Aalto University
School of Business

THE IMPACT OF FINANCIAL INCENTIVES ON THE ACADEMIC PERFORMANCE OF AALTO UNIVERSITY STUDENTS

Master's Thesis
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Abstract

Finnish universities struggle with long graduation times. By using data from Aalto University in 2013-2018 and a difference-in-differences method, I study the effects of a short-term monetary reward on the share of students completing their studies at annual target pace (60 credits annually), amount of annual credits and students' average grade. The reward is a EUR 500 scholarship, which can be earned annually if a student completes one's studies at target pace. It was taken into use in October 2016 in two out of six Aalto University schools.

The scholarship increased the share of students proceeding at annual target pace by 4.6 percentage points, while the control group did not change. The treatment group experienced a clear jump in the 60 credit threshold, while the control group had no similar effect. The effect of the scholarship was especially large in academic year 2017-2018, which might be due to the fact that it was the only full year in the post-treatment period when the scholarship was in use. Meanwhile, I observe no statistically significant impact on grades. Aalto University pays approximately EUR 2,500 for motivating one additional student to complete studies at annual target pace. As universities receive funding for students proceeding in their studies near target pace, Aalto University gained a return per additional student of EUR 302 in 2017, and EUR 224 in 2018. The real returns are likely to be larger as universities are also funded based on student graduation from bachelor and master's degrees.

Keywords financial incentives, academic performance, university students, economics

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Tiivistelmä

Suomalaisilla yliopistoilla on ollut hankaluuksia saada opiskelijansa valmistumaan tavoiteajassa. Tässä pro gradu -tutkielmassani hyödynnän dataa Aalto-yliopiston opiskelijoiden akateemisista suorituksista aikaväliltä 2013-2018. Tutkin miten vuosittain toistuva taloudellinen kannustin vaikuttaa siihen opiskelijoiden osuuteen, jotka suorittavat opintojaan vuosittaisessa tavoitevauhdissa (60 opintopistettä vuosittain), vuosittaiseen opintopisteiden määrään ja opiskelijoiden arvosanoihin. Hyödynnän tutkimuksessani erotus erotuksissa -menetelmää (eng. difference-in-differences). Rahallinen kannustin on 500 euron stipendi, jonka koeryhmän opiskelijat voivat ansaita vuosittain, mikäli he suorittavat opintojaan tavoiteajassa. Stipendi otettiin käyttöön lokakuussa 2016 kahdessa Aalto-yliopiston kuudesta korkeakoulussa.

Stipendi lisäsi koeryhmässä niiden opiskelijoiden osuutta, jotka suorittavat opintojaan tavoitevauhdissa 4,6 prosenttiyksikköä. Kontrolliryhmässä ei tapahtunut muutosta. Koeryhmässä oli näkyvissä selkeä nousu 60 opintopisteen rajan kohdalla, kun taas kontrolliryhmässä vastaavaa vaikutusta ei ollut. Stipendin vaikutus oli suuri etenkin lukuvuonna 2017-2018. Tämä saattaa johtua siitä, että tämä oli ainoa kokonainen lukuvuosi, jonka aikana stipendi oli käytössä. Stipendi ei vaikuta tilastollisesti merkitsevällä tavalla arvosanoihin. Aalto-yliopisto maksaa noin 2500 euroa yhden ylimääräisen opiskelijan motivoimisesta suorittamaan opintojaan tavoitevauhdissa. Koska yliopistot saavat valtiolta rahoitusta opiskelijoista, jotka suorittavat opintojaan lähellä tavoitetahtia (opiskelijat, jotka suorittavat vähintään 55 opintopistettä/lukuvuosi), Aalto-yliopisto sai stipendistä voittoa 302 euroa/lisäopiskelija vuonna 2017 ja 224 euroa/lisäopiskelija vuonna 2018. Todelliset voitot ovat kuitenkin todennäköisesti suuremmat, sillä yliopistot saavat rahoitusta myös opiskelijoista, jotka valmistuvat kandidaatin ja maisterin tutkinnoista.

Avainsanat taloudelliset kannustimet, akateeminen suoriutuminen, yliopisto-opiskelijat, taloustiede

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The Impact of Financial Incentives on the Academic Performance of Aalto University Students

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August 2019

Abstract

Finnish universities struggle with long graduation times. By using data from Aalto University in 2013-2018 and a difference-in-differences method, I study the effects of a short-term monetary reward on the share of students completing their studies at annual target pace (60 credits annually), amount of annual credits and students' average grade. The reward is a EUR 500 scholarship, which can be earned annually if a student completes one's studies at target pace. It was taken into use in October 2016 in two out of six Aalto University schools.

The scholarship increased the share of students proceeding at annual target pace by 4.6 percentage points, while the control group did not change. The treatment group experienced a clear jump in the 60 credit threshold, while the control group had no similar effect. The effect of the scholarship was especially large in academic year 2017-2018, which might be due to the fact that it was the only full year in the post-treatment period when the scholarship was in use. Meanwhile, I observe no statistically significant impact on grades. Aalto University pays approximately EUR 2,500 for motivating one additional student to complete studies at annual target pace. As universities receive funding for students proceeding in their studies near target pace, Aalto University gained a return per additional student of EUR 302 in 2017, and EUR 224 in 2018. The real returns are likely to be larger as universities are also funded based on student graduation from bachelor and master's degrees.

*I would like to express my sincere gratitude to my instructor, Professor Manuel Bagues, for his invaluable guidance and excellent advice. I want to thank Aalto University for providing me the data, and the people there who have helped me with my additional requests and questions.

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1 Introduction

Though Finland is often praised for its education system, it has substantial difficulties in its long university graduation times. In Finland, university students not only start their studies older but also take longer to graduate. This is problematic, as long study times may delay the amount of full-time workforce and decrease labor supply.

In Finland, the median age of new entrants in university education is 21.3 years, while OECD average is 20.4 years (OECD, 2010). Meanwhile, the median age of graduation is nearly 27 years, which is the third highest in the OECD area, only after Iceland and Sweden. For most degrees in Finland the target time for graduation is five years, where three years is for completing a bachelor's degree and two years is for completing a master's degree. However, the median graduation time is 6.5 years (Statistics Finland, 2012). In addition to the costs of late graduation, the government also heavily subsidizes education. There are no tuition fees for students coming inside the EU/EEA area, students receive financial aid and also enjoy a wide range of benefits.

Since 2010, the Finnish university system was reformed and universities became independent legal entities. They are now more autonomous than before, but still rely largely on public funding. The largest part of university funding is formed by the Ministry of Education and Culture's core funding model, which changes approximately every fourth year. Possible changes in the core funding model can largely affect universities' incentives. In 2013, a new section was added in the core funding model. This section measured the amount of students completing at least 55 credits per academic year, when the credit amount needed to graduate on time is 60 credits per academic year. The core funding model also has sections on graduating from bachelor and master's degrees. During 2017-2020, 29% of the core funding model is formed by these measures.

With different policies universities can decrease the risk of late graduation. One possible policy is utilizing financial incentives. Financial incentives are expected to motivate students that otherwise would not exert sufficient effort. However, behavioral economics suggests that financial incentives may crowd out one's intrinsic motivation, particularly if a student perceives that they cannot reach an objective (Camerer & Hogarth, 1999) or be ineffective if a student lacks understanding of how to improve one's performance. The way students allocate their effort is also uncertain, as students could react to incentives merely by increasing their effort, or change how their effort is allocated among different tasks (Holmstrom & Milgrom, 1991). However, many researchers find that financial incentives have positive effects to student performance and graduations times (Garibaldi et al., 2012; Gunnes et al., 2013; Scott-Clayton, 2011; Leuven et al., 2010).

In this thesis, I study the effects of a short-term monetary reward introduced in Aalto University

by using rich data, which includes all academic performances of Aalto University students in 2013-2018. In 2016, two schools in Aalto University begun using financial rewards to increase their share of students completing at least 60 credits per year. This reward, later on referred as the Dean's incentive scholarship, is worth of EUR 500 and students can earn it each academic year, with its maximum worth being EUR 2,500. As only two out of six Aalto University schools have implemented this scholarship, it offers a chance to study the scholarship's effects on students' academic performance in a difference-in-differences framework. Academic performance refers here to the share of students completing at least 60 credits per academic year, the amount of annually completed credits per student and students' average grade.

I find that after the scholarship was introduced, the share of students completing at least 60 credits increased by 4.6 percentage points during the post-treatment period, while the control group did not change. Meanwhile, I observe no statistically significant impact on grades. For motivating one additional student to complete 60 credits annually, Aalto University also pays to four other students, which would have completed 60 credits even without the scholarship. Thus, the cost for the university of motivating one more student is approximately EUR 2,500. In 2013-2018, Aalto University received on average EUR 3,738 for each student completing 55 credits. However, in 2017-2018 the amount of funding per student decreased, and was only EUR 2,802 in 2017, and EUR 2,724 in 2018. Hence, Aalto University gained a return per additional student of EUR 302 in 2017, and EUR 224 in 2018. The decrease in the amount of funding is likely due to decreases in university funding. It might also be partly due to the changes in the core funding model in 2017, after which universities received 1 percentage point less from students completing at least 55 credits annually. However, as universities also receive funding from students graduating from their bachelor and master's degree, the returns are likely be larger than the ones estimated above.

This paper contributes to the existing literature in several ways. First, it is conducted in a different institutional setting. Finland has a comprehensive social security system, welfare programs and a high-quality health care system, which provides additional support to low-income individuals such as students. The Finnish government provides monetary support for students such as cheap housing, monetary aid, discounts for public transportation and affordable loans. Also students coming inside the EU/EEA area pay no tuition fees. This increases students' benefits to study longer, and may partly contribute to higher study duration times. Second, as students have an opportunity to earn the monetary reward annually, I can study the effects of a short-term incentive rather than a long-term incentive. Incentive theory suggests, that incentives are more likely to have higher effects if they are given on shorter time periods (Holmstrom & Milgrom, 1987). Short-term rewards also have a higher net present value and may prevent shirking by forcing students to per-

form evenly in each academic year. Third, I aim to assist Aalto University and the Finnish society by studying the effectiveness of financial incentives on the performance of university students. I hope to bring valuable information to decision makers and help them plan structures, which reduce higher education graduation times.

The remainder of this paper is organized as follows. Section 2 presents the relevant literature. Section 3 describes the university system in Finland. Section 4 presents the structure of Aalto University and the Dean's incentive scholarship. Section 5 describes the data and descriptive statistics. Section 6 presents the empirical strategy. Section 7 presents the results. Section 8 concludes.

2 Impact of Financial Incentives in Higher Education

Though financial incentives in education attract the attention of many researchers, the specific topic of how university students respond to financial incentives remains limited.[2] While most studies tend to find a positive impact, its size varies depending on the context and the specific scheme that has been adopted. Below I describe the main studies in the literature.

Garibaldi et al. (2012) evaluate how an increase in the continuation tuition[3] affects the probability of late graduation by conducting a regression discontinuity design on data from Bocconi University in Milan, Italy. Garibaldi et al. (2012) show that a EUR 1,000 increase in continuation tuition reduces the probability of late graduation by 5.2% when the benchmark probability is 80%.

Gunnes et al. (2013) study the effect of a reform that rewarded students completing their higher education degree on time. The reform enabled that students in Norway completing certain graduate education programs in 1990-1995 received a restitution of NOK 18,000 (USD 3000) from the Norwegian State Educational Loan fund provided they graduated on time. By comparing treated and control programs in a difference-in-differences method, Gunnes et al. (2013) find that the average delay in the treatment group decreased by on average 0.8 semesters during the reform period, and by 1.5 semesters in the following two years.

[2] A related literature has studied the impact of financial incentives in primary and secondary education (Fryer Jr, 2011; Angrist et al., 2002; Angrist & Lavy, 2004; Kremer et al., 2009), and in PhD studies (Booth & Satchell, 1995; Ehrenberg & Mavros, 1992; Siegfried & Stock, 2001). Other studies focus for example on student selection and enrollment (Nielsen et al., 2010; Dynarski, 2003; Leslie & Brinkman, 1988; Fuller et al., 1982; McPherson & Schapiro, 1991; Kane, 1995) and on the relationship and funding of government and higher education institutes (Barr, 2004; Alexander, 2000; Hillman et al., 2014).

[3] Continuation tuition is a tuition fee, which is charged for each semester after students' expected degree completion period.

Scott-Clayton (2011) examines the PROMISE program in West Virginia, which offers free tuition to students who maintain a minimum GPA and course load. Scott-Clayton (2011) utilizes a regression discontinuity design and cohort analysis to identify causal effects. Scott-Clayton (2011) finds robust and significant impacts on key academic outcomes, which are especially large regarding time-to-degree. The PROMISE program increased bachelor's degree attainment rate by 1.8 to 2.3 percentage points and produced approximately 1,000 additional graduates over its first two cohorts.

Angrist et al. (2009) study the evidence of a randomized field experiment to answer how financial incentives combined with support services affect the academic performance of college freshmen. Angrist et al. (2009) observes a positive impact on women's grades and study skills, but the program has no effect on men. Though incentives were given only in first year, these differences continued to exist also in the end of second university year. Angrist et al. (2009) suspect that this is due to an increase in the study skills of women.

Especially close to this thesis' topic is the study by Leuven et al. (2010). Leuven et al. (2010) study the effects of a randomized field experiment, in which first-year undergraduate students in economics and business at the University of Amsterdam could earn financial rewards for passing 60 credits within one year, which form first-year requirements. Leuven et al. (2010) find that the average effects on the first-year pass rate are small, not statistically significant, and that there are no average effects on the number of achieved credit points by the end of the first year. Leuven et al. (2010) find that financial incentives affect positively in high-ability students but negatively in low-ability students. A potential explanation for why high-ability students react could be that high-ability students might have lower costs for reaching first-year goals. For example high-ability students could learn faster or be already closer to the 60 credit threshold than their low-ability peers. Hence, the cost of completing extra credits would be lower and the returns to cost be higher for high-ability students. Leuven et al. (2010) conclude that though financial incentives were only given during the first year, effects increased and were statistically significant after three years.

There also exists some evidence on the impact of financial incentives on university students in Finland. Häkkinen & Uusitalo (2003) studied the effects of a Finnish 1992 student aid reform with a duration model, when a loan-based student aid system was replaced with a system relying on student grants. Additionally, the maximum duration of the student aid was also reduced. Häkkinen & Uusitalo (2003) find only modest effects, limited to study fields with long median durations. However, they suspect that most of this decline in time-to-degree was due to increase in the unemployment rates, which reduced student employment opportunities.

The amount of relevant literature is limited, and to my best knowledge, there are no studies

of how continuous short-term monetary rewards affect on the academic performance of higher education students. Most of the existing literature also differs from the institutional setting of Finland, though the studies completed in Nordic countries are in this aspect quite close. From the existing literature we can however suspect that financial incentives could have a larger effect on high-ability students and decrease graduation times. It is also possible, that these effects increase during the following years after the treatment.

3 Universities in Finland

Finnish universities are quite young, as majority of them were established in the 20th century. Currently Finland has 13 universities, and had 153 400 university students in 2018. When compared to other Nordic countries, Finland has the largest amount of higher education institutes[4] (OECD, 2017). In 2018, the largest three fields were the field of arts and humanities, the field of business, administration and law and the field of engineering, manufacturing and construction. Approximately 54 % of students were female, though the amount varied a lot between fields of education. The highest number of students studied in University of Helsinki, Aalto University and University of Turku, respectively. Universities can select their students independently, and competition for university places among students is fierce. In 2018, only 25% of university applicants received an offer from a university. However, the reach of the Finnish higher education system is still high when compared internationally. In 2015, 43% of Finnish people between ages 25-64 had completed tertiary education, which raised Finland among the top EU member states, with the United Kingdom, Ireland and Norway (OECD, 2017).

In the beginning of 1990's in Finland, the university degree structure was reformed, and the bachelor's degree was introduced to most fields of study, with the exceptions of fields in medicine, technology and architecture (Ministry of Education and Culture, 2003). However, in 2005 due to the reforms of the Bologna Process, a two-tier degree structure with obligatory bachelor's degree was implemented to all fields, except for some faculties in the medical field. The Bologna Process was first launched in 1999, and it aims to create a common European Higher Education Area to increase the attractiveness and competitiveness of Europe's higher education system. Unlike in many other countries, the two-tier degree structure did not decrease graduation times in Finland, as in Finland students are often expected to graduate with a master's degree. In Finland, there are

[4]Finland has a dual higher education system, which in addition to universities has 23 universities of applied sciences. Universities focus more on scientific research and education based on it, while universities of applied sciences focus more on fulfilling the needs of the labor market.

no separate admissions processes between bachelor and master's degrees. On the contrary, when students sign up into a three year bachelor's degree, they automatically get a study right to the two years master's degree program in the same university, and they can even begin their master level studies before they have graduated from their bachelor's degree. As the minimum degree for many regulated professions is a master's degree, bachelor's degree currently does not have much of relevance in the Finnish labor market.

Before 2010 universities were owned by the state. After a change in university legislation in 2010, universities became independent legal entities, and now are either foundations or corporations under public law. Universities gained more responsibilities in organizing their own actions and funding. This change was in line with the trend in Nordic and European countries, which have aimed to increase the autonomy of public universities (OECD, 2017). The state continued as the primary financier of universities, and direct government funding covers about 64% of university budgets. Education is free, as there are no tuition fees for students coming inside the EU/EAA area. Students also receive financial aid during their higher education studies.

3.1 Financing of Universities in Finland

The Finnish government enhanced their role within universities in the late 1960's, when private universities were nationalized, new universities built, and the decentralized mass higher education system was built to increase the nations' level of education (Hölttä, 1998; Kupiainen et al., 2009; Seuri & Vartiainen, 2018). In the 1980's, the government increased their funding and with it, their interest in universities' effectiveness enhanced (Seuri & Vartiainen, 2018).

As the government is a major financier for universities, it can affect universities incentives. The Ministry of Education and Culture decides of a core funding model, which is usually determined for a four year time period. Each year, Finland's Parliament decides on the amount of core funding, which is then allocated to universities by the Ministry of Education and Culture. This core funding forms the largest part of university funding, but in addition to this universities also receive external public funding from the Academy of Finland, the Finnish Funding Agency for Innovation (Tekes), the European Union and other funding from foundations and enterprises.

After a long period of increased public university funding, Finnish university funding has stagnated and faced high cuts (OECD, 2017). In 2011 university funding was significantly decreased, with more cuts introduced in 2016, which increased the pressures of universities to be more efficient and collect external funding (Seuri & Vartiainen, 2018; OECD, 2017). This should also increase universities' incentives to fulfill the goals of the Ministry of Education and Culture's core funding

model in order to collect more public funding.

In 2013 the Ministry of Education and Culture renewed the criteria for university core funding, after which universities have been also funded based on the amount of students completing ≥ 55 credits per an academic year. Before 2013, universities were rewarded based on the amount of students completing ≥ 45 credits per an academic year, but this goal was considered to lack ambition (Ministry of Education and Culture, 2011). During 2013-2016 universities received 35% of their core funding from measures which determine students' academic progress. This funding was based on three measures: student's completing their master's degree (15%), completing their bachelor's degree (9%) and number of students who have gained at least 55 study credits in an academic year (11%) (Ministry of Education and Culture, 2011). In 2017-2020 these three components are 13%, 6% and 10% respectively and formed all together 29% of university core funding (Ministry of Education and Culture, 2015). Figures 11 and 12 in the Appendices show the whole funding model of universities, while table 3 in the Appendices shows the specific amount of core funding allocated to all Finnish universities in 2018.

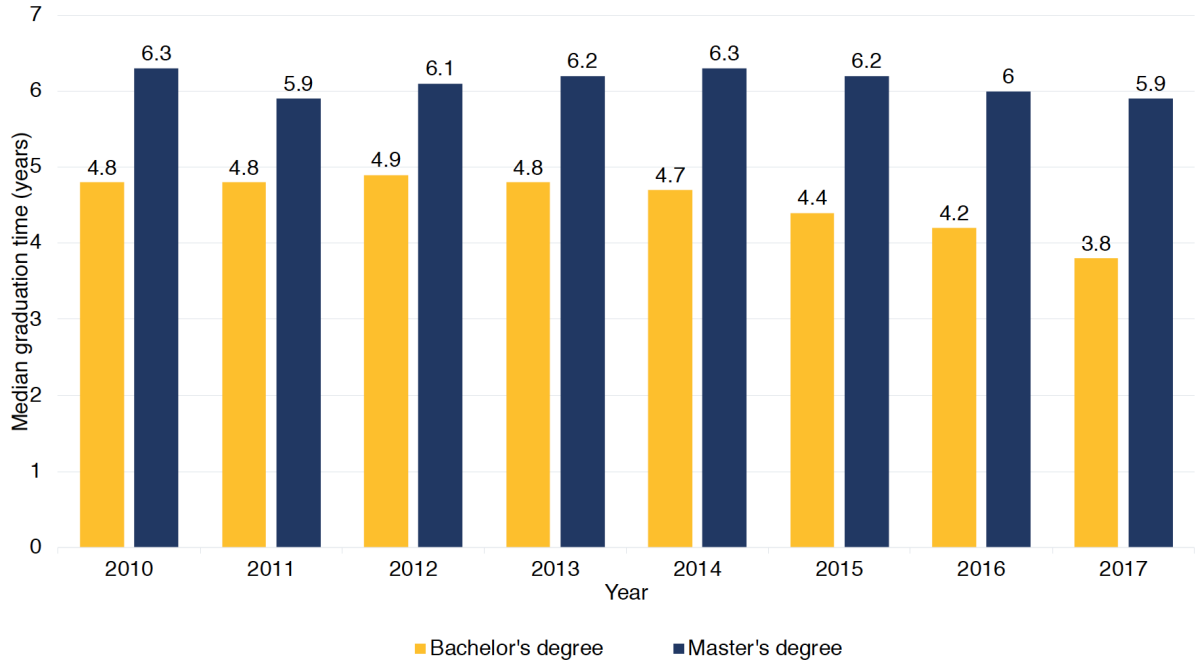
In the beginning of 2019 the Finnish Government decided of a new core funding model for universities, which will come into effect in 2021. This model differs from the previous ones, as here funding is no longer based on the amount of students completing ≥ 55 credits per an academic year. Instead, the model rewards universities for students graduating from their bachelor and master's degrees (11% and 19% of the core funding model, respectively). The funding of completed degrees is valued with different coefficients. The coefficients are the following: degree completed on target time (coefficient 1.5), degree completed ≤ 12 months after target time (coefficient 1.3) and degree completed > 12 months after target time (coefficient 1.0). Figure 13 in the Appendices presents all sections of the new funding model.

This change might affect how universities motivate their students to proceed in their studies. Before 2021, the core funding model has rewarded universities from student graduation, but the time it took for students to graduate played no part in the amount of funding. Also, students completing their bachelor and master's degree formed a smaller part of university funding than after 2021 (5 p.p. and 6 p.p. less, respectively). This might increase the role of financial incentives on student performance. Financial incentives could be short-term incentives, such as the Dean's incentive scholarship, or long-term rewards, which could for example reward students from graduating on time.

3.2 Graduation Times and Academic Progress

In Finland the median graduation time in 2001-2013 was 6.5 years (Statistics Finland, 2014). Figure 1 presents median graduation times from bachelor and master's degrees in Finnish universities. Graduation times from both degrees have declined from 2010 to 2017. However, the time of completing a degree is still behind target times. In bachelor's degree, the median graduation time in 2017 was 3.8 years, while the target graduation time is three years. In master's degree, the median graduation time in 2017 was 5.9 years, while the target graduation time to complete both degrees is five years.

Figure 1: Median graduation time



Notes: The figure is based on data from Vipunen (2019a). Graduation times for both bachelor and master's degrees are expressed as median years, in order to decrease the effect of outliers, e.g. students who have been in the university for several years, perhaps with no intention to graduate and with an eternal study right.

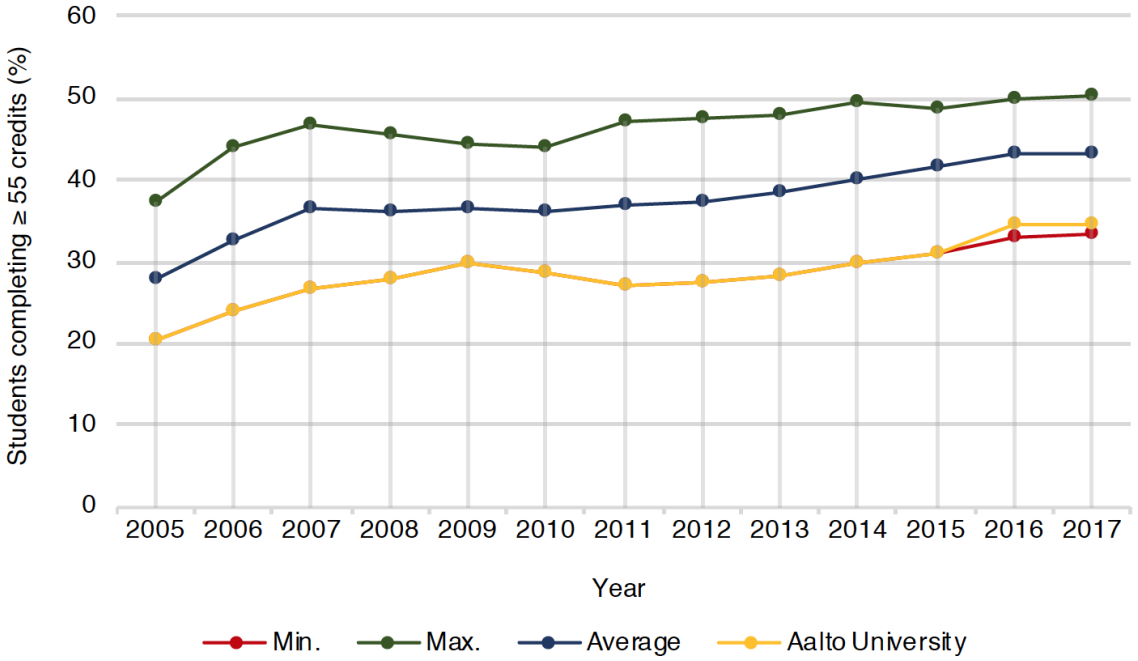
Meanwhile, the share of students who have completed at least 55 credits per academic year varies from 20-50% in different universities, as can be seen from figure 2. As graduation on time requires 60 credits per academic year, 55 credits is near the target. During 2005-2016, Aalto University had the smallest share of students completing at least 55 credits per academic year. However, in 2016-2018 Aalto University has slightly improved its performance. As employment

during studies is more common than the average for the whole country in Uusimaa[5] region (Official Statistics of Finland, 2019), it is possible that Aalto University students (and students in other universities in the Uusimaa region) work more, and hence perform studies at a slower pace. However, this cannot be the whole truth, as students in University of Helsinki have a higher share of students completing 55 credits annually than Aalto University, and in academic year 2017-2018 was 40.8% versus 34.5%, respectively. In addition, University of the Arts Helsinki has been among the top performers within the share of students completing at least 55 credits annually. These differences between universities could partly be due to e.g. differences in employment opportunities, nature of employment or university structures within universities' fields of study. Unfortunately, as I do not have data available of employment in different universities, I cannot confirm whether Aalto University students work more or less than their peers in other universities in the Uusimaa region. Other top performers in the highest share of students completing at least 55 credits per academic year include University of Eastern Finland, University of Turku and University of Oulu[6].

[5]Other regions with high student employment include Ostrobothnia, Southeast Finland and Åland.

[6]University of Oulu has been the only one to break the 50% share threshold. The university states that this is due to improvements in university structures and student campaigning. For more information please see Oulun ylioppilaslehti at `https://www.oulunylioppilaslehti.fi/55-opintopistetta-suorittaneet/`.

Figure 2: Share of students completing ≥ 55 credits per academic year



Notes: The figure is based on the data from Vipunen (2019b). Each line shows shares (in percent) of students completing at least 55 credits per academic year.

3.3 National Structures Affecting Academic Progress

In Finland, university studies are highly subsidized. This can be justified due to university education's positive externalities. Subsidizing happens if a student does not pay the full cost of their education in the form of tuition. Though subsidizing increases the net return of completing a higher education degree, it can lower students' effort as the subsidies are often received from study time and not for the study effort and completion of degree. Hence, students may be tempted to spend too much time in the education system and enjoy student benefits. In the following subsections I present the model of student subsidization, factors that might increase students' graduation times, and structures supporting students' academic progress.

3.3.1 Student Subsidization

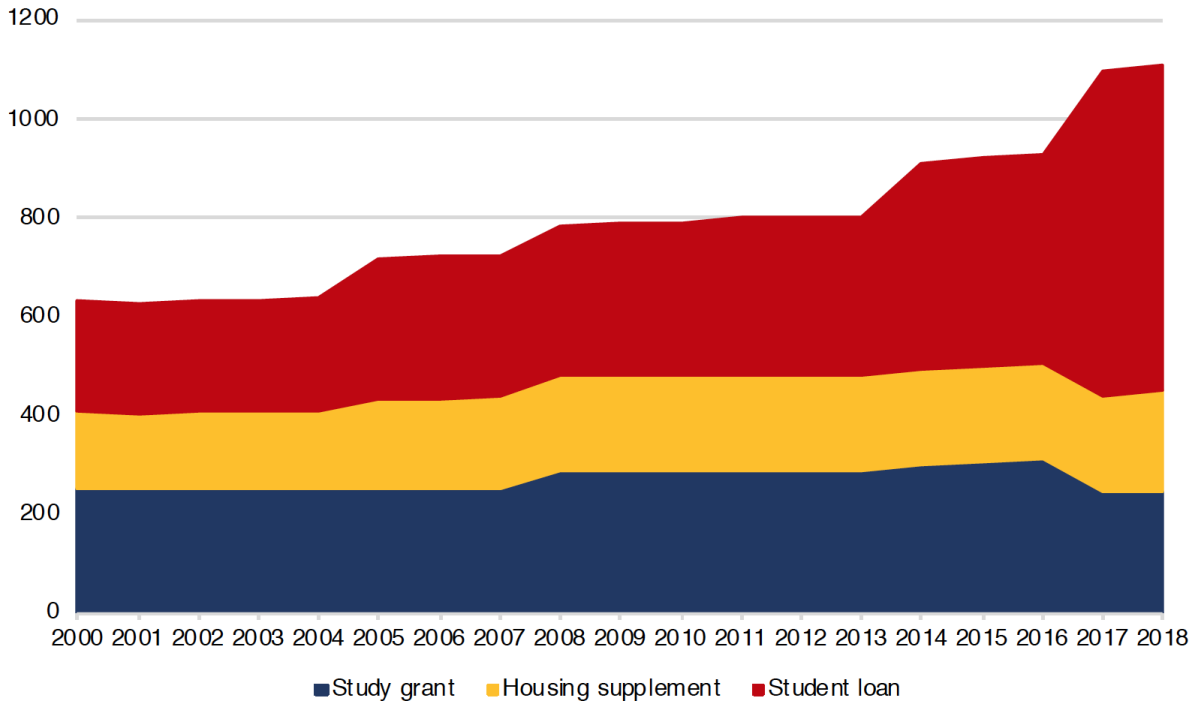
The Finnish society offers plenty of benefits for students. First, education for students is free as there are no tuition fees for students coming inside the EU/EEA area. Second, students receive monetary benefits from studying, including study grant, housing supplement, and student

loan (which form students' financial aid) from Social Insurance Institution of Finland, Kela, an independent social security institution supervised by the Finnish Parliament. Students also have an opportunity to get heavily subsidized meals from universities, cheaper public transportation, affordable health-care and other benefits. Student loans can also be compensated if a student graduates at most two years after target time.

The financial aid system has been through several reforms. Before August 2017, it is likely that students who begun their studies in different academic years have received different amounts of financial aid. On 1 August 2017 three major changes took place. First, before August 2017, some students received monthly study grant of either EUR 336.76 or EUR 303.19 depending on which year they begun their studies. Since August 2017 however, all students received a maximum of EUR 250.28 per month. Second, payment of student housing supplement ended and students were transferred under general housing allowance. Third, government guaranteed student loan was increased from the most typical loan amount of EUR 400 per month to EUR 650. After August 2017, low-income students living alone in rental accommodation could receive as much as EUR 450 more financial aid, but the aid decreased for students who did not qualify for the general housing allowance because of the income of their spouse, partner or another household member (Kela, 2019b). Hence, even though an individual would have a low-income level, one might not receive any housing allowance if a household member had high earnings. Figure 3 demonstrates the development of Kela's financial aid components for university students. The increase in student loan and decrease in study grant is clearly visible in the figure, while changes in housing supplement do not visually seem to have changed much. Figure 14 presents the average financial aid for university students, which in 2018 was EUR 885 per month.[7]

[7]Please note, that this is the real value for university students' financial aid, and so differs from the estimations in figure 3.

Figure 3: Average financial aid per month



Notes: The figure is based on data from Kela (Kela, 2018a, 2019c) and own calculations. The components above form the monthly financial aid. This amount is however merely an estimate of the division of financial aid, as Kela does not provide information on the components on university student level. Please see real values of university students' financial aid from figure 14 in the Appendices. As Kela has also changed its principles in study grant, housing supplement and student loan, it is important to notice that students are likely to have different amounts of financial aid and loan compensation.

Students might also receive a different amount of loan compensation. The student loan compensation can be at most 40 percent of the amount of outstanding student debt exceeding EUR 2,500. The amount of compensation depends on which year a student has begun one's studies, and is highest (40%) for those who have begun their studies after 1 August 2014. For most master's programs (worth 300 credits), the maximum amount of loan recognized is EUR 18,000 and the maximum amount of compensation is EUR 6,200. (Kela, 2019a,e).

3.3.2 Factors Increasing Graduation Times

Though the Finnish government heavily subsidizes higher education, most students work while studying. In 2017, 56% of students worked while they were enrolled in a university (Official Statistics of Finland, 2019). Students typically leave home when they begin higher education studies,

and face high living expenses especially in the Uusimaa region. Students cover approximately 50% of their living expenses with their salary, and spend approximately 20 hours a week in employment (Häkkinen, 2006). Though working while studying might increase graduation times, it does not necessarily do so, especially in the beginning of university studies (Saari, 2013).

In Finland, all male citizens have a duty to serve the country as conscript between ages of 18 to 28. The conscript, which is either military or non-military service, lasts either 165, 255 or 347 days. As conscription intakes can be on mid-year, while academic years start in August, one's university studies could be delayed as much as two years, depending on the intake date (Dobson, 2010). Other factors affecting negatively on graduation times include emotional and health aspects, uncertainties in career choices and employment prospects or combining studies with other time consuming activities such as student organizations or family life (Saari, 2013; Ketonen, Elina, 2017).

3.3.3 Structures Supporting Graduation on Time

Kela also has restrictions for receiving student aid. First restriction is related to study progress. University students must complete at least 5 credits on average for each month of financial aid and at least 20 credits in each academic year. Even if a student had received financial aid for only one month within a single academic year, one must still complete at least 20 credits. Students can however reduce the number of months of financial aid that are taken into account when monitoring study progress, by cancelling one's financial aid or by paying back received aid. If a student does not make satisfactory progress and fails to give an acceptable reason, then Kela can either discontinue the aid, make it payable for a specified period of time or require the aid to be payed back (Kela, 2019g).

The second restriction is related to student income, which affects the number of months a student can receive financial aid. For example, in 2018-2019 (2017 or earlier), if a student earns $\leq$ EUR 11,973 ($\leq$ EUR 11,850), then she can receive aid for 9 months. In 2018-2019 (2017 or earlier), in order for a student to receive aid for one month or more, student's annual income must be $\leq$ EUR 22,557 ($\leq$ EUR 22,330) (Kela, 2019f). Values for all number of months of aid and annual income limits can be found from table 4 presented in the Appendices. Financial aid restrictions aim to reduce graduation times, and increase the benefits of studying compared to working.

Student aid restrictions are not the only structures aimed to support graduation on time. In 2005, study right was cut down from an eternal study right to a limited study right, which is in most fields seven years for completing both bachelor and master's degrees (Finlex Data Bank,

2009). However, students can still register as absent for an academic year two times, without any consequences to the amount of study right. If a student is completing compulsory military service, completing national defense obligation or is on a maternity or paternity leave, then this does not affect the amount of study right or the amount of years a student can be absent. Students can also apply for a maximum of two years extension for their study time if they can present a goal-oriented and feasible plan to complete their studies. However, the amount of times one can apply for an extension is not limited so it is possible for students to apply for an extension as many times as they wish. An OECD report from 2010 stated that even though the legislation of study right limitation was introduced in 2005, it appears to be quite easy to extend study time (OECD, 2010). This is aligned with the public opinion in Finland, where media sources have reported that it is easy to apply for more study time [8]. However, as universities are funded from students graduating it might be difficult to change universities' incentives without changing this section of the core funding model.

4 Dean's Incentive Scholarship in Aalto University

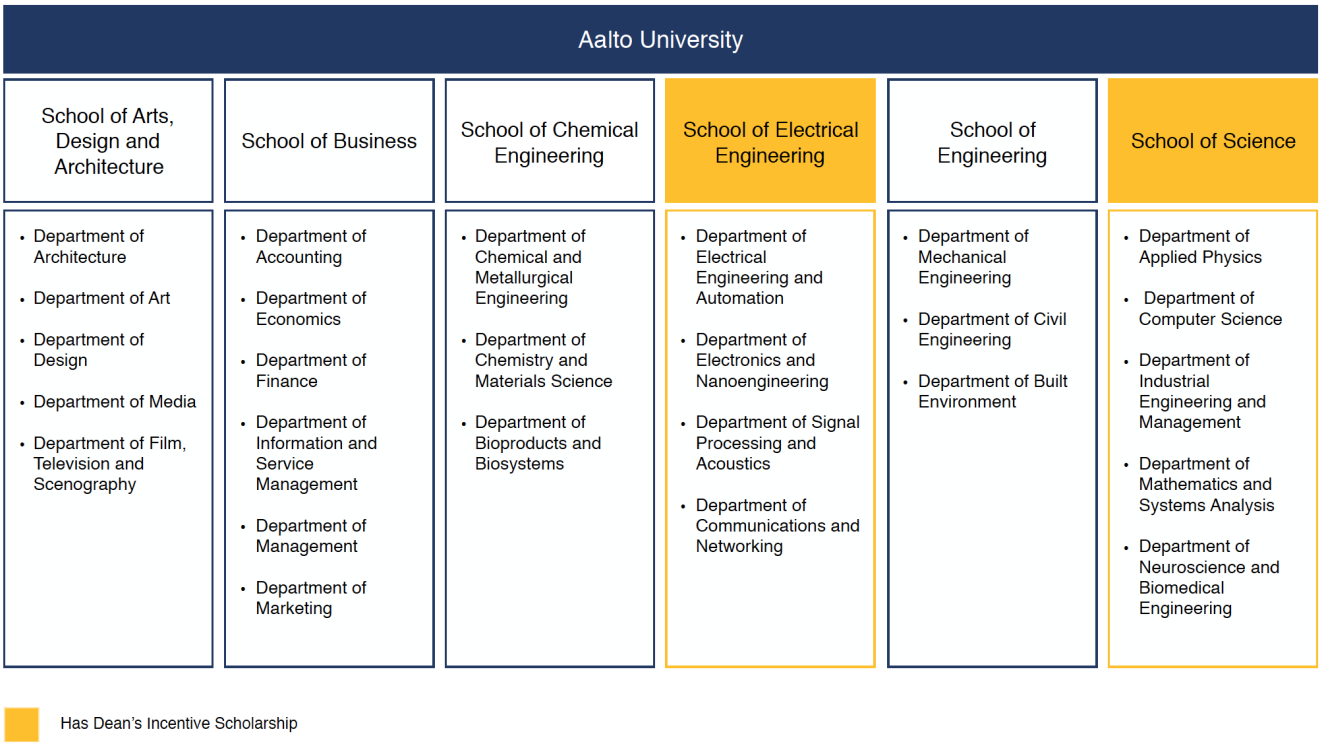
Aalto University was founded by merging the Helsinki School of Economics, Helsinki University of Technology and the University of Art and Design Helsinki. The idea of the merger was first presented in 2005 and in 2010 the merger was completed. Aalto University is a foundation based university, and formed its capital from donations worth of EUR 700 million (EUR 500 million Government donation and EUR 200 million from Finnish industries and financiers). Similar to other universities in Finland, Aalto University charges no tuition fees of its students coming inside the EU/EEA area[9].

At its current form, Aalto University consists of six schools: School of Arts, Design & Architecture, School of Business, School of Chemical Engineering, School of Electrical Engineering, School of Engineering and School of Science. Each school has a dean, an academic committee and own departments as in figure 4 below:

[8]For more information please see Yle News at https://yle.fi/uutiset/3-6268076, Turun Sanomat at https://www.ts.fi/uutiset/kotimaa/373941/Opintooikeus+katkesi+jopa+tuhansilta+korkeakouluopiskelijoilta and Suomen Kuvalehti at https://suomenkuvalehti.fi/jutut/kotimaa/opiskelijan-pelko-ehdinko-valmistua-seitsemassa-vuodessa/.

[9]However, students outside EU/EEA must pay an annual tuition fee, which varies between EUR 4000-18 000. For additional information please see Study in Finland at http://www.studyinfinland.fi/tuition_fees_and_scholarships/non_eu_tuition_fees_and_scholarships.

Figure 4: Aalto University schools



Notes: The figure shows all Aalto University Schools. It separates the two schools, which took Dean's incentive scholarship into use from those schools, which did not. School of Chemical Engineering has its own stipend, which rewards students from graduating on time from bachelor or master's degree. This school does not belong either in the treatment or control group, and so it is left out of the analysis.

Out of the schools in figure 4, School of Electrical Engineering and School of Science have utilized an incentive scheme, which will be later on referred as the Dean's incentive scholarship.

The Dean's incentive scholarship is a fairly new incentive method for encouraging students to complete their studies on time within an academic year. An academic year begins 1st of August and ends next year on 31st of July. The Dean's incentive scholarship was first introduced in academic year 2016-2017, is worth EUR 500 and is awarded for completing 60 credits per an academic year, according to a criteria set by a given school. Currently only two Aalto University Schools, School of Electrical Engineering and School of Science, have taken the scholarship into use. In academic year 2016-2017 School of Electrical Engineering admitted the scholarship only for bachelor students, but next year they also admitted the scholarship for master level students. In academic year 2017-2018 School of Science also admitted the scholarship for both bachelor and

master level students. Both schools have quite similar criteria for receiving the scholarship.[10]

School of Arts, Design and Architecture, School of Business and School of Engineering have not utilized the Dean's incentive scholarship [11]. School of Chemical Engineering has a scholarship rewarding students graduating on time from their bachelor or master's studies. As this scholarship's effects might bias the results, I leave this school out of the analysis.

As the Dean's incentive scholarship was first introduced in the end of October 2016, the scholarship might not have motivated students as strongly as it could have had. At this time, students had already done their study planning and completed one period of the academic year, which has five periods. In academic year 2017-2018 the school informed the students about the scholarship in the beginning of the academic year, in September 2017, and students had more time to plan their studies and complete credits. Hence, the scholarship could be more motivating in later academic years.

5 Data

I use data of the academic performance of all Aalto University students in 2013-2018. The Aalto University data combines students' all academic performances, and contains rich information on gender, nationality, courses completed, date of completion, grades, school and other variables on an individual level. I also have data on how much Aalto University and all Finnish universities combined have received funding in all core funding components in 2013-2018.

My main focus is in the effects of the Dean's incentive scholarship, which was taken into use in October 2016. I compare the evolution of Aalto University schools, which took the Dean's incentive scholarship into use to those which did not. The treatment group consists of School of Electrical Engineering and School of Science. The control group consists of School of Arts, Design and Architecture, School of Business and School of Engineering. School of Chemical Engineering was left out of this analysis as they have another stipend, which could bias the results if it were included

[10] Some differences: School of Electrical Engineering (School of Science) requires that 30/60 (24/60) credits have been pre-registered in a study plan. School of Science also requires that a student is present when academic year ends and that bachelor degree students applying for the scholarship have been studying no longer than seven years. For more information please see the websites of School of Electrical Engineering at `https://into.aalto.fi/display/fikandelec/Dekaanin+kannustusstipendi` and School of Science at `https://into.aalto.fi/display/fikandsci/Dekaanin+kannustusstipendi`.

[11] However, some schools have other stipends for rewarding excellent students, e.g. School of Business bachelor students can receive a stipend from Ilkka Kontula Foundation worth EUR 1,000 if they have excellent academic performance and have completed at least 80 credit units during their first three terms.

in the analysis. I also conduct a cost-benefit analysis on the perspective of Aalto University to find out whether the scholarship was financially profitable for the university.

I am focusing on student performances until academic year 2017-2018. Students are observed within each academic period during the academic year. The dataset includes information on 27,218 individuals on different academic years. The control group consists of 17,852 students and the treatment group of 9,366 students.[12]

The share of students completing at least 60 credits per academic year is extremely low. On average only 21% of all Aalto University students complete at least 60 credits annually. Students remain far from the 60 credit threshold, and complete on average only 40.5 credits per academic year, with no large variation between the schools. The share was lowest in the School of Arts, Design and Architecture (15%) and highest in School of Business (26%). Meanwhile, the average grade was 3.6 on a scale of 1-5.

Approximately 35% of Aalto University School students are female, with the highest percentage being in the School of Business (45%). All schools have a high share of Finnish students, with the share in all schools combined being 87%. Table 1 further demonstrates the most relevant statistics.

Table 1: Descriptive statistics

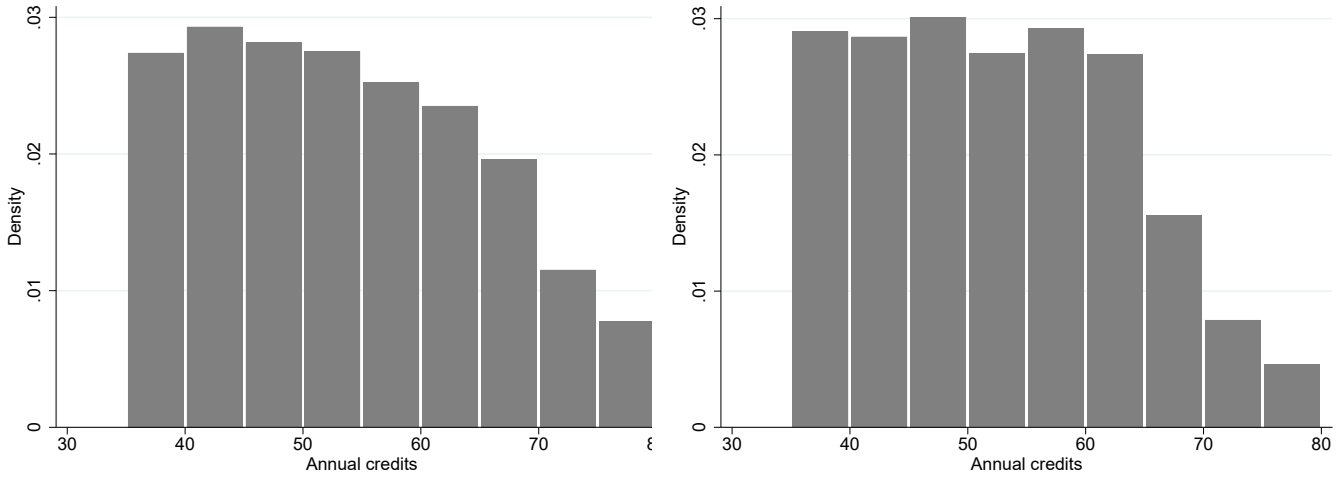
School	Female	Finnish	Annual credits	$\geq$ 60 credits	Average grade	Students
Arts, Design & Architecture	67%	83%	38.0	15%	3.9	5,145
Business	45%	88%	43.7	26%	3.8	6,908
Electrical Engineering	15%	88%	39.3	18%	3.4	4,308
Engineering	22%	91%	41.5	23%	3.4	5,799
Science	19%	84%	39.0	20%	3.8	5,058
Chemical Engineering	40%	91%	40.0	18%	3.3	2,316
All schools	35%	87%	40.5	21%	3.6	29,534

Notes: The table shows descriptive information of shares (in percent) of female and Finnish students, and share of students completing at least 60 credits annually. The table also shows amount of average annual credits completed, average grade and amount of students. This information is presented by school level, and from all Aalto University schools.

[12]Additionally, there are 2,316 students in the School of Chemical Engineering.

Figure 5 shows the distribution of annual credits in treatment and control groups during pre-treatment period. The figure shows that neither of the groups increase their effort in the 60 credit threshold. On the contrary, figures 5a and 5b show a decrease in the 60 credit threshold. This suggests that students near the 60 credit threshold do not conduct additional effort to reach the threshold, even though they would be very close to it.

Figure 5: Annual credits in pre-treatment period



(a) Control group

(b) Treatment group

Notes: The figure shows two histograms from the pre-treatment period. Subfigure 5a shows the annual credits completed by the control group, while 5b shows those of the treatment group. Both figures show no significant increases in any credit threshold.

It is important to notice that the data does not show whether a student has utilized a course's credits and grade in their degree. Hence, it is possible that even though an individual student in the treatment group has completed 60 credits in an academic year and received Dean's incentive scholarship, that student might not graduate any faster. As the data contains only one full academic year after taking the scholarship into use, I can only observe the scholarship's short-term effects. Also, as the data does not show which students are bachelor and master students, I cannot make reliable conclusions of how the scholarship affects graduation times or students who are completing different level degrees (bachelor or master).

6 Empirical Strategy

6.1 Design

To estimate the effects of the scholarship, I use a difference-in-differences method. Here I use the evolution of the outcome variable in the control group to construct a counterfactual of what would have happened in the treatment group without the treatment. I estimate the following equation:

$$Y_{it} = \alpha + \beta T_i + \gamma A_i + \delta(T_i * A_i) + \kappa X_i + \eta_i + \varepsilon_i \quad (1)$$

The outcome variable Y_{it} measures three different outcomes, share of students completing at least 60 credits per academic year, amount of annual credits and average grade. I will study these three different outcomes in the section 7 below, respectively.

The difference-in-differences method recognizes that treatment and control groups can differ from each other. T refers to treatment status $T = 0, 1$, where 0 indicates the group which does not receive any treatment (control group) and 1 indicates the group that receives treatment (treatment group). A refers to two time periods $A = 0, 1$, where 0 indicates the time before the treatment group received the treatment (i.e. pre-treatment period, before academic year 2016-2017) and 1 indicates the time period after the treatment group receives treatment (i.e. post-treatment, beginning from academic year 2016-2017). Every observation is indexed by the letter $i = 1, ..., N$, where most individuals (those before beginning their studies at the latest in academic year 2016-2017) have two observations, one pre- and one post-treatment. X_t is a vector of covariates such as dummy variables for gender, nationality, year of entry and school. ε is an error term. β is the treatment group specific effect accounting for average differences between treatment and control groups, γ refers to the time trend common for treatment and control groups and δ is the true effect of treatment (the difference-in-differences causal effect, which I aim to find a good estimate for). As students within a certain school are likely to be quite a homogeneous group and academic years might correlate within performance, standard errors are clustered within school and academic year level. I also control for fixed effects on individual level. η refers to student level fixed effects.

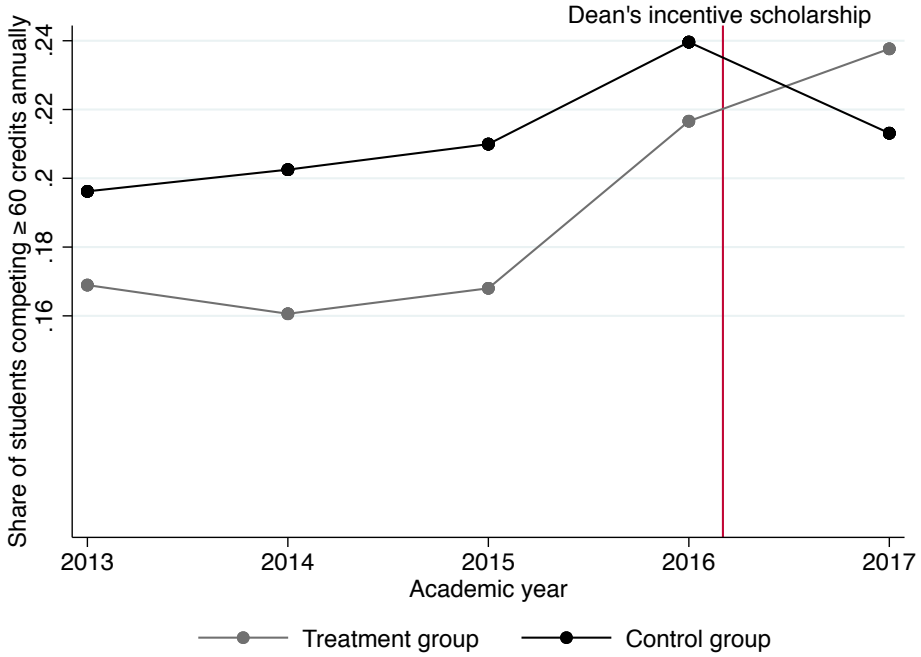
6.2 Assumptions

The difference-in-differences strategy relies on three assumptions. First assumption is that the treatment and control group would have evolved similarly in the absence of the treatment. This is a strong assumption, and difficult to certainly state as true. During years 2013-2015 the share of students completing 60 credits or more remained steady, while in 2016 there was a large increase in

both groups. In 2017 however, there was an intriguing change of development, and the two groups evolved in opposite directions. In the control group, the share of students completing 60 credits or more decreased, while it increased in the treatment group. Then, if the assumption is satisfied, we should expect that in absence of the treatment, the share of students completing at least 60 credits annually would have also decreased in the treatment group. Figure 6 supports that the assumption is fulfilled within treatment and control groups, though it does not completely ensure this. It is reassuring however, if the treatment and control groups have evolved similarly before the Dean's incentive scholarship. As shown in table 2 column 1, we cannot reject statistically that the two groups evolved similarly in the past.

Figure 6: Share of students completing at least 60 credits per academic year

(a) Graph: Treatment and control groups before and after treatment



(b) Table: Treatment and control groups before and after treatment

Treatment	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
0	0.196	0.202	0.210	0.240	0.213
1	0.169	0.161	0.168	0.217	0.237

Notes: Subfigure 6a shows graphically how the treatment and control group have evolved before and after treatment, while 6b shows the numerical values.

Second assumption is that the timing of the scholarship should have been as good as random. When considering this assumption from the students' point of view, I have reason to believe that the assumption is fulfilled. In most schools' deans made the decisions whether to take the scholarship into use or not without involving the students. The only exception here is the School of Arts, Design and Architecture, where the school asked for the students' opinion. Here however, the students decided to not utilize the scholarship and instead wished that the money would be used to improve the school and teaching.

Third assumption is that there should be no other policies introduced at the same time, which could have affected the treatment or control group. In August 2017, Kela changed the structure of students' financial aid as presented in subsection 3.3.1. Before this students were likely to receive different amounts of financial aid if they had begun their studies on different academic years. This could potentially affect some students, and increase incentives for those low-income students who received smaller amount of financial aid than their low-income peers, who had begun their studies in a different academic year. Even though the reform in August 2017 in many ways unified financial aid for students, it also caused some inequalities. Through the transfer from student housing supplement under general housing allowance, those low-income students who lived alone in rental accommodation received higher amount of aid than those of their equally low-income peers, who did not qualify for the general housing supplement because of the income of their spouse, partner, or other household member. Hence, even after the reform it is likely that some students had more need for other financial support. The assumption could be violated, if students from certain schools are more likely to receive different amount of housing supplement for example because they have a high-income partner or live in a different municipality. However, students' relationship status or living with a high-income household member does not likely differ significantly between schools. Though some Aalto University school students are more likely to live in different municipalities[13], the differences in housing supplement in these municipalities are not high, especially when compared to rental expenses. Table 5 presents maximum housing costs in different municipalities. To the best of my knowledge the assumption should be fulfilled.

Fourth assumption is that the treatment should not have affected the control group in the post-treatment period. Though the Dean's incentive scholarship is only given to students in treatment group schools, there may be some individual students who are enrolled in more than one school, and might be qualified to receive a scholarship. In theory it is possible that a student enrolled in both treatment and control group schools might be motivated by the scholarship, and would because of the scholarship complete more courses in the treatment school, and reduce courses in control school. However, as the amount of these students remains likely small, this should not endanger the assumption. As all assumptions seem to be fulfilled, I can interpret my results from difference-in-differences estimation as causal.

[13]Students from technical schools might have lived more often in Espoo and students from School of Business and School of Arts, Design & Architecture in Helsinki due to later moving schedules of these schools from Helsinki to Otaniemi, Espoo.

7 Results

Below I discuss the results. First, I present the effects of the Dean's incentive scholarship on the share of students completing at least 60 credits, completed annual credits and grade. Second, I conduct a cost-benefit analysis from the perspective of Aalto University.

7.1 Effects of the Dean's Incentive Scholarship

7.1.1 Main Results

My main set of results are presented in table 2, which shows the relations and effects of the Dean's incentive scholarship on the share of students completing at least 60 credits, completed annual credits and grade.

Column one shows the development of the share of students completing at least 60 credits per academic year. In the first post-treatment year, academic year 2016-2017, the scholarship increased the share of students that complete 60 credits by 1.8 percentage points, though was not statistically significant. In the second post-treatment year, academic year 2017-2018, the scholarship increased the share of students that complete 60 credits by 4.6 percentage points compared to control group, and was statistically significant.

The share of students affected positively by the treatment appears to have increased rapidly in a relatively short time period of only two academic years. However, some caution is required when interpreting the results due to lack of statistical significance in the first post-treatment year. These increasing effects of financial rewards in later years are consistent with existing literature. A considerable difference is that in the existing literature financial incentives were only given in the first year of studies. As the Dean's incentive scholarship is a short-term continuous reward, it might have even larger effects on future years. 4.6 percentage points equals to approximately 430 students, who might graduate on target time if this pace begins from first year of studies and continues through their studies. When compared to the median graduation time of 6.5 years, this would mean that approximately 430 students might have a 1.5 year longer career than their peers, when there are 9,366 students in the treatment group (table 1). As Aalto University also receives funding from these students, it might affect positively on the quality of university studies and resources.

Table 2: The effect of scholarship on credits and grade

	$\geq$ 60 credits	Annual credits	Grade
Treatment*2014	-0.011	-0.356	-0.022
	(0.017)	(0.725)	(0.087)
Treatment*2015	-0.011	-0.664	-0.100
	(0.019)	(0.889)	(0.092)
Treatment*2016	0.018	0.765	-0.071
	(0.023)	(0.954)	(0.107)
Treatment*2017	0.046*	1.870*	-0.075
	(0.025)	(1.043)	(0.129)
Fixed effects	yes	yes	yes
Adj. R-squared	0.5	0.6	0.3
N	59,064	59,064	41,756

* p<0.10, ** p<0.05, *** p<0.01

Notes: Standard errors are in parentheses. Fixed effects are controlled on individual level, and outcome grade on course level.

Column two shows the development of annual credits. In academic year 2017-2018, annual credits increased by 1.87. This could suggest that the scholarship had the largest effect on students near the 60 credit threshold or high-ability students, as they have lower costs on reaching the threshold. This is also consistent with the existing literature.

Both outcomes' lower values and lack of statistical significance in the first post-treatment year might be due to the fact that the Dean's incentive scholarship was introduced in the middle of the academic year, in October 2016. This might have decreased the effects, as students had already done their study plans, and completed one study period out of five. In academic year 2017-2018 both outcomes are positive and statistically significant. This is a positive signal regarding the scholarship's effectiveness, and implies that we can rule out the possibility of the scholarship decreasing students' annually completed credits.

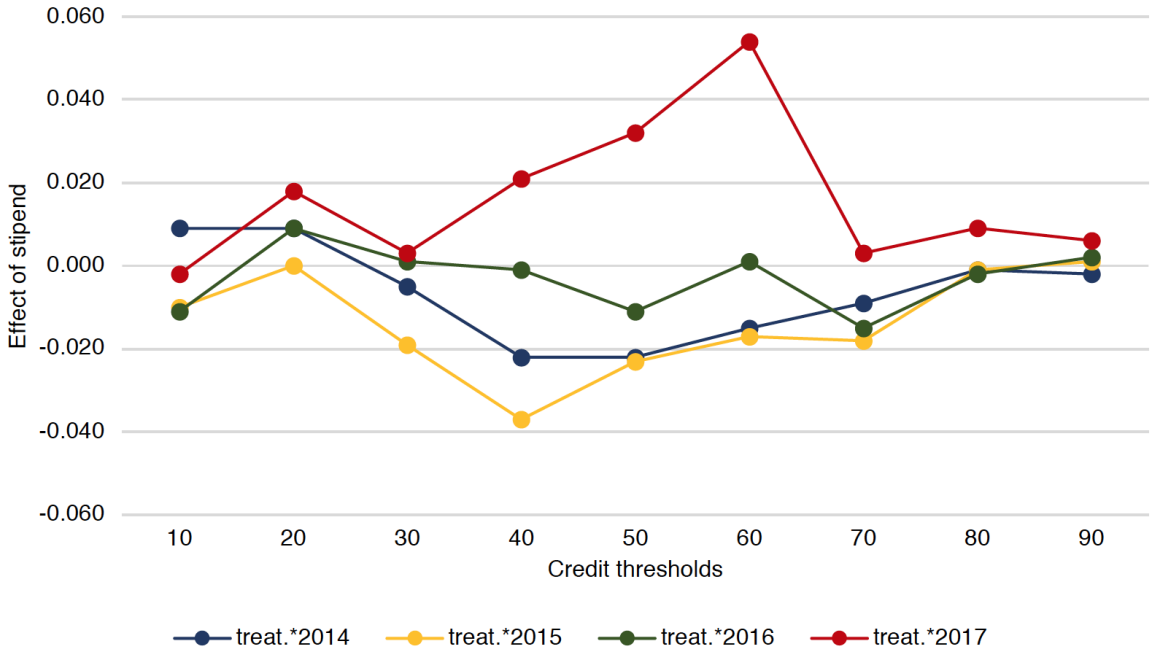
Column three shows how students' average grades have developed. I conducted this regression

at course level to control for course fixed effects. The column shows a decline in grades for the entire time period, though none of the values are statistically significant. However, we can likely assume that the scholarship does not increase students' grades. This could suggest that though students increase their time spent on studying, they do not increase it enough to preserve or improve learning outcomes. It is also possible that students do not increase their time of studying at all, but rather allocate their time between a larger number of courses, which then would decrease students' learning outcomes. This is in line with the concept introduced in section 1, which stated that the way students allocate their effort is uncertain (Holmstrom & Milgrom, 1991).

7.1.2 Effects on Credit Thresholds

To further examine the scholarship's effects on credits completed, we can study its effects on different credit thresholds. Figure 7 and table 6 in the Appendices study the effects of the Dean's incentive scholarship on different thresholds of completed annual credits. Figure 7 shows, that the effect is largest in academic year 2017-2018 at the 60 credit threshold (0.054 from table 6). As the effect is especially visible in the 60 credit threshold, this could imply that students are encouraged by the Dean's incentive scholarship to complete 60 credits per academic year. Table 6 shows that the result is statistically significant at a 1% level, which increases the reliability of this estimate. Meanwhile, in academic years 2014-2015, 2015-2016 and 2016-2017 there are no similarly large jumps in the 60 credit threshold though in academic year 2016-2017 there is a small increase in the 60 credit threshold. This also supports the deduction presented earlier in this section, that as the Dean's incentive scholarship was introduced in the middle of academic year 2016-2017, it did not have enough time to reach best results. However, in academic year 2017-2018 students knew about the scholarship before planning their studies and had better opportunities to change their behaviour.

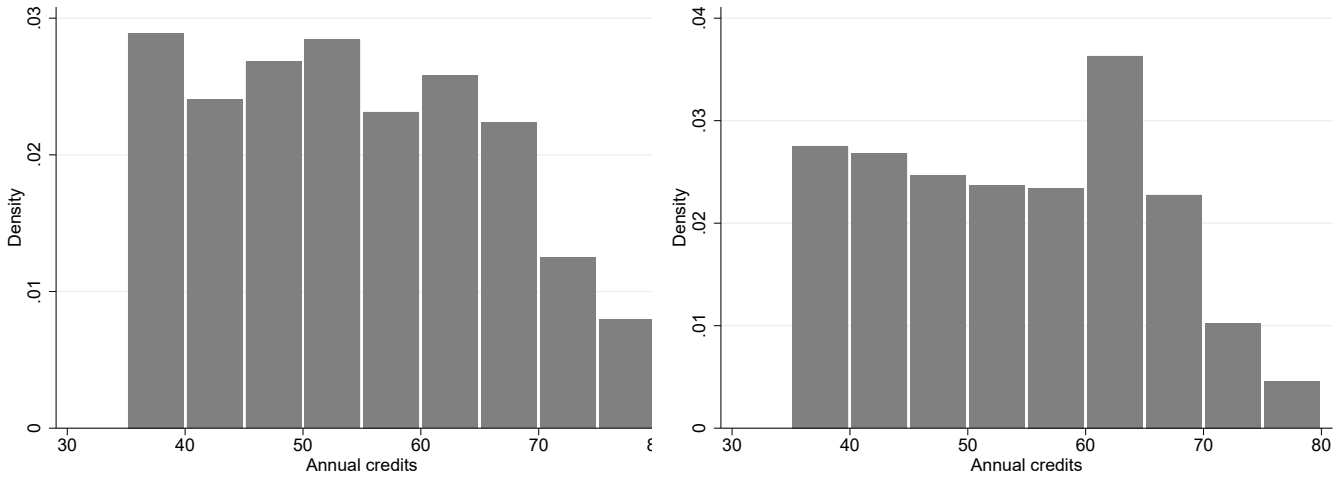
Figure 7: The effect of Dean's incentive scholarship on different thresholds



Notes: The figure shows the effects of Dean's incentive scholarship on different credit thresholds in the treatment group during pre- and post-treatment periods.

In order to compare the development of credits completed between control and treatment groups, figure 8 shows the distribution of completed annual credits in treatment and control groups during post-treatment period. The figure shows a clearly visible change in credits completed among the treatment group in the 60 credit threshold. Meanwhile, there are no similar effects in the control group. This supports the conclusion that the scholarship affected the treatment group positively, and motivated students as it was planned to. Especially high-ability students and other students near the 60 credit threshold have more incentives to do few additional courses and so receive the EUR 500 scholarship. Additionally, some students could also apply their credits earlier e.g. from exchange studies, where credits are admitted by request. Then, it is also possible for some students to achieve the 60 credit threshold with extremely low effort.

Figure 8: Annual credits in post-treatment period



(a) Control group

(b) Treatment group

Notes: The figure shows two histograms from the post-treatment period, where subfigure 8a shows the annual credits completed by the control group, and 8b shows those of the treatment group. 8b shows a visible jump in the 60 credit threshold.

7.1.3 Limitations

Though the results provide interesting insights of the scholarship's effects, there are three potential threats to validity. First, the post-treatment period is relatively short, with only two post-treatment period observation points and only one full post-treatment period observation point. Then, it is impossible to observe whether the scholarship has increasing effects on later academic years, such as the existing literature suggests. With more data from later academic years, I could observe a larger amount of significant results and deduct possible trends. Second, though I discussed the difference-in-differences assumptions thoroughly in subsection 6.2, it is possible that they do not hold.

Finally, it is possible that if the students in the treatment group increase their study effort, then this behaviour might spill over to their control group peers. This could for example happen in the case of elective or minor studies. In Aalto University, all students can to some extent take courses from other schools. Let us consider a situation, where few control group students take a course in a treatment group school, where a majority of students are from the treatment group. Let us also assume that the course has a few group assignments, and groups are assigned randomly. Then, if the scholarship affects treatment group students in a way that they work harder, the control group

students might feel pressured to increase their effort as well when they see other students working harder, and perhaps pressuring control group students to participate more in group assignments. Possibly, the control group students could carry the hard working habits to other courses as well, where they could spread these new habits to other control group students. However, I consider spillover effects to be quite unlikely for three reasons. First, the example above had quite a few assumptions. If we remove one assumption e.g. that the control group students would not observe their peers' increased effect (no group work), they consider the course to be too demanding and drop it, simply do not care if other people increase their effort or if treatment group students do not increase their effort, but rather allocate their study time differently (and spend less time per course), then the scenario would collapse. Second, the amount of students participating in other school's classes might not be significant, as students often complete elective courses and minors within their own school, though in a different department. Third, it is unlikely that these potential newly learned working habits would be sustained with individuals, who had not worked hard in their previous studies (minor studies and electives are generally completed after at least some own programme studies), not to mention that these new habits would spread to other control group students as well.

7.2 Cost-benefit Analysis

From table 2 we can see that in academic year 2017-2018 the Dean's incentive scholarship increased the share of students that complete 60 credits by 4.6 percentage points. Meanwhile, table 6b shows that in the same time 23.7% of the students receive the scholarship. Then, 19.1% of students in the treatment group would have completed 60 credits even without the treatment. For motivating one more student to complete 60 credits annually, Aalto University pays also to four other students, who would have completed these credits even without the scholarship. Then the cost for Aalto University to motivate one more student to complete 60 credits per academic year is approximately EUR 2,500.

In 2013-2018, Aalto University received on average EUR 3,738 for each student completing 55 credits, while all Finnish universities received on average EUR 3,299.[14] However, in 2017 the

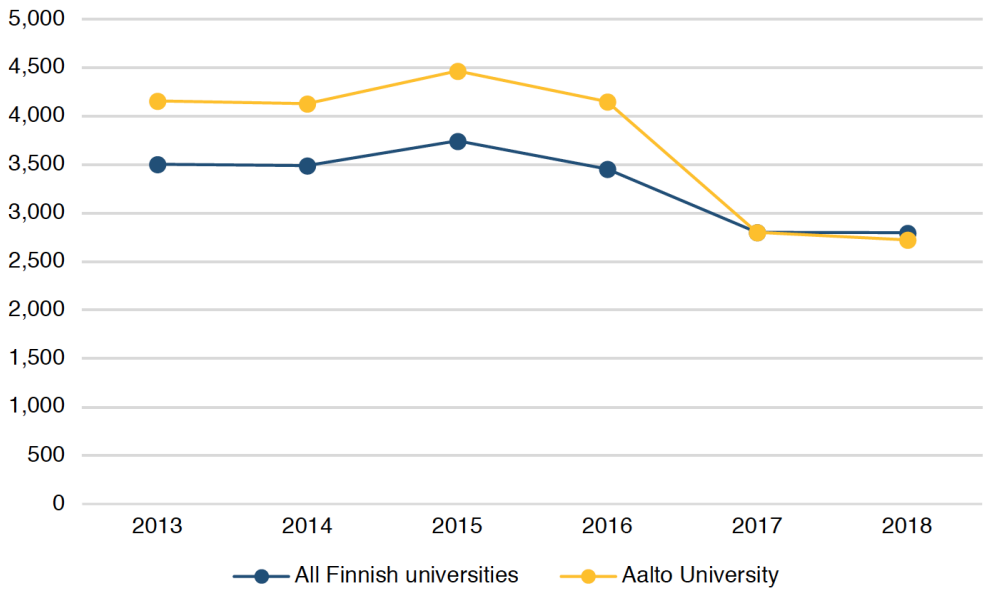
[14]Different estimations of university funding for students completing 55 credits have been presented in various media sources, with estimates going to EUR 6,400 at highest. These values have been presented on Aamulehti newspaper at Aamulehti newspaper at `https://www.aamulehti.fi/kotimaa/yliopistot-kuittaavat-ahkerasta-opiskelijasta-yli-6000-euroa-kannustaa-ymparivuotiseen-opiskeluun-23831225` and Kaleva newspaper at Kaleva newspaper at `https://www.kaleva.fi/uutiset/kotimaa/yliopistot-kuittaavat-ahkerasta-opiskelijasta-yli-6000-euroa-myos-opiskelijat-havahtuivat/734720/`. However, as these media sources provide no calculations, I cannot be sure how they have estimated these returns.

amount of funding per student decreased, and was EUR 2,802 in 2017, and EUR 2,724 in 2018. Hence, Aalto University gained a return per additional student of EUR 302 in 2017, and EUR 224 in 2018. Though the amount of funding decreased, the Dean's incentive scholarship was a profitable investment for Aalto University as it brought monetary returns to the university.

The decreases in funding per additional student are likely due to the overall decreases in university funding, which are decided annually by the Finnish Parliament. A smaller factor is the change in the core funding model in 2017, where in 2017 universities received 1 percentage point less funding from students completing at least 55 credits annually, with a drop from 11% to 10%. As the absolute amount of core funding shared between universities doesn't increase, then when the amount of students completing at least 55 credits annually increases, it decreases the marginal value of each student if a university doesn't increase its share more than other universities. Figure 9 shows the changes in university funding while figure 10 shows the changes in the amount of students completing at least 55 credits per academic year. Table 7 in the Appendices presents more detailed information of university funding.

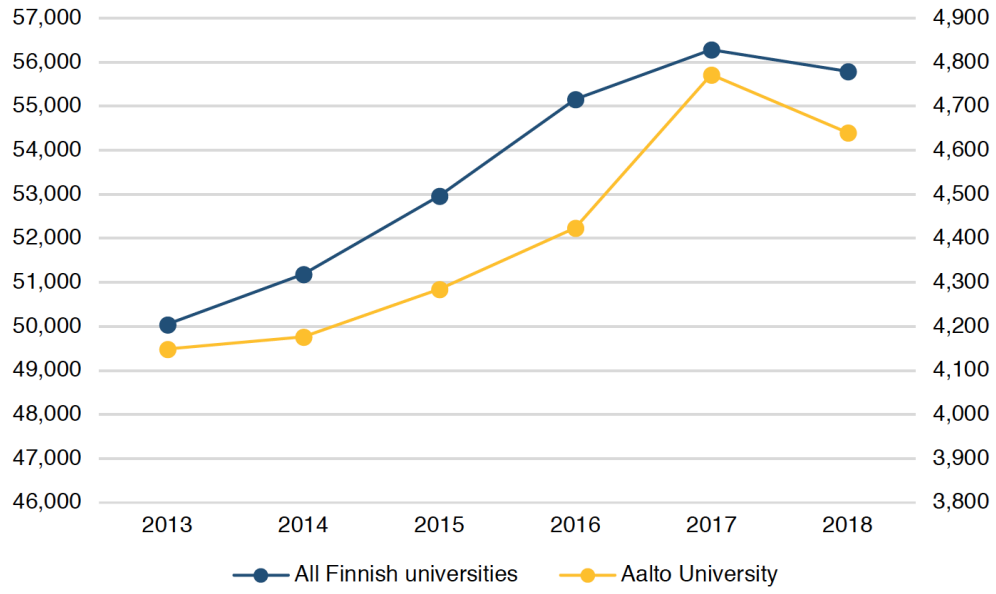
To better understand the scholarship's effects, I present a hypothetical example. Let us assume that the scholarship was taken into use in all Aalto University schools in the beginning of academic year 2017-2018, and it had similarly motivated one out of five students to complete 60 credits annually. At the time, there were 4,641 university students who completed at least 55 credits per academic year (table 7 in Appendices). Then, the amount of students completing 60 credits annually would have increased by approximately 928 students $(4,641 * 1.2 - 4,641)$, who all completed 60 credits because of the treatment. Thus, the scholarship would had brought Aalto University approximately returns of EUR 207,872 $(928 * 224)$. However, as we cannot be certain that the scholarship would have similar effects in all schools, this serves merely as an example of the scholarship's possible effects on a larger scale.

Figure 9: University funding of students completing at least 55 credits per student



Notes: The figure is based on data from Aalto University, Vipunen (2019b) and own calculations.

Figure 10: Amount of students completing at least 55 credits per year



Notes: The figure is based on data from Vipunen (2019b). Left y-axis describes the amount of students with at least 55 credits per year in all Finnish universities, while the right y-axis describes the amount of students in Aalto University. X-axis describes years.

Universities also receive funding from students graduating from their bachelor and master's degrees, which was not taken into account in the previous analysis. These returns become especially meaningful in 2021, as then the core funding model no longer rewards universities from students completing at least 55 credits annually. Instead, student graduation will become a more significant measurement in university funding. Unlike before, the amount of funding will also be affected by graduation times. Then, students who graduate on target time will be more valuable to the university. Table 8 in the Appendices shows the funding from bachelor and master's degrees, and their share of university funding.

7.3 Discussion

If the Dean's incentive scholarship was more valuable in terms of money than EUR 500, it would likely motivate more students to complete 60 credits annually. However, if the costs per additional student increase while the marginal value of each student decreases, the returns of the scholarship could quickly turn negative. As Aalto University currently has a low share of students completing 55 credits annually when compared to other universities (figure 2), and many universities have steadily increased their share of these faster graduating students, I consider it to be likely that with a more valuable scholarship the returns for Aalto University could turn negative. This prediction would not apply, if the real returns of the stipend would be higher (as if the university's funding from student graduation would also be calculated in the estimate), if Aalto University would increase its share of students completing at least 55 credits annually fast enough when compared to other Finnish universities or if the Finnish Parliament would substantially increase its funding for universities (in total or in this criteria).

Though I do not observe the scholarship's effect on graduation times or learning outcomes (grades or course selection), I can make a few speculations. It is important to keep in mind that students can within certain constraints choose, which courses they keep in their official bachelor and master's degree reports. This could have at least three different effects. First, as the incentive scheme relies on the number of credits completed, it may motivate students to switch their effort from courses which they struggle to pass to courses, which they expect to gain higher grades. This might be a problem, if the more difficult courses would have been more valuable from a human capital perspective.

Second, students could complete easier courses to reach the annual 60 credits threshold, then drop these courses out of their degrees, and replace them with more difficult and valuable courses. In this scenario, students would still receive the scholarship, but would not graduate any faster.

On the contrary, graduation times could even increase. This would certainly be undesired from the university's perspective if their costs increased and amount of funding decreased.

Third, it is possible, that students increase their effort instead of changing its allocation. This would be the best-case scenario from the university's perspective. In this scenario, the Dean's incentive scholarship would both bring higher returns per additional student for the university (if the university would perform relatively better than other Finnish universities), increase university funding and decrease costs (as students would graduate earlier). If students were to react to the monetary reward by only increasing their effort, it could also be worth considering the possible effects of rewarding students of graduating on time, perhaps with differently priced scholarships (as the coefficients in the new university core funding model of 2021).

However, as I do not observe possible changes in the allocation of students' effort, these are merely speculations to keep in mind when considering the benefits of the Dean's incentive scholarship after 2020, when the university core funding model changes. It could be that a financial incentive method relying on something else than annual credits completed (or grades completed as it would introduce the same problem) would be more effective. However, if students were rewarded from graduation on target time only such as in the School of Chemical Engineering, it introduces a new problem as according to behavioural economics (Holmstrom & Milgrom, 1987) short-term incentives could be more effective. Perhaps one alternative would be something similar to the incentive method studied by Angrist et al. (2009), which combined financial incentives with support services. Also, it might be interesting to compare how different incentives (not just financial incentives) motivate students to increase their academic performance.

8 Conclusion

Despite the Finnish government's efforts to decrease graduation times, the median graduation time still lags behind of the target with 1.5 years. By using rich data from the academic performance of Aalto University students and a difference-in-differences method, I have shown that with short-term financial incentives it is possible to increase the amount of annual credits completed. I have presented two main sets of results.

First, I showed that when controlling for other changes, the scholarship increased the share of students that complete at least 60 credits by 4.6 percentage points, compared to control group. This implies that approximately 430 students might have a 1.5 year longer career than their peers, given that they begin this pace from their first year and continue it through their studies. Meanwhile, annual credits increased by 1.87, which could suggest that the scholarship had the largest effect

on high-ability students or other students near the 60 credit threshold. The effect of the Dean's incentive scholarship was clearly largest in the 60 credit threshold in academic year 2017-2018 in the treatment group. Meanwhile, the control group experienced no similar increase in the 60 credit threshold. This suggests that the scholarship motivated students in the treatment group to reach the 60 credit threshold to gain the EUR 500 reward, while the study efforts of the control group remained quite similar. Meanwhile, I observed no statistically significant impact on grades. This could suggest, that students either do not increase their time spent on studying enough to increase their learning outcomes, or that they simply allocate their study efforts between a larger amount of courses.

Second, I have shown that the scholarship has been a profitable investment for Aalto University. Motivating one additional student to complete 60 credits annually costs approximately EUR 2,500 for the university, as the university also pays to four other students who would have completed these credits even without the scholarship. Aalto University gained a return of EUR 302 in 2017, and EUR 224 in 2018 per additional student. The real returns are likely to be larger, as universities also receive money of student graduation.

Though students increase their amount of annual credits completed, I do not draw conclusions of how the scholarship affects graduation times. It is possible, that students complete more credits but do not utilize them in their degree as there is no limit on how many courses students can complete. The effects of short-term financial incentives on graduation times would be an interesting topic for further research when more data is available. Other interesting research topics include studying these outcomes for a longer time period. As the scholarship is a fairly new incentive method, I have data only from one complete academic year in post-treatment period. Hence, I could not present information of the long-term effects. Based on the existing literature, we could suspect that the effects would increase in the future years.

As my final remarks, I encourage Aalto University to explore the possibility of implementing the Dean's incentive scholarship to other schools as well. Based on the results of this thesis, the scholarship brings added value especially if the goal is to increase the share of students completing their studies at annual target pace. However, as stated before, this scholarship brings returns in the current university funding model, and does not necessarily lead to decreased graduation times. However, if the scholarship is continued in the current treatment group schools, it is possible to study the scholarship's effects on graduation times. If the university is interested in exploring these effects, then I also suggest ensuring that data is available for student's degree status over time (whether a student is completing bachelor or master level studies and graduation dates). This enables a more reliable analysis, as then it is possible to detect without a doubt the time

students take to complete their studies. Effects on graduation times become especially relevant in 2021, when the university core model changes. Then, universities will no longer be rewarded from students completing their studies near the annual target pace but instead universities will be increasingly funded based on graduation times. The findings in this thesis are consistent with the existing literature, though partly larger. Future research could focus on how financial incentives affect graduation times and their long-time effects.

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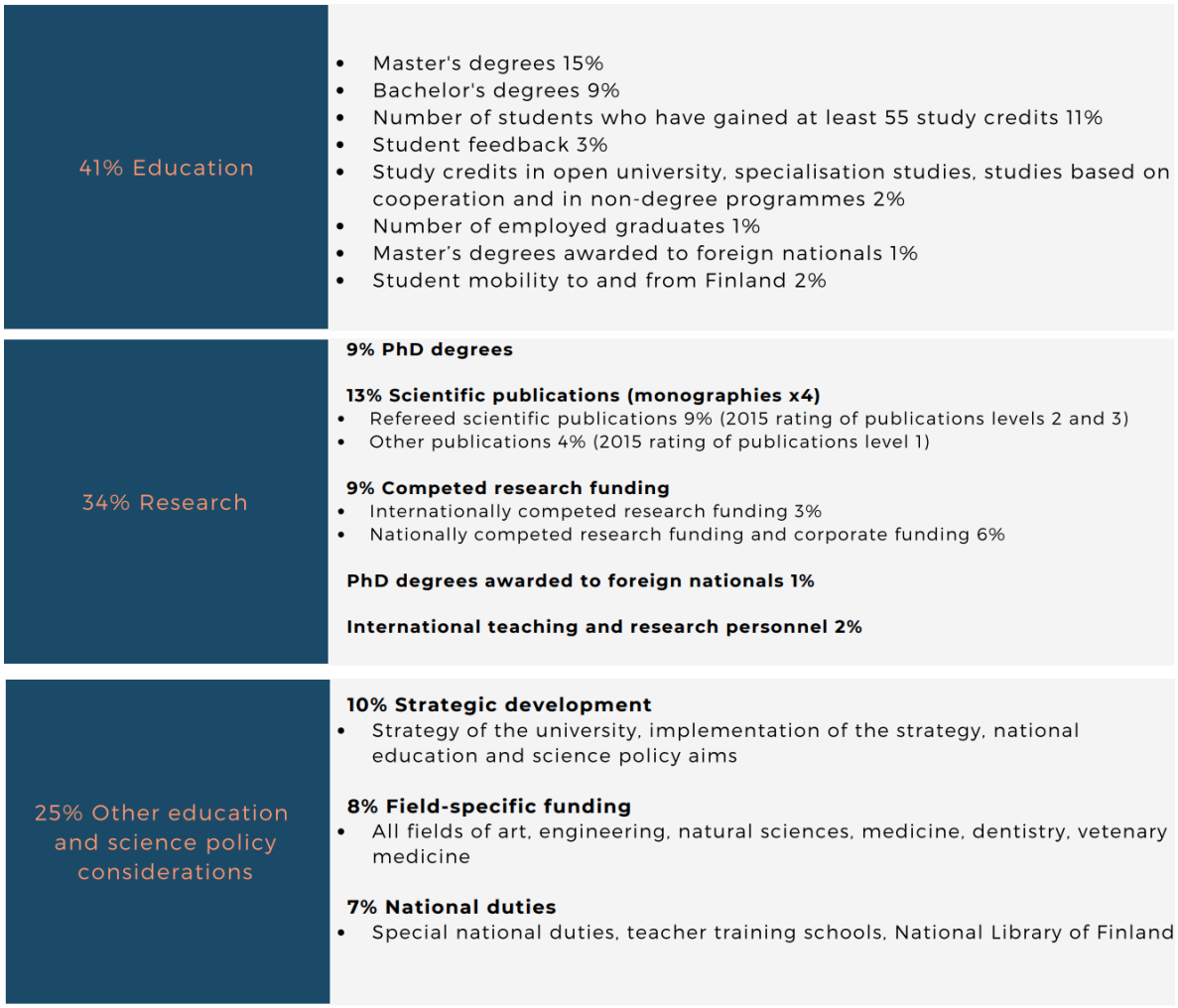
Appendices

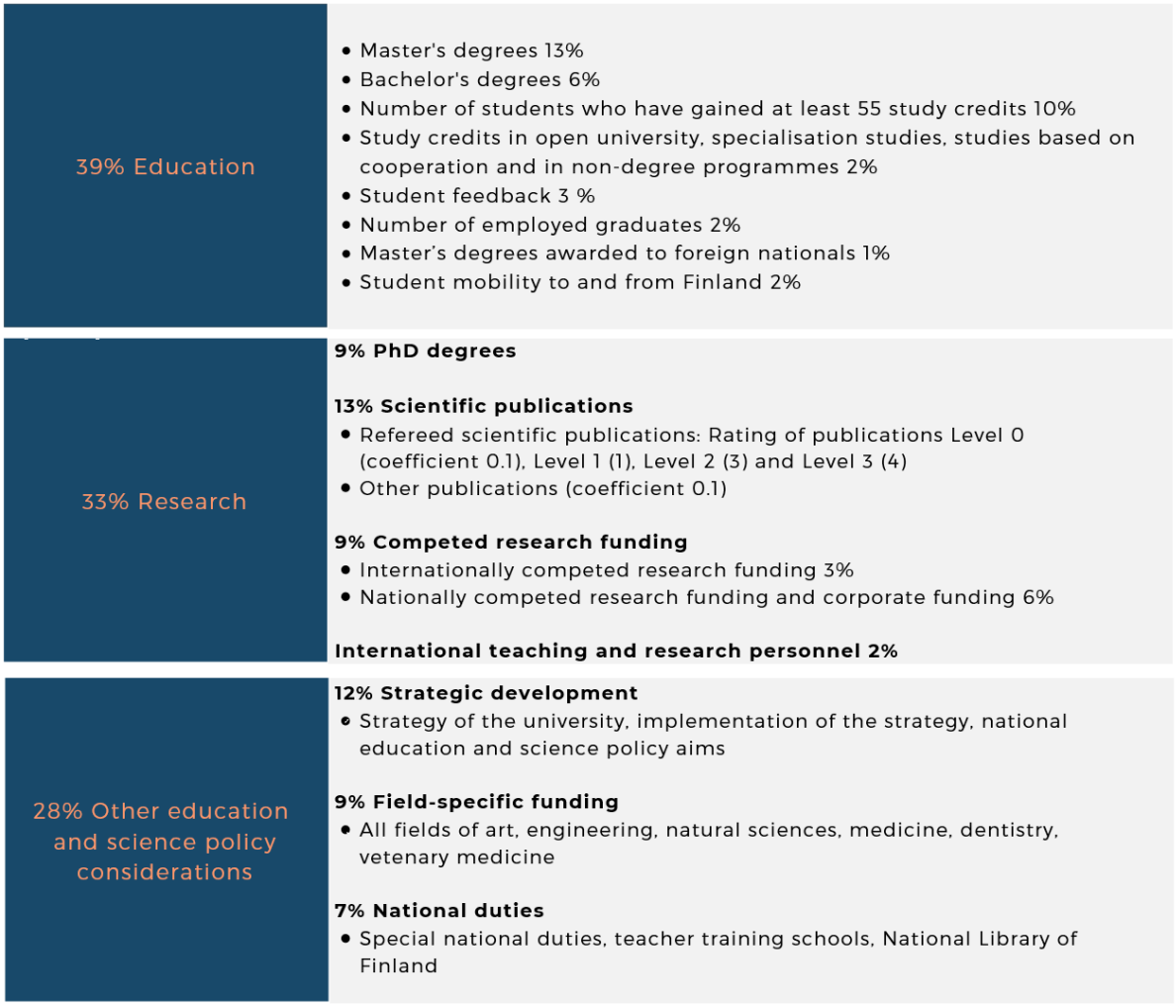
A University Funding

Figure 11: Universities core funding from 2013(-2016)



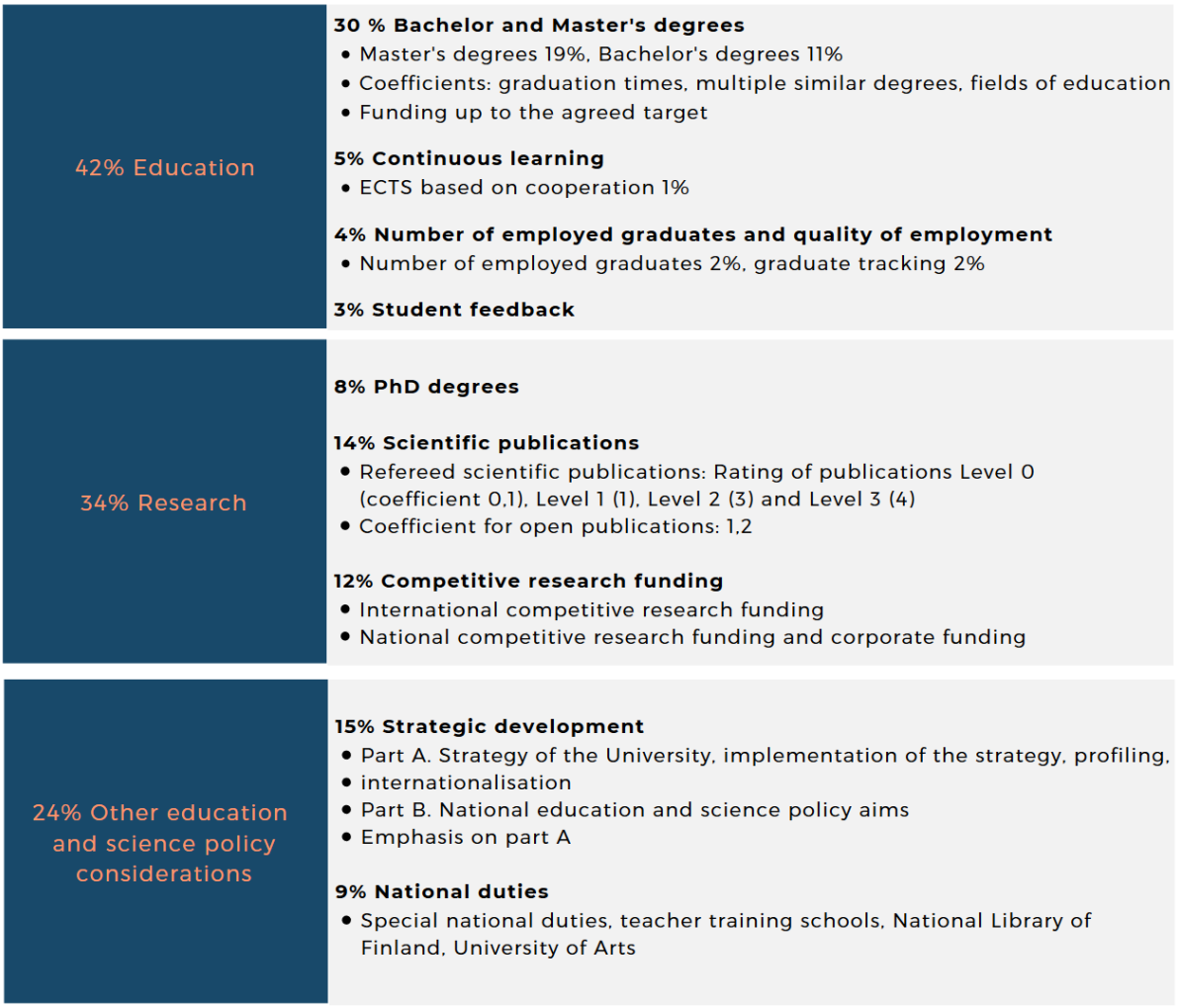
Notes: The original figure is from the Ministry of Education and Culture's presentation (Ministry of Education and Culture, 2012).

Figure 12: Universities core funding from 2017(-2020)



Notes: The original table is from Ministry of Education and Culture (2017).

Figure 13: Universities core funding from 2021(-2024)



Notes: The original table is from Ministry of Education and Culture (2019).

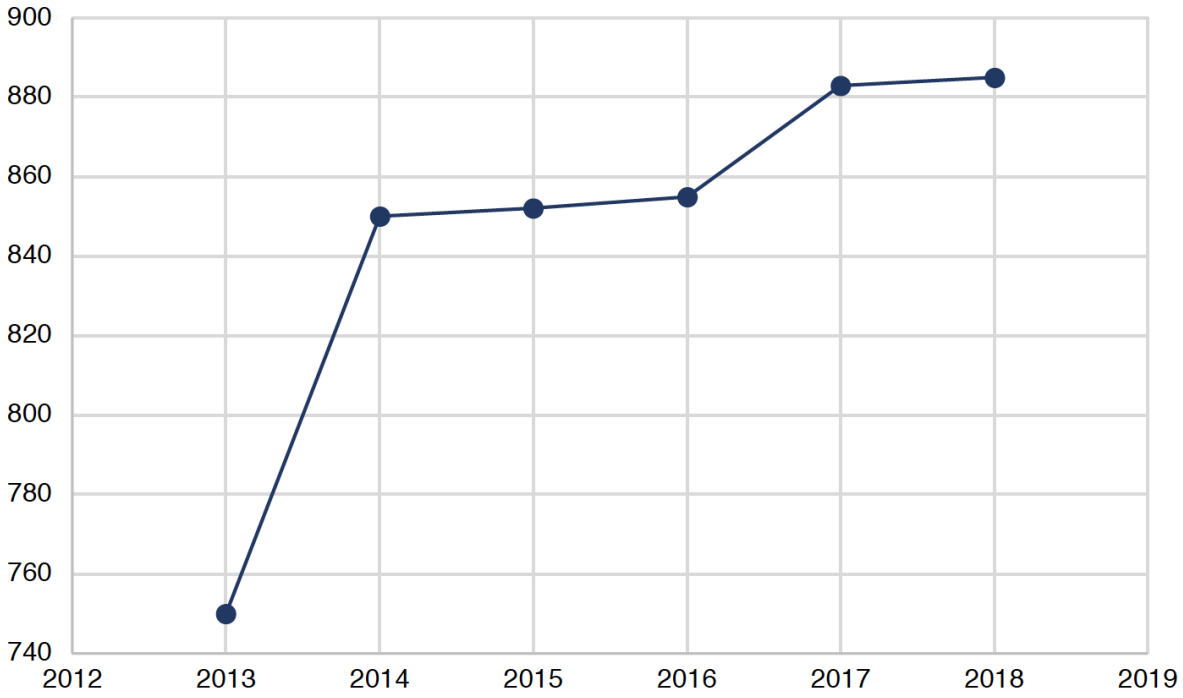
Table 3: University funding in 2018

University	Measures to renew structures and practices, EUR	Quality and impact of research, EUR	Funding of universities, EUR
University of Helsinki	1,650,000	4,069,000	5,719,000
Aalto University	1,650,000	2,473,000	4,123,000
Abo Akademi University	1,650,000	130,000	1,780,000
Hanken School of Economics	250,000	12,000	262,000
University of Oulu	3,750,000	951,000	4,701,000
University of Turku	1,650,000	640,000	2,290,000
University of Eastern Finland	2,250,000	798,000	3,048,000
Tampere University of Technology	5,000,000	933,000	5,933,000
LUT University	3,750,000	194,000	3,944,000
University of the Arts Helsinki	250,000	-	250,000
Tampere University	5,000,000	264,000	5,264,000
University of Vaasa	1,650,000	85,000	1,735,000
University of Jyväskylä	2,250,000	882,000	3,132,000
University of Lapland	3,750,000	69,000	3,819,000
In total	34,500,000	11,500,000	46,000,000

Notes: The original table is from Ministry of Education and Culture (2018). Though the table presents 14 universities, the current number of universities in Finland is 13, after the merger of Tampere University of Technology and Tampere University in 2019.

B Financial Aid from the Social Insurance Institution of Finland, Kela

Figure 14: Average financial aid per month for university students



Notes: The figure is based on various data sources from Kela (Kela, 2015, 2016, 2017, 2018b, 2019c). Financial aid includes student grant, housing supplement, and student loan from Kela.

Table 4: Student's annual income limits

Annual number of aid months	Annual income limit (EUR per calendar year)	
	2018-2019	2017 and earlier
1	22,557	22,330
2	21,234	21,020
3	19,911	19,710
4	18,588	18,400
5	17,265	17,090
6	15,942	15,780
7	14,619	14,470
8	13,296	13,160
9	11,973	11,850
10	10,650	10,540
11	9,327	9,230
12	8,004	7,920

Notes: The table is based on data from Kela (2019f).

Table 5: Housing costs in different municipalities and households

Maximum housing costs: Rates in 2019				
Household size, persons	Municipality in category I, EUR per month	Municipality in category II, EUR per month	Municipality in category III, EUR per month	Municipality in category, EUR per month
1	516	499	396	349
2	746	717	579	509
3	951	903	734	651
4	1,111	1,054	869	775
+ each additional person, EUR per month	139	132	119	114

Municipalities in category I: Helsinki

Municipalities in category II: Espoo, Kauniainen ja Vantaa

Municipalities in category III: Hyvinkää, Hämeenlinna, Joensuu, Jyväskylä, Järvenpää, Kajaani, Kerava, Kirkkonummi, Kouvola, Kuopio, Lahti, Lappeenranta, Lohja, Mikkeli, Nokia, Nurmijärvi, Oulu, Pori, Porvoo, Raisio, Riihimäki, Rovaniemi, Seinäjoki, Sipoo, Siuntio, Tampere, Turku, Tuusula, Vaasa and Vihti

All other municipalities belong to category IV.

Notes: The original table is from Kela (2019d).

C Results

Table 6: The effect of Dean's incentive scholarship on different thresholds

	Credit thresholds								
	>10	>20	> 30	> 40	> 50	>60	>70	> 80	> 90
treat.*2014	0.009	0.009	-0.005	-0.022*	-0.022	-0.015	-0.009	-0.001	-0.002
	(0.009)	(0.005)	(0.006)	(0.011)	(0.017)	(0.014)	(0.007)	(0.003)	(0.002)
treat.*2015	-0.010	0.000	-0.019**	-0.037***	-0.023	-0.017	-0.018*	-0.001	0.001
	(0.009)	(0.006)	(0.008)	(0.011)	(0.015)	(0.015)	(0.009)	(0.003)	(0.002)
treat.*2016	-0.011	0.009	0.001	-0.001	-0.011	0.001	-0.015***	-0.002	0.002
	(0.010)	(0.007)	(0.010)	(0.014)	(0.014)	(0.012)	(0.005)	(0.003)	(0.002)
treat.*2017	-0.002	0.018	0.003	0.021	0.032*	0.054***	0.003	0.009***	0.006*
	(0.013)	(0.011)	(0.015)	(0.014)	(0.016)	(0.016)	(0.006)	(0.003)	(0.003)
N	59,064	59,064	59,064	59,064	59,064	59,064	59,064	59,064	59,064

* p<0.10, ** p<0.05, *** p<0.01

Notes: The table has the same values as figure 7, but it also shows standard errors in parentheses and statistical significance.

Table 7: University funding from students completing at least 55 credits annually

		2013	2014	2015	2016	2017	2018
University funding	All Finnish universities	175,440,000	178,695,000	198,426,000	190,676,000	157,530,000	156,127,000
from 55 credits/year	Aalto University	17,238,000	17,253,000	19,140,000	18,354,000	13,369,000	12,642,000
Amount of students	All Finnish universities	50,051	51,186	52,969	55,154	56,285	55,789
	Aalto University	4,149	4,177	4,285	4,424	4,772	4,641
Funding per student	All Finnish universities	3,505.22	3,491.09	3,746.08	3,457.16	2,798.79	2,798.53
	Aalto University	4,154.74	4,130.48	4,466.74	4,148.73	2,801.55	2,723.98

Notes: The table is based on data from Aalto University, Vipunen (2019b) and own calculations.

Table 8: University funding from students completing at least 55 credits annually and graduation

		2013	2014	2015	2016	2017	2018
University funding	All Finnish universities	175,440	178,695	198,426	190,676	157,530	156,127
from 55 credits/year	Aalto University	17,238	17,253	19,140	18,354	13,369	12,642
University funding	All Finnish universities	143,542	146,205	99,213	95,338	94,518	93,676
from BSc degrees	Aalto University	13,576	15,041	11,051	10,921	10,934	11,424
University funding	All Finnish universities	239,237	243,675	231,497	222,455	204,789	202,965
from MSc degrees	Aalto University	30,195	29,077	24,273	24,363	24,024	25,455
All university funding	All Finnish universities	1,834,121	1,887,593	1,904,269	1,823,623	1,795,675	1,767,426
combined	Aalto University	294,544	294,107	282,072	259,743	251,353	240,761
Share of funding	All Finnish universities	9.6 %	9.5 %	10.4 %	10.5 %	8.8 %	8.8 %
from 55 credits/year	Aalto University	5.9 %	5.9 %	6.8 %	7.1 %	5.3 %	5.3 %
Share of funding	All Finnish universities	30.4 %	30.1 %	27.8 %	27.9 %	25.4 %	25.6 %
from 55 credits, BSc & MSc	Aalto University	20.7 %	20.9 %	19.3 %	20.7 %	19.2 %	20.6 %

Notes: The table is based on data from Aalto University and own calculations.