing students'. Any effort to address an issue for this group of students will necessarily be an effort reduce the gender gap. Focus should thus be on reducing dropout rates for the weakest students in general, and not specific to genders.

How to best address the low performing students is a complex issue. Many point to the need for sufficient resources in the school, to allow for more individually adapted teaching and enhanced support. A much debated topic in that regard is class size, where

[52] Excluding, perhaps, the very most popular ones.
[53] On the other hand, studies such as that of Autor and Wasserman (2013) have found that educational obtainment, especially at the tertiary level, among adolescent males is in fact declining, compared to previous rates.

the effect of smaller classes is not yet settled in the literature. Notable contributions from Chetty et al. (2011) and Fredriksson et al. (2013) do however find positive effects from reducing class sizes. Interestingly, the effect is found to be stronger on boys than girls, suggesting that increased funding to allow for more teachers could be advantageous in reducing the gender gap. Another popular measure is programs targeting struggling students at an early age, though studies find mixed results concerning their efficiency[54]. Regardless, such early intervention remains popular among policy makers. The significance of early childhood development in determining life outcomes is becoming increasingly well documented, accentuating the need for effort at young ages to reduce lagging. Hence, targeted policy intervention at the high school level in an effort to reduce dropouts might be too little too late.

A possible quick fix targeted at underachieving males could come in the form of quotation. Such mechanisms have already been implemented for some cases at the university level, where students applying to degrees that is overwhelmingly skewed towards one gender have been awarded extra credit[55]. An equally unbalanced distribution of gender could encourage similar measures to be tested for applications to high schools[56]. In a recent White paper on equality, the governmental parties acknowledge the possibility of awarding gender points for study programs where the student mass consist of 80 % or more of one gender (Ministry of Children and Equality, 2015). It is conceivable that this could reduce the gender gap in the most extreme cases, notably at the top and bottom of the grade distribution, though it would not solve the underlying issue of boys being more likely to fall behind and drop out. The temporary nature of such a measure is a likely explanation of why it has only garnered modest popularity among policy makers.

[54] For example, Ludwig and Miller (2007) examine the comprehensive Head Start program in the US, but fail to find conclusive evidence of long term effects in educational outcomes. In contrast, Knudsen et. al. (2006) reports that several programs have shown to have significant impact on children's early development of skills

[55] Female students applying for technical engineering degrees, and males applying to veterinary studies are some examples of groups that have been favored.

[56] An example of such unbalance was reported in another major city, Stavanger, where the intake of students to the highest ranked school consisted of 84 % girls (Birkemo, 2016).

# 8 Concluding remarks

The thesis aims to measure the effect of a school choice reform in Hordaland County. By creating a competitive market for education, we would expect some individuals to thrive more than others. Therefore, we might observe different effects of the reform on different groups. I examine if this is the case for gender. Results of the study points to the introducing of school choice having and adverse effects on students in academic track programs. The effect was found to be stronger for boys, where estimates showed an increase in dropouts of 1.7-2.7 %, compared to an estimate of 1.2-1.5 % for girls, though the difference is not statistically significant. Considering a pre-treatment dropout rate of ~ 6-7 % and 5-6 % respectively, the effect should be viewed as considerable. For neither GSP nor VSP-groups a reduction in dropouts could be identified. This is contrary to several existing studies, which have found efficiency gains when allowing for school choice. However, the possibility of positive outcomes for other variables should not be ruled out.

The treatment effect of the reform was explored in a difference-in-differences framework. The identifying assumption in this model is that of the parallel trend, meaning that in the absence of treatment we would observe similar trends for the treated and the control. A comparable pre-treatment trend is therefore imperative for the validity of the analysis. Assessments of this showed that the assumption holds reasonably well for the academic track programs, but less so for vocational programs. Hence, an effect can only be identified for the former group, while results from the latter could not be considered with any certainty. Estimates were found to hold up well under some robustness tests, proving to be fairly consistent. There are however some issues with certain specification, which perhaps stems from limitations of the data leading to a lack of precision in the identification. The treatment effect for GSP-students is however perfectly timed with the introduction of the reform, strengthening the hypothesis that the increase in dropouts in the latter half of the 00's can be traced to the policy change in 2005.

Student's right to choose schools remain a key ideological battleground. Yet, the economic arguments in favor of such systems are contested. The main concern is the potential for clustering of students according to skill, effectively creating a tiered hierarchy in school quality. Existing data suggests that the weakest students benefits least from school choice, and present the greatest risk of dropping out. In Hordaland, they were found more likely to not get accepted at the schools they preferred, especially those living in Bergen, and more likely to have to endure long commutes. Both factors are likely contributors to an increased risk of dropping out at later stages. Since boys are overrepresented both among low skill students and dropouts, an effort to reduce dropout rates will also be an effort to reduce the gender gap. When girls on average earn better grades than boys, we would expect a school choice system to impact the latter group more, exacerbating the gender gap in the process.

There are some policy measures that could abate the problem. They key issue of low performing students, particularly boys, at the secondary level must be tackled before applications to schools are sent out. Some underline the importance of early intervention to reduce the risk of students falling behind and lagging throughout their schooling years. School choice in itself might not cause the divergence between groups of students, but rather serve to accentuate differences that are already present. Efforts to decrease the gender gap at earlier grades should be of primary concern. For the supply of education at the high school level an increase in capacity in Bergen city center could reduce both dropout rates and the gender gap. Increasing the likelihood of students getting admitted to the school of their preference will likely also increase their chances of completing their education. Increased supply could also mean a decrease in the GPA required for the popular GSP-schools, promoting heterogeneity in the student mass.

Considering the political attention given the topic and the amount of questions that still surrounds the effects of school choice, continued research should be warranted. This thesis contributes to an ongoing debate on how to mitigate adolescents falling out of school, especially when it comes to males. Although the analysis in this thesis has limitations, it could very well lay the foundation for more in-depth analysis at a later stage.

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# Appendix

## A. Overview of schools in Hordaland

Table A.1 lists all schools at the upper secondary level in Hordaland in the period 2000-d.d.

Note that not all schools are still operational. Some have merged, while some have been closed, giving place to new ones.

Institutions with several locations are listed for each of them.

***Table A.1: List of schools in Hordaland***

| Name | Ownership | Bergen Municipality | City center |
|---|---|---|---|
| Akademiet Bergen | Private | Yes | Yes |
| Amalie Skram VGS | Public | Yes | Yes |
| Arna Gymnas | Public | Yes | No |
| Arna Yrkesskole, Avd. Storaneset | Public | Yes | No |
| Arna Yrkesskole, Avd. Ulfsnesøy | Public | Yes | No |
| Askøy VGS | Public | No | No |
| Austevoll VGS | Public | No | No |
| Austrheim VGS | Public | No | No |
| Bergen Katedralskole | Public | Yes | Yes |
| Bergen Maritime VGS | Public | Yes | Yes |
| Bergen Private Gymnas | Private | Yes | Yes |
| Bergen Tekniske Fagskole | Public | Yes | Yes |
| Bergen Handelsgymnasium | Public | Yes | Yes |
| Bjørgvin VGS | Public | Yes | Yes |
| Bømlo VGS | Public | No | No |
| Danielsen Intensivgymnsa | Private | Yes | Yes |
| Danielsen VGS | Private | Yes | Yes |
| Bergen Maritime Fagskole | Public | Yes | Yes |
| Etne VGS | Public | No | No |
| Fana Gymnas | Public | Yes | No |
| Fitjar VGS | Public | No | No |
| Framne Kristne VGS | Private | No | No |
| Fusa VGS | Public | No | No |
| Fyllingsdalen VGS | Public | Yes | No |
| Garnes VGS | Public | Yes | No |
| Hjeltnes Gartnarskule | Public | No | No |
| Hop VGS | Private | No | No |
| Knarvik VGS | Public | No | No |
| Kongshaug Musikkgymnas | Private | No | No |
| Kristianborg VGS | Private | Yes | No |
| Krohnsminde VGS | Public | Yes | No |
| Krokeidesenteret | Private | Yes | No |
| Kvinnherad VGS | Public | No | No |
| Kyrre Skole | Public | Yes | Yes |
| Laksevåg Gymnas | Public | Yes | No |

| | | | |
|---|---|---|---|
| Laksevåg VGS | Public | Yes | No |
| Hordaland Helsefagskole | Public | No | No |
| Langhaugen VGS | Public | Yes | No |
| Lindås Gymnas | Public | No | No |
| Lønborg VGS | Public | Yes | No |
| Nordahl Griegs VGS | Public | Yes | No |
| Norheimsund VGS | Public | No | No |
| Odda VGS | Public | No | No |
| Olsvikåsen VGS | Public | Yes | No |
| Os Gymnas | Public | No | No |
| Os VGS | Public | No | No |
| Osterøy VGS | Public | No | No |
| Rogne VGS | Public | No | No |
| Rubbestadneset VGS | Public | No | No |
| Rudolf Steinerskolen Bergen | Private | Yes | No |
| Sandsli VGS | Public | Yes | No |
| Slåtthaug VGS | Public | Yes | No |
| Sonans VGS Bergen | Private | Yes | Yes |
| Sotra VGS | Public | No | No |
| St. Paul Skole | Private | Yes | Yes |
| Steinerskolen Skjold | Private | No | No |
| Stend Jordbrukskole | Public | Yes | No |
| Stord VGS | Public | No | No |
| Stord Yrkes- og tekniske skole | Public | No | No |
| Tanks VGS | Public | Yes | Yes |
| Tertnes VGS | Public | Yes | No |
| U. Pihl VGS | Public | Yes | No |
| Voss Gymnas | Public | No | No |
| Voss Husflidskule | Public | No | No |
| Voss Jordbrukskule | Public | No | No |
| Voss VGS | Public | No | No |
| Øystese Gymnas | Public | No | No |
| Årstad VGS | Public | Yes | No |
| Åsane VGS Nyborg | Public | Yes | No |

## B. School choice in Norway

Table A.2 details which counties employs school choice in the period 2000-2010. For those switching systems during the 00's it is noted in the table.

The classification of counties in FSC and PP-groups is my own based on available information (see for example Stortingets Utredningsseksjon (2003).

FSC: Free school choice PP: Proximity principle

***Table A.2: List of high school admission systems***

| County | System | Note |
|---|---|---|
| Østfold | PP | |
| Akershus | FSC | Changed in 2003 |
| Oslo | FSC | PP in 2005-08 |
| Hedmark | PP | |
| Oppland | FSC | Changed in 2003 |
| Buskerud | PP | |
| Vestfold | FSC | |
| Telemark | PP | |
| Aust-Agder | FSC | |
| Vest-Agder | PP | |
| Rogaland | FSC | |
| Hordaland | FSC | Changed in 2005 |
| Sogn og Fjordane | FSC | |
| Møre og Romsdal | FSC | Changed in 2001 |
| Sør-Trøndelag | PP | |
| Nord-Trøndelag | PP | |
| Nordland | PP | |
| Troms | PP | |
| Finnmark | FSC | |