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Alexandra de Gendre
The University of Sydney, IZA and ARC Life Course Centre

Jan Kabátek
The University of Melbourne, ARC Life Course Centre, IZA and Tilburg University

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

From Subsidies to Loans: The Effects of a National Student Finance Reform on the Choices of Secondary School Students*

We analyse the effects of a national student finance reform in the Netherlands, which replaced universal subsidies for higher education students by low-interest loans. We show that this reform had a large impact on education choices of secondary school students, lowering their enrolments in college-preparing tracks and increasing the share of students specializing in STEM subjects. The reform also affected the living arrangements of new college entrants. Our findings highlight that secondary school students respond to the modes of higher education financing well ahead of their graduation, and that financial aid uncertainty alone can deter many from pursuing higher education.

JEL Classification: I22, I23, I24

Keywords: Netherlands, higher education, student finance, financial aid, policy uncertainty

Corresponding author:
Alexandra de Gendre
University of Sydney
City Road
Camperdown NSW 2006
Australia

E-mail: alexandra.degendre@sydney.edu.au

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1. Introduction

Financing of higher education is a notoriously contentious topic of the contemporary policy debate. Is it preferable to mandate high tuition fees, and provide students with loans and means-tested aid to cover the costs of education for the underprivileged (*i.e.*, the US model)? Or should countries rather rely on low tuition fees and unconditional financial support for all students (*i.e.*, the European model)? At the core of this debate is the question whether students incorporate the costs of higher education into their decision making. If students' choices to pursue higher education prove largely cost-inelastic, then there may be little need for subsidization. However, if their choices are contingent on the intrinsic costs, then the policy design becomes much more complex, facing unavoidable trade-offs between the generosity of the financial support system and the take-up of higher education.

The consensus in the literature is that reducing the costs of higher education can increase college enrolments and graduation rates, in particular among financially constrained students. Yet, it is important to note that these effects vary considerably across countries. While U.S. studies tend to find large and positive effects (see the review of Dynarski and Scott-Clayton 2013), European studies find effects that are much more ambiguous in terms of their magnitude and direction.[1] Indeed, some European studies even find that the receipt of financial aid may have null or small negative effects on student performance and time to graduation (Belot, Canton and Webbink, 2007; Murphy, Scott-Clayton and Wyness, 2017; Montalbán, 2019).

Perhaps reflecting this ambiguity, many European policy makers are calling for a reduction of the unconditional financial support for students in higher education, and an introduction (or expansion) of centralized systems of low-interest student loans. One of the central tenets of these proposals is that reducing unconditional financial support is unlikely to deter many students from pursuing higher education, since the students will be still able to cover the costs of their studies using government-backed loans. However, whether or not this is the case is an empirical question that remains woefully understudied – particularly due to the lack of relevant policy variation.

[1] see Canton and de Jong 2005; Belot, Canton and Webbink, 2007; Kelchtermans and Verboven, 2010 for studies in the Netherlands, Dearden, Fitzsimons and Wyness, 2014, Azmat and Simion, 2017; Murphy, Scott-Clayton and Wyness, 2017 in the United-Kingdom; Hübner, 2012, Bahrs and Siedler, 2019; Bietenbeck, Marcus and Weinhardt 2019 in Germany; Nielsen, Taber and Sorensen, 2010 in Denmark; and Montalbán, 2019 in Spain.

In this paper, we exploit a rare national reform of student finance in the Netherlands to show that the mode of higher education financing wields a considerable influence over students' decision making. The reform we study was implemented in 2015, and it turned a universal unconditional subsidy for students in higher education into a low-interest, income-contingent loan. By doing so, it raised the price of higher education from €1,900 per year to €3,100 per year (approximate figures for the median student). Critically, students in post-secondary vocational education programs were not affected by this change. They were allowed to keep the universal subsidy, which raised the attractiveness of vocational education among the prospective cohorts of students. The reform constituted a radical change of Dutch education policy, and this was reflected in a six-year-long announcement period that preceded its implementation. This period started in June 2010, when the government announced its intention to move away from the subsidy-based system of student finance. At this point, no further details were disclosed to the public, which meant that the future receipt of study subsidies became uncertain. In October 2012, the government revealed the details of the new student finance system, including the timeline of its implementation. At this point, the uncertainty was lifted, and students learnt about the expected costs of their post-secondary education options. The reform came into effect in September 2015, with the first cohort of students entering post-secondary education programs being subject to the new system of student finance.

To analyse the effects of the reform and its announcements on students' decision making, we build an analytical dataset from linked administrative register data provided by *Statistics Netherlands*. The dataset contains characteristics and outcomes of all students enrolled in Dutch secondary and post-secondary education programs between years 2005 and 2017. Our analyses focus mainly on the outcomes of secondary school students, although we analyse select outcomes of college entrants as well.[2] The primary outcome of interest is students' choice of the secondary school track (as observed in Grade 10). This choice is critical for students' subsequent education pathways because students intending to pursue higher education need to obtain a diploma from one of the two college-preparing tracks (as opposed to a vocational track diploma). Accordingly, if it were the case that the reform discouraged students from pursuing higher education, it should be reflected

[2] Our focus on secondary school students has two main advantages. It allows us to study the decisions of students under policy uncertainty (secondary school students were most likely to be affected by the uncertainty that followed the 2010 reform announcement), and it also ensures that our analyses are not distorted by strategic behavior around the time of the reform implementation. Strategic behavior was observed among older students, who tried to expedite their college enrolments in order to qualify for the universal subsidy package.

in their Grade 10 track enrolments. We also assess whether the reform affected Grade 10 students' choices of subject specialization, and whether it induced Grade 11 students to correct their initial track and subject choices in light of the new information. Our analyses use an event-study design, which is necessitated by the nation-wide implementation of the reform that leaves us with no viable control group. We conduct an extensive set of checks to ensure that the reform effects are not attributable to other confounding factors, such as macroeconomic conditions, changes in the student characteristics and abilities, or other changes in the institutional environment.

Consistent with the change in underlying incentives, we find that the reform increased the share of secondary school students pursuing the vocational track and decreased the share of students pursuing the college-preparing tracks. This shift began immediately after the first reform announcement and grew stronger over time. The effect stabilized after the 2015 implementation of the reform, with the share of students enrolling in college-preparing tracks being 6.8 percentage points lower than the no-reform counterfactual. We also observe a short-lived surge in the number of Grade 11 students correcting their initial track choices, opting for an easier track after learning about the reform. Parallel to this development, we observe that students in college-preparing tracks became more likely to specialize in STEM and Medicine subjects. This shift is partially attributable to the changing composition of the student pool in college-preparing tracks, but it also reflects students' decisions to refocus their attention towards subject fields with higher earning potential. Our analyses of the outcomes of new college entrants show that many responded to the reform by changing their living arrangements. Specifically, they chose to cohabit with their parents instead of living on their own closer to the university. This allowed them to reduce the costs of living and thereby reduce the need for taking up a student loan. Nevertheless, the overall take-up of student loans did increase after the reform implementation, indicating that the loan-based financing is a viable option for a subset of higher education students.

To the best of our knowledge, only a handful of articles asses how different forms of higher education financing affect students' decisions and outcomes. Linsenmeier, Rosen and Rouse (2006) and Rothstein and Rouse (2011) exploit a unique policy change in an elite college in the United-States, in which student loans were suddenly replaced by student grants for freshmen. Linsenmeier, Rosen and Rouse (2006) show that admitted students eligible for the grants became somewhat more likely to enrol into this college, although the results did not prove statistically

significant. Rothstein and Rouse (2011) show that incumbent students eligible for the loans were more likely to choose majors that led to occupations with higher earnings potential. Field (2009) conducted a field experiment with law students at NYU, finding that the students were willing to trade away their preferred major and occupational choice so that they could avoid taking on debt. Both Rothstein and Rouse (2011) and Field (2009) argue that their findings are in line with students exhibiting substantial debt aversion.[3]

Our study makes several distinct contributions to the literature. First, we analyse a rare national reform of higher education financing, showing that students do respond to nationwide changes in the costs of higher education. We show that these responses are substantive and that they are in line with the underlying economic incentives. This suggests that the previous findings of null or negative responses to access to financial aid may be specific to the studied interventions and their institutional settings (Belot, Canton and Webbink, 2007; Murphy, Scott-Clayton and Wyness, 2017; Montalbán, 2019). Second, we show that secondary school students respond to the costs of higher education well ahead of their graduation and college enrolment. This has important consequences for empirical design of studies analysing student responses to the reforms of higher education financing. Specifically, it suggests that the immediate effects of unexpected reforms (reported, *e.g.*, by Dearden et al., 2014) are likely to constitute a lower bound for the total effects that manifest among later cohorts of treated students. This is because later cohorts are subject to reform announcements at an earlier stage of their studies, which means that they have more time to adjust their effort levels and study choices in response to the new incentive structures. Third, we show that policy uncertainty alone can dissuade many students from pursuing pathways that lead to higher education programs. These findings echo a growing body of work which shows that informing students about the cost of higher education can influence their decision whether to apply to college and which major to study (Hoxby and Turner, 2013, 2015; Oreopoulos and Dunn, 2013; Peter and Zambre, 2017). Closely related to our study, Dynarski, Libassi, Michelmore and Owen (2021) conduct an RCT to show that guaranteeing financial aid to low-income students in a

[3] There might also be market failures in access to credit during college or later in the life cycle, such that it might be rational to avoid taking on early debt (see discussion in Rothstein and Rouse, 2011). Students might also lack information or are misinformed about the availability and conditions of student loans (e.g. Schmeiser, Stoddard and Urban, 2016); In addition, a growing body of evidence has indicated that students tend to have wrong expectations about the costs and returns to college education, and that these expectations contribute to the SES gap in college enrolments (see e.g. Avery and Hoxby 2004, Jacob and Wilder, 2011, Hoxby and Turner 2013, 2015, Delavande and Zafar 2019).

flagship state university in the United States dramatically increases application and enrolment of treated students. Our study shows that making the costs of college uncertain deters students from pursuing university-preparing education as early as upon entering secondary school.

The paper is organized as follows. Section 2 provides the necessary details on the institutional setting. Section 3 develops a conceptual framework to predict how uncertainty about financial aid affects students' high school track choice and subject choice, and which students are more likely to respond to this uncertainty. Section 4 presents the data. Section 5 explains our identification strategy. Section 6 presents the main results. Section 7 presents additional results to support our framework, and Section 8 discusses in details robustness checks and threats to identification. Section 9 concludes.

2. Institutional Setting

2.1. Secondary school in the Netherlands

Dutch children enter secondary school in Grade 7 (age 12), following 6+2 years of primary schooling.[4] The Dutch system of secondary schooling is distinct from other national systems in that it sorts children into ability-based tracks at a relatively early age. Students can choose from three available tracks which differ in terms of their length and difficulty: vocational track (VMBO, 4 years), general track (HAVO, 5 years), and academic track (VWO, 6 years). To facilitate their choice, students are issued two individualized track recommendations, one based on their standardized test scores and another based on the assessment of their head teacher. The timing of the track choice varies between schools, however by the end of the third year of secondary school (Grade 9), every student has to be assigned to a track. The track choice is crucial because it shapes the entire educational path of the student. In particular, university education is only available to students who hold a diploma from the academic track, and professional higher education is only available to students who hold a diploma from either academic or general tracks. The initial track choice is not necessarily final. Students who wish to switch to a different track within the course of their studies are allowed to do so, although this can be costly in terms of their time and effort.

[4] The first two years of primary schooling (for children aged 4 to 5) are akin to kindergarten. Standard curriculum begins in the third year (*Groep 3*). To conform with the international standards, we denote this year 'Grade 1', and count the years of schooling from this year onwards.

In the fourth year of secondary school (Grade 10), students in the general and academic tracks also choose their subject specialization. This denotes the pool of subjects that the students will focus on throughout the rest of their secondary schooling. The offered subject specializations can be broadly divided into two categories: 1) STEM and Medicine, and 2) Social Sciences and Humanities. The choice of the subject specialization is also very important because the focal subjects in these specializations often constitute pre-requisites for higher education courses in the same fields. More details on this are available in **Appendix Section A.1**.

2.2. Post-secondary education and student finance in the Netherlands

In the last year of high school, students submit their applications to post-secondary education institutions. These institutions include: vocational schools (MBO), professional higher education institutions (HBO, also known as universities of applied sciences), and universities (WO).[5] Post-secondary education in the Netherlands is almost exclusively public and non-selective. Tuition fees are set centrally, being indexed to inflation, and fixed across programs and schools. In 2014, the nominal value of annual university tuition fees was €1,903, which is equivalent to roughly 9.5% of the full-time annual minimum wage. Tuition fees are low compared to tuition fees in Anglo-Saxon countries, but similar to tuition fees in neighbouring countries such as France, Germany, Belgium, Luxembourg, Denmark, or Sweden (for a comparison of European systems, see Eurydice, 2013).

For almost 30 years, the Dutch government maintained a system of post-secondary student finance that offered three types of financial support: 1) a universal basic subsidy, 2) a means-tested subsidy, and 3) an opt-in loan with below-market interest rates. Key characteristics and parameters of this system are summarized in the first column of **Table 1,** further details are available in **Appendix Section A.2**. The universal basic subsidy was awarded at two rates depending on students' living arrangements (cohabiting with parents or living independently), and it was accompanied by a free public transport card. The award rate of the means-tested subsidy depended on parental income, students' living arrangements and family composition. Eligibility for any financial support was conditional on: 1) being less than 30 years old, 2) being enrolled in a full-

[5] Universities and professional higher education institutions constitute the Dutch higher/tertiary education sector. Vocational schools are classified as post-secondary non-tertiary education institutions.

time or dual post-secondary program, and 3) being a Dutch national or a Dutch resident with the same rights (DUO, 2018). Booij, Leuven and Oosterbeek (2012) show that Dutch students were well-informed about the student finance system and its conditions.

In 2015, the Dutch government implemented a major reform of the student finance system. This reform brought forth two main changes: 1) the universal basic subsidy was turned into an opt-in income-contingent loan, and 2) the repayment period of student loans was extended from 15 to 35 years. These changes differed in terms of their coverage. The first applied only to students at universities and professional higher education institutions, while the second was universal. This benefitted vocational students, who were allowed to retain the universal basic subsidy while enjoying the extended loan repayment period. The reform also simplified award rates of the means-tested subsidy, making them independent of students' living arrangements. This benefitted students who were planning to cohabit with their parents. The reform further changed the maximum amount of the means-tested subsidy, lowering it for students entering vocational schools, and increasing it for students entering higher education institutions. The latter was meant to compensate low-income students in higher education institutions for the loss of the basic subsidy. The eligibility criteria remained unaffected by the reform. The first cohort of students affected by the reform entered post-secondary education institutions in the academic year 2015-2016. Students who began their studies prior to this academic year were allowed to finish their degrees under the old regime. Key characteristics and parameters of the reformed system are presented in the second column of **Table 1**.

The 2015 reform constituted a major change in the mode of student financing, leading to large changes in the effective price of higher education. For most higher education students, the change of subsidies increased the price of a 4-year degree by either €5,000 or €14,000 (depending on their living arrangements). To put these figures into perspective, the annual tuition fees for academic year 2014-2015 amounted to €1,903. However, not all students were made worse off by the policy change. Disadvantaged students who were eligible for the full means-tested subsidy and who were intending to live with their parents had their total monthly subsidy increased by €31, amounting to a total reduction of €1,488 in the cost of a 4-year degree. In addition, the expansion of the loan program and extension of the repayment period created a buffer for the overall price increase,

benefiting particularly those students who would have taken up student loans regardless of the policy change (approximately 32% of the students).

Table 1. Student finance package before and after 2015: awarded amounts and conditions

Panel A. University and Professional higher education students	Before the reform (2014)	After the reform (2015)
Basic package:		
Basic subsidy, living with parents	€ 100.3	€ 0
Basic subsidy, living independently	€ 279.1	€ 0
Means-tested subsidy (max. award)	€ 258.4	€ 378.2
Public transport card	Yes	Yes
Opt-in components:		
Tuition Fees credit	€ 158.6	€ 162.6
Subsidized loan (max. amount)	€ 295.7	€ 475.9
Repayment period	15 years	35 years
Panel B. Vocational education students	Before the reform (2014)	After the reform (2015)
Basic package:		
Basic subsidy, living with parents	€ 79.0	€ 81.0
Basic subsidy, living independently	€ 257.9	€ 264.4
Means-tested subsidy (max. award)	€ 344.9	€ 260.5
Public transport card	Yes	Yes
Opt-in components:		
Tuition Fees credit	€ 0	€ 0
Subsidized loan (max. amount)	€ 172.2	€ 176.5
Repayment period	15 years	35 years

Note: Financial aid amounts retrieved from *Rijksoverkeid* and *DUO* archives and Dutch Statistical Yearbooks 2002-2018. Further details are listed in **Appendix Tables A1** and **A2**.

2.3. Reform announcement and implementation

The 2015 student finance reform was preceded by a long announcement period. The announcement period covered six years and consisted of two stages, each of which was initiated by an information shock.

In the first stage, the government announced its intention to reform student finance. This announcement followed the June 2010 general elections, which took place in the context of austerity. Campaigns of political parties therefore emphasized budget cuts in non-priority areas. Education was one of the more controversial topics of the elections, with some parties advocating

cuts to the education budget and other parties strongly opposing such measures. The elections were unexpectedly won by the conservative-liberal party (VVD), whose agenda included the removal of the basic subsidy from the student finance package. At this stage, however, the winning party had no exact plan for implementing the reform of student finance. For prospective students, the election outcome introduced uncertainty about the future availability of the universal subsidy, and thereby increased the expected cost of both vocational and higher education.

In the second stage, the government revealed the details of the new system. This announcement took place in October 2012, following another round of general elections. The new coalition (led again by VVD) announced the timing and contents of the student finance reform. The reform was expected to be introduced in the academic year 2014-2015, implementing the changes described in the previous subsection. For prospective students, this resolved the uncertainty about the future availability of the universal subsidy, further increasing the expected costs of higher education and lowering the expected costs of vocational education.

The eventual implementation of the reform was delayed by one year. In late May 2014, the coalition announced that the implementation of the reform would be postponed until September 2015 (academic year 2015-2016). This postponement was a result of political instability which led to delays in passing new legislation. The student finance bill was passed in May 2014, which was deemed too late for the new system to be implemented in the upcoming academic year.

The long announcement period allowed prospective students to respond to the reform well ahead of its implementation. Our data indicate that the 2012 information shock prompted a non-negligible number of secondary school graduates to expedite their university admissions (in order to qualify for the old student finance package).[6] We note that this is an identification concern for analyses aiming to uncover the effects of the reform on students' college-entry decisions. This is because the strategic behavior ahead of the reform implementation renders the standard discontinuity-based methods of causal inference largely invalid. Importantly, our analyses are unlikely to be affected by this type of confounding. This is because we focus on students' decisions

[6] This could have been done by skipping a gap year or by accepting a second-best non-selective program. Further details available upon request.

made well ahead of graduation, which makes any strategic behavior following the 2012 announcement practically irrelevant for our outcomes of interest.

3. Conceptual model

In this section, we present a conceptual model of decision making of secondary school students. The model allows us to motivate students' responses to the reform and highlight the expected margins of heterogeneity in these responses. We build on the conceptual model of Charles, Hurst and Notowidigdo (2018), which we adapted and expanded to fit our setting. The key distinguishing feature of our model is that it allows us to study the effects of uncertainty regarding the prospective receipt of financial aid.

3.1. Setting

Secondary school students in our model choose among three mutually exclusive education tracks: vocational (*V*), general (*G*), and academic (*A*). In contrast to the real setting, we assume that the track choice takes place in the first year of secondary school, and that it is irreversible and deterministic of student's eventual education attainment. Each modelled track combines secondary and post-secondary education, and we assume that there is no dropout. The tracks differ in terms of their length, with *V* being shorter than *G* and *G* being shorter than *A* ($t_V < t_G < t_A$). For simplicity, we assume that students receive financial aid over the entire duration of their secondary and post-secondary studies, and that the yearly financial aid rates are identical across tracks.

Financial aid is defined as a government transfer s that consists of a universal transfer s^0 and a means-tested transfer s^1. Receiving the means-tested transfer is conditional on student's eligibility status, such that $s = s^0 + s^1\mathbf{1}_{\{elig\}}$. The take-up of financial aid is assumed to be universal. Let p_{0j} and p_{1j} be the probabilities that s_0 and s_1 must be paid back to the government – i.e., the probabilities that the study subsidies are turned into loans.[7] To facilitate the modelling of the 2015 reform, the repayment probabilities are assumed to be track-specific ($j = \{V, G, A\}$).

[7] Similar extension of the framework by Charles, Hurst and Notowidigdo (2018) could be applied to model financial aid that is awarded conditional on meeting specific performance indicators, such as a minimum GPA threshold, or a maximum number of years to graduation.

Students choose the track that maximizes their expected lifetime payoff. For a student i with ability $\theta_i \sim \text{unif}(0,1)$, the expected lifetime payoff of track j is $R_i^j(\theta_i)$. Normalizing the expected lifetime payoff of the vocational track to $R_i^V(\theta_i) = 0$, we can express the payoffs for tracks $j = \{G, A\}$ as:

$$
\begin{aligned}
R_i^j(\theta_i) = & \sum_{t=t_j+1}^{T-t_j} E(\Pi_t^j) \\
& - \sum_{t=1}^{t_V} \left\{(1+b)(F_j - F_V) + \left(\kappa_j - \kappa_V\right)(1-\theta_i)\right\} \\
& - \sum_{t=t_V+1}^{t_j} \left\{(1+b)\left[F_j - \left(1-p_{0j}\right)s^0 - \left(1-p_{1j}\right)s^1 \mathbf{1}_{\{elig\}}\right] + \kappa_j(1-\theta_i) + E(Y_t^V)\right\}
\end{aligned}
$$

The first sum corresponds to the expected accumulated labour market premium of track j over track V from the time of graduation t_j until retirement T. Π_t^j denotes the difference between stochastic wages Y_t^j and Y_t^V at time t. The next two sums represent the excess costs of pursuing track j over track V. The costs are divided into two periods, one covering the length of the vocational track t_V, and the other covering the excess time spent in track j. During the first period, the excess costs consist of direct out-of-pocket costs F_j (in the form of living expenditures and tuition fees), and psychic (or effort) costs $\kappa_j(1-\theta_i)$, where κ_j captures the difficulty of the selected track ($\kappa_V < \kappa_G < \kappa_A$). Psychic costs are decreasing in students' abilities θ_i. The costs are compensated by the government transfer s, however this term is irrelevant in the first period as there are no differences in the transfer receipt across tracks. In the second period, the costs of track j are compensated by the excess financial aid s, and the psychic costs of vocational education are replaced by expected forgone earnings of graduates from the vocational track $E(Y_t^V)$. We assume that all costs are covered by student loans procured at an interest rate b. Students do not face any binding borrowing constraints, which is in line with the real setting (Dutch students are allowed to borrow from the government regardless of their financial situation).

When choosing an education track, students take into account their own abilities. For each education track j, the expected lifetime payoff increases with ability ($\partial R_i^j / \partial \theta_i > 0$). To avoid corner solutions, we assume that students with lowest abilities reap the highest payoffs from the

vocational track and the lowest payoffs from the academic track. This ordering is reversed for students with highest abilities.

$$R_i^V(0) > R_i^G(0) > R_i^A(0)$$

$$R_i^V(1) < R_i^G(1) < R_i^A(1)$$

Under these assumptions, there exists an ability level θ_G^* at which the lifetime payoff functions $R_i^V(\theta)$ and $R_i^G(\theta)$ intersect, rendering the students at this ability level indifferent between tracks *V* and *G*. Similarly, there exists an ability level θ_A^* at which students are indifferent between tracks *G* and *A*. Accordingly, students with abilities lower than θ_G^* will choose track *V*, students with abilities in between θ_G^* and θ_A^* will choose track *G*, and students with abilities higher than θ_A^* will choose track *A*. The closed-form solutions for θ_G^* and θ_A^*, and comparative statics of the effects of a policy shock are presented in **Appendix B**.

3.2. Reform predictions

Prediction 1: Overall reform effects

We consider a simplified version of the 2015 reform. We denote the pre-reform policy regime as the baseline *B*, with the probabilities of repayment set to zero for both the universal and the means-tested transfer ($p_{0j}^B = p_{1j}^B = 0$). Under this policy regime, students sort themselves into education tracks according to the baseline ability thresholds θ_A^{B*} and θ_G^{B*}. Once implemented, the reform *R* changes the regime by setting the probability of repaying the universal transfer to one for all students in tracks *A* and *G* ($p_{0A}^R = p_{0G}^R = 1$). Students in track *V* are exempted from this change, so $p_{0V}^R = 0$. The probability of repaying the means-tested transfer is zero under both regimes ($p_{1A}^R = p_{1G}^R = p_{1V}^R = 0$), and all the transfer rates remain the same. This change shifts the ability thresholds to the right, with students above the first baseline threshold moving from track *A* to track *G*, and students above the second baseline threshold moving from track *G* to track *V*. Intuitively, we would expect the outflow from track *G* to be stronger than the outflow from track *A*, although this is not necessarily the case for all possible parameterizations of the model.

Prediction 2: Uncertainty and means-testing

The reform implementation is preceded by a period of policy uncertainty *U*. Under this policy regime, students do not know whether they will have to repay either the universal or the means-tested transfer. This means that the subjective probabilities of repayment increase for *both* the universal and the means-tested transfer ($p_{0j}^{U} > 0$, and $p_{1j}^{U} > 0$). Similar to the reform itself, policy uncertainty shifts the ability thresholds rightwards from the baseline, such that we have $\theta_A^{U*} > \theta_A^{B*}$ and $\theta_G^{U*} > \theta_G^{B*}$. Importantly, the magnitude of this shift is contingent on students' eligibility for the means-tested transfer.

Students who are *ineligible* for the means-tested transfer respond to policy uncertainty less than to the reform itself, because under the regime *U* they still have a non-zero chance of receiving the universal transfer without repayment. Students who are *eligible* for the means-tested transfer may respond to policy uncertainty less, but also more than to the reform itself (depending on the value of p_{1j}^{U}). Under realistic parameterizations of the model, they should be also less affected by the eventual resolution of uncertainty and transition to the reform regime *R*. This is because their loss of the universal subsidy is compensated by the newly established certainty of receiving the means-tested transfer without repayment.

Prediction 3: Uncertainty and gender

Our model does not explicitly consider gender-specific effects. However, gendered responses may arise if male and female students differ in characteristics that are relevant for their decision-making process. Here, we focus on the role of relative risk aversion. Women are generally found to be more risk averse than men (see, *e.g.*, Charness and Gneezy, 2012; Falk et al. 2019) and this may influence their behavior under policy uncertainty.

For the sake of simplicity, we assume that higher risk aversion of female students translates into higher subjective probabilities of repayment under policy uncertainty. In this setup, our model predicts female students to have stronger behavioural responses to policy uncertainty than male students. Once the reform is implemented and uncertainty is resolved, we expect gendered responses to become more aligned. We may, however, still see some residual gender differences

if low-income students face some latent uncertainty regarding the receipt (or the amount) of the means-tested subsidy.[8]

4. Data

Our empirical analysis draws on administrative data provided by the Dutch national statistics agency, *Statistics Netherlands*. The cornerstone of our dataset is the education register, which tracks the population of students at every level of schooling between years 2005 and 2017. Based on this registry information, we create a dataset of student-year education records, extracting the characteristics of the education program pursued by each student at the start of each academic year. The education register contains unique personal identifiers, which allow us to link individual records to other registry data and retrieve a rich set of students' background characteristics. These include gender, age, immigration background, employment, and income histories (both own and parental), residential history, and, for a subset of students, standardized test scores taken in Grade 6 (age 11), accompanied by teacher's high school track recommendations.

4.1. Sample: Selection criteria and descriptive statistics

Our analyses use several extracts from the full dataset of student-year records. Each of these extracts contains students who are at the same stage of their educational paths. Our primary extract contains students who are in the fourth year of secondary school (Grade 10). As outlined in **Section 2**, this is the first grade in which we are able to determine the education track pursued by every secondary school student in the Netherlands. It is also the grade in which academic and general track students choose their subject specialization. For other analyses, we use extracts of students in the fifth year of secondary school (Grade 11), and first-year students in post-secondary education.

Our analytical extracts are not subject to any substantive selection criteria, as we are primarily interested in the reform effects on the entire cohort of secondary school students. We only exclude

[8] This uncertainty would align with the real-world setting. Low-income secondary school students in the Netherlands are never completely sure that they will be eligible for the means-tested subsidy. This is because: 1) the eligibility is tested against prospective parental income, and 2) the income cut-offs are not disclosed to the public.

students enrolled in special education programs for students with learning disabilities (which constitute a standalone secondary school track), as they do not qualify for higher education.

In **Table 2**, we present descriptive statistics corresponding to the focal group of Grade 10 students, which we split by their observed track choice. We note that student characteristics differ systematically across tracks. The share of females, the share of native Dutch, standardized test scores and parental incomes are highest among students in the academic track, and lowest among students in the vocational track. Among academic track students, 57% have chosen the STEM and Medicine subject specialization. Among general track students, this share is 28%. In terms of cohort shares, 20% of Grade 10 students follow the academic track, 28% follow the general track, and 52% follow the vocational track.

Table 2. Descriptive statistics of Grade 10 secondary school students, years 2005-2017

	High school track:		
Variables	Academic	General	Vocational
Female (%)	53.2	50.3	47.7
Native Dutch (%)	82.8	80.9	75.5
Age	15.6	16.0	15.9
	(0.3)	(0.3)	(0.3)
Standardized test score (percentile)	83.2	60.8	30.3
	(14.0)	(19.2)	(20.7)
Parental annual income (in thousands €)	81.6	65.2	49.8
	(71.2)	(46.6)	(33.3)
Urbanization index (1: highest; 5: lowest)	2.8	3.0	3.0
	(1.2)	(1.3)	(1.3)
STEM / Medicine specialisation (%)	57.2	37.1	N/A
Number of students	549,649	770,106	1,431,798
Share of students	20.0%	28.0%	52.0%

Note: Average characteristics of secondary school students observed in Grade 10 within the period 2005 to 2017. Standard deviations in parentheses.

4.2. Students' choices over time

Next, we present the dynamics of Grade 10 track shares over the period of observation. The aim is to highlight the trends in students' track enrolments in the period preceding the first reform announcement, and contrast them with the patterns observed during the period of two reform announcements and the period of reform implementation. In **Figure 1,** we show Grade 10 track shares recorded in 2005, the first year of observation (Panel A), and then we show how these track shares evolved over the following years (Panel B).

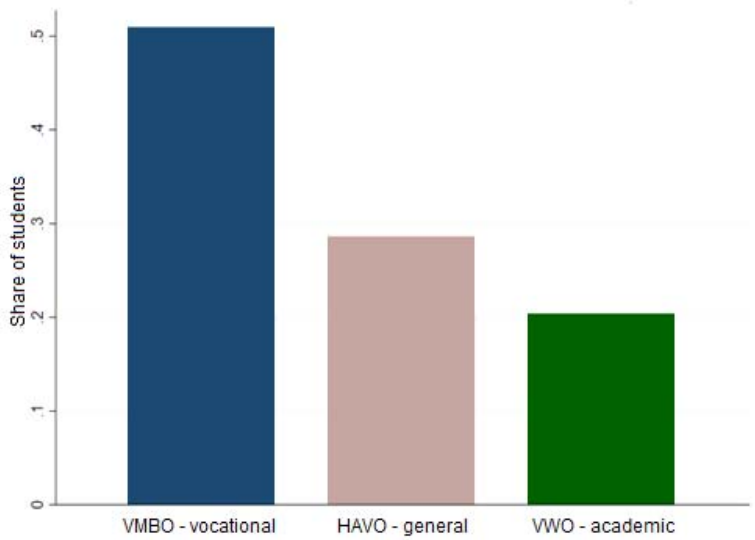
Panel B presents the magnitudes of year-specific Grade 10 track shares in relative terms, taking the 2005 track shares as the reference point. This is to facilitate the exposition of dynamics across tracks that differ substantially in terms of their overall cohort shares. The figure shows that, over the pre-announcement period (2005-2009), the three track shares follow sustained linear trends. Academic and general tracks are consistently growing, to the point of being almost 8% larger in 2009 compared to 2005. This growth is at the expense of the vocational track, which saw a steady decline in student numbers during this period.

In the period following the first announcement (2010-2012), we see a clear reversal of the pre-announcement trends. The share of Grade 10 students in the vocational track starts increasing, the share of students in the general track plateaus, and the share of students in the academic track starts declining.[9] The trend reversal is sustained also through the period covering the second announcement (2013-2014), and the reform year (2015). From 2016 onwards, the track shares appear to resume the initial trends, with the shares of academic- and general-track students increasing, and the share of vocational-track students decreasing. This suggests that the reform led to an overall drop in the demand for academic and general high school education, but it did not change the underlying trends in demand for the respective education tracks.

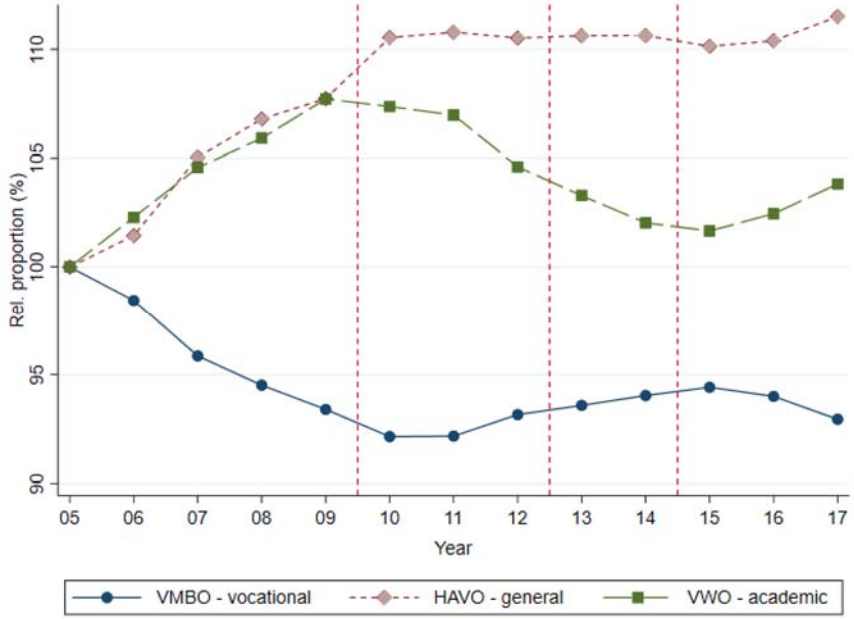
[9] We note that the responses of the 2010 cohort are modest at best. This might be attributed to the fact that these students were informed about the reform shortly prior to their summer holidays, leaving them with little-to-no time to respond (the cohort shares are measured in September, at the start of the academic year).

Figure 1. Grade 10 track shares, years 2005-2017

Panel A. Grade 10 track shares recorded in 2005



Panel B. Magnitudes of Grade 10 track shares, years 2005-2017, relative to the track shares recorded in 2005



Note: Authors' calculations of secondary school track shares over the period of observation. Panel A plots the Grade 10 track shares in year 2005, and Panel B plots the changes of Grade 10 track shares over the next twelve years, taking the shares in year 2005 as the point of reference. The shares are measured in September, at the start of the school year. Dutch education register data for Grade 10 secondary school students, excluding students in special education institutions, years 2005-2017. The years on the x-axis correspond to the calendar year. Dashed vertical lines indicate the timing of the two reform announcements and the eventual reform implementation.

5. Empirical strategy

We are interested in modelling how students' decisions made in secondary school depend on their beliefs regarding the future receipt of financial aid. Because we cannot observe students' beliefs directly, we exploit the timing of the 2015 reform announcements as quasi-random shocks to those beliefs. As described above, the announcements generated exogenous variation in the probability of receiving the pre-reform aid package, first by introducing uncertainty regarding its receipt, and later by setting the probability of receiving its universal component to zero.

The primary outcome of interest is students' choice of secondary school track, as observed in Grade 10. Since students can choose from three tracks, we model the Grade 10 track enrolments in a multinomial logit framework. The functional form of the model can be found in **Appendix C**. Leveraging our linked administrative data, we use an extensive set of control variables including gender, immigration and ethnic background and residential characteristics. To account for the pre-announcement trends in track shares (see **Figure 1**), we use linear time trends. Models with alternative time trend specifications are discussed in **Section 8**.

The effects of the reform announcements and later implementation are captured by a set of yearly dummies covering the announcement and implementation periods. The crucial identifying assumptions are that the students are comparable across cohorts (conditional on their observed characteristics and the time trend), and that the only changing factor in their decision environments is their exposure to the reform information shocks. Given that these are both strong assumptions, we conduct a battery of supplementary analyses to determine whether they are likely to hold (see **Sections 7** and **8**).

6. Main Results

6.1. The effects on Grade 10 track enrolments

The key results corresponding to the model of Grade 10 track enrolments are presented in **Table 3**. To simplify the exposition of our results, we aggregate the reform-effect estimates into three coefficients, one capturing the reform effect over the first announcement period (2010-2012), another corresponding to the second announcement period (2013-2014), and the last one corresponding to the post-implementation period (2015-2017). These coefficients capture the announcement effects and the reform effect relative to a no-reform counterfactual in which the aggregate track shares are influenced only by the students' observable characteristics and the general time trend. Formal definitions of these composite coefficients can be found in **Appendix**

C. The estimates are presented in the form of average marginal effects (AME), and they are expressed both in absolute (Panel A) and relative terms (Panel B).

Table 3. Average marginal effects of the 2015 reform on Grade 10 track enrolment

Panel A. Pre-announcement track shares and absolute effects (in percentage points)

Track	Pre-announcement track shares (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Academic	20.9%	-1.07***	-2.29***	-3.57***
		(0.06)	(0.08)	(0.12)
General	28.9%	-0.54**	-1.59***	-3.23***
		(0.22)	(0.30)	(0.44)
Vocational	50.2%	1.61***	3.89***	6.80***
		(0.26)	(0.37)	(0.53)

Panel B. Relative effects (in percent)

Track	Uncertainty	Uncertainty resolution	Post-implementation
Academic	-5.37***	-11.57***	-18.09**
	(0.30)	(0.43)	(0.62)
General	-1.94	-5.70***	-11.50***
	(0.77)	(1.07)	(1.54)
Vocational	3.24***	7.83***	13.69***
	(0.53)	(0.74)	(1.06)

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the multinomial logit model of Grade 10 high school track enrolment. The model uses 2,693,023 individual observations over years 2005-17. Controls: Age, gender, migration status, ethnic background, parental income and employment status, linear trend, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

In line with the track share dynamics presented in **Figure 1**, we see that the policy uncertainty which followed the 2010 announcement lowered the share of academic track students by 1.07 percentage points (5.4%), lowered the share of general track students by 0.54 percentage points (1.9%), and increased the share of vocational track students by 1.61 percentage points (3.2%). The reform effects become more pronounced following the second announcement, which conforms with the corresponding resolution of uncertainty. The effects reach their highest magnitudes during the post-implementation period (from 2015 onwards). The shares of academic and general track students decrease by 3.57 percentage points (18.1%) and 3.22 percentage points (11.2%) respectively, whereas the share of vocational track students increases by 6.8 percentage

points (13.7%) relative to the no-reform counterfactual.[10] These results constitute strong evidence that secondary school students anticipate the future costs of higher education when choosing their education track.

The relative magnitudes of the reform effects are well-aligned with our theoretical framework. We observe that the responses to policy uncertainty are smaller than the responses to the resolved uncertainty in the second announcement phase. Further, we see that under the initial policy uncertainty, the magnitude of student outflow from the academic track is similar in absolute terms to the magnitude of student inflow into the vocational track. However, once students become aware of the fact that vocational education will be largely unaffected by the reform, the inflow into the vocational track intensifies, eventually becoming almost twice as large as the outflow of students from the academic track.

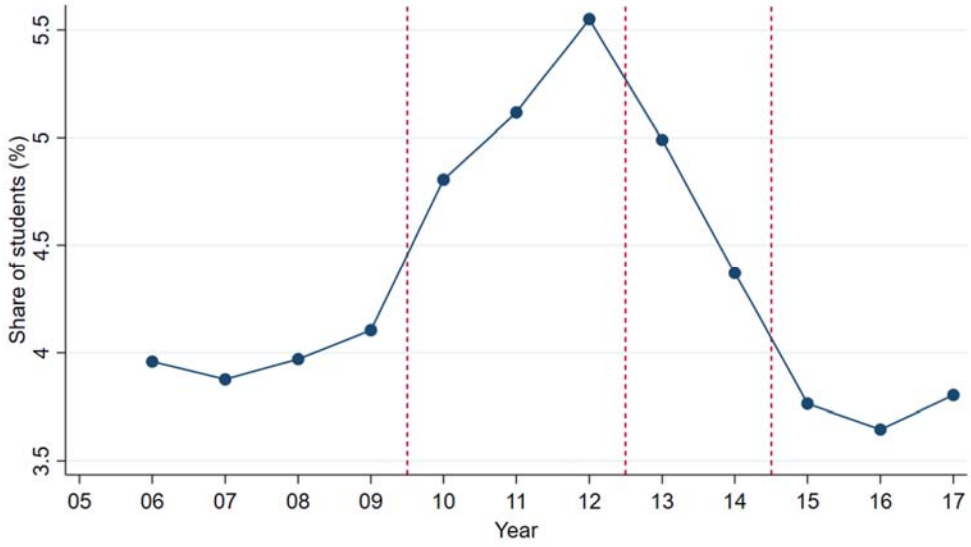
6.2. The effects on track changes in Grade 11

As discussed in **Section 2**, the initial track choices made by students are not necessarily final. Students may choose to switch tracks, and more than 5% are observed to do so. Almost all of these switches are into a lower (academically less demanding) track. In **Figure 2**, we plot the yearly shares of Grade 11 students who made the switch to a lower track (that is, they were observed in a higher track in Grade 10). The shares are reported from 2006 onwards because we are unable to determine previous tracks for Grade 11 students observed in year 2005. The incidence of Grade 11 switching is stable during the pre-announcement period (2006-2009), with approximately 4% students switching to lower tracks every year (corresponding to approximately 2,800 students). Following the 2010 reform announcement, the share of switching students increases substantially. It peaks in the academic year 2012-2013 with 5.5% students switching to a lower track (approximately 4,000 students).

After 2012, the share of students switching to lower tracks declines, and from 2015 onwards it drops back to the levels observed prior to the first announcement. This is to be expected, because all students observed at this stage were fully informed about the reform prior to making any secondary school track decisions, and so they did not have to correct their initial choices in subsequent years.

[10] The yearly dummies corresponding to the period 2015 to 2017 are not significantly different from each other, which suggests that, from 2015 onwards, the reform effect stabilized and students fully incorporated the new information into their decision making.

Figure 2. Incidence of switching to a lower track in Grade 11, years 2006-2017



Note: Authors' calculations of the incidence of switching to a lower high school track in Grade 11 over the period of observation. Track switching is recorded if a Grade 10 student enrolled in an academic (general) track in year 10, was recorded to enrol in a general (vocational) track in the subsequent academic year. Dutch education register data for Grade 11 secondary school students who were enrolled in either an academic or a general track in Grade 10, years 2006-2017.

In order to quantify the reform effects on Grade 11 track switching, we estimate a binomial logistic model with the outcome variable being equal to one if the student switched to a lower track between Grades 10 and 11, and zero otherwise. The estimation sample consists of Grade 11 students who were enrolled in either academic or general track in Grade 10. The set of covariates is based on the model of track choice in Grade 10, as specified in **Appendix C**.

The key results are presented in **Table 4.** Our model indicates that policy uncertainty following the 2010 announcement led to a 1.24 percentage point (28.6%) increase in the incidence of switching to a lower track. The reform effect following the second announcement in 2012 was slightly smaller (1.10 percentage point, 25.5%), and there was no statistically significant effect during the post-implementation period. As discussed above, this is likely due to the fact that the decision to switch tracks is by its nature a corrective decision, which is altering an earlier choice that is no longer deemed optimal. Students in the post-implementation period did not need to correct their initial choices, because they had already incorporated the reform information into their initial track choice.

Table 4. Average marginal effects of the 2015 reform on switching to a lower track in Grade 11

Panel A. Absolute effects (in percentage points)

Outcome	Pre-announcement share (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Switching to a lower track	4.1%	1.24*** (0.17)	1.10*** (0.17)	-0.08 (0.17)

Panel B. Relative effects (in percent)

Outcome	Uncertainty	Uncertainty resolution	Post-implementation
Switching to a lower track	28.60*** (3.91)	25.47*** (3.90)	-1.77 (3.88)

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit model of Grade 11 high school track switching. The model uses 958,512 individual observations over years 2006-17. Controls: Age, gender, migration status, ethnic background, parental income, employment status, linear pre-trend covering the period 2006 to 2009, region fixed effects and an urbanization index. ***= 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

7. Additional results and supporting evidence

Next, we discuss heterogeneity of the reform effects, and we analyse other decisions that may have been affected by the reform. The first set of models considers income heterogeneity. We use cohort-specific terciles of parental income distribution to split Grade 10 students into three groups (low-income, medium-income, and high-income), and we estimate the Grade 10 track enrolment model for each group separately. The choice of income terciles is motivated by the fact that students in the lowest tercile roughly correspond to the group who would later qualify for means-tested subsidy. **Appendix Table D1** presents the effects of the reform corresponding to these models.

We note that comparisons of the group-specific reform effects are complicated by large baseline differences in track enrolments across the three income groups. Our discussion will focus mainly on the vocational track because it helps us illustrate the variation in students' incentives across the three reform periods. Under policy uncertainty, the timing and contents of the reform were unknown. Perhaps reflecting this uncertainty, the inflow of low-income and medium-income students into the vocational track increased by comparable margins (2.17 and 2.29 percentage points, respectively). Upon the second announcement, low-income students learned that they would be partially sheltered from the reform through an increase in the means-tested subsidy for

higher education. In line with this change of incentives, we see that their vocational track inflows during the second period increased by a smaller margin than the inflows of medium-income students (4.61 and 5.18 percentage points, respectively). This disparity widened further following the reform implementation (7.56 and 9.06 percentage points, respectively). Corroborating these patterns, auxiliary models of Grade 11 switching to a lower track show that low-income students became less likely to switch once the uncertainty was resolved, whereas middle-income students became more likely to switch (see **Appendix Table D2**).

The second set of models considers heterogeneity by gender. **Appendix Table D3** presents reform effects corresponding to the gender-specific models of Grade 10 enrolments. The results indicate that female students have been more responsive to the reform than male students. The gender disparities are particularly pronounced under policy uncertainty. For example, the inflow of female students into academic track declines by 1.77 percentage points (8.3%), which is four times the decline experienced by male students (0.37 percentage points, 2%). This result is in line with female students being more risk-averse than male students. The gendered responses become larger and more aligned once the uncertainty is resolved, although females still prove to be more responsive than males. After the reform implementation, the decline of inflows into the academic track amounts to 4.54 percentage points (21.5%) for female students and 2.6 percentage points (14.2%) for male students. Auxiliary models of Grade 11 track switching show that female students were also more likely to switch under policy uncertainty, while male students were more likely to switch once the uncertainty was resolved. The overall reform effects on track switching are larger among male students (see **Appendix Table D4**).

Third, we analyse whether students' choice of Grade 10 subject specialization was also affected by the reform. We estimate a model of subject specialization for Grade 10 students in the academic and general tracks, with the outcome being a dummy variable equal to one if students chose STEM and Medicine, and zero if they chose Social Sciences and Humanities (further details can be found in **Appendix Section D.4**). **Appendix Table D5** presents our estimates of the reform effects. The results indicate that the first reform announcement did not lead to an immediate change in subject specialization. However, we do see a 2.28 percentage points (4%). increase in the take-up of STEM and Medicine following the second announcement, and 3.0 percentage points (5.3%) increase following the reform implementation. This lag in students' responses to the reform suggests that re-focusing to a different subject specialization may require

more time and effort than choosing a different education track.[11] Additional analyses show that the reform announcements also lowered the share of students abandoning the STEM and Medicine curriculum in Grade 11. The results show that the share of STEM and Medicine students switching to Social Sciences and Humanities fell by 1.2 percentage points (32%). For details, see **Appendix Section D.5**.[12] Supplementary analyses show sizable heterogeneity of the reform effects on specialization with respect to gender (female students respond more than male students) and income (medium-income students respond the most, sheltered low-income students do not respond in terms of subject specialization). The corresponding reform effects are presented in **Appendix Tables D7** to **D9**. These results suggest that the reform induced students to reorient towards subject that are associated with better job prospects and higher earnings potential. Such responses are in line with the findings of Field (2009) and Rothstein and Rouse (2011), who document similar behavior among American students.

Fourth, we show that students who entered higher education under the new financing regime became much more likely to cohabit with their parents. University students were most responsive in this regard with the share of cohabiting freshmen increasing by 18 percentage points (from 53% to 71%) between years 2014 and 2015. The average commuting time to school increased almost twofold, while the locational choice of study programs appears to be unaffected. For details, see **Appendix Section D.7**. By avoiding the costs of rental housing, the students were likely to lower their expenditures and reduce the need for additional financing through loans. This is also reflected in the take-up of student loans which increased only by 20 percentage points (from a stable 30% between 2001 and 2014 to almost 50% in 2015).

The residential choice appears to be one of the primary margins of adjustment for higher education students who started their degrees shortly after the reform implementation. Supplementary analyses suggest that neither students nor their parents responded to the reform by adjusting their labour supply.[13] And while it is likely that students entering higher education shortly after the reform implementation also responded by choosing different majors than the

[11] While technically feasible, an immediate adjustment of subject specialization would have been challenging for the first cohorts of students who were informed about the reform. This is because the specialization choices encompass students' preferences, interests, and knowledge accumulated over the preceding years of schooling. Reorienting to a different subject specialization is likely to require development of new skills and knowledge, which would make an immediate change particularly costly. In contrast, many students would have been able to make immediate changes to their track choices, because the choice of an education track pertains largely to the desired level of complexity *within* the preferred subject area.

[12] We do not see an increase of switching in the opposite direction, as such behavior is extremely rare.

[13] Labour participation of students is discussed in **Appendix Section D.8**. Labour participation of parents is discussed in **Appendix Section F.5**.

pre-reform cohorts of students, the relative importance of this adjustment margin is obfuscated by the presence of anticipation effects and strategic behavior (as discussed in **Section 2.3**).

Lastly, we analyse additional data from *Studenten Monitor,* a nationally representative survey of students in higher education. The survey shows that the share of higher education students taking up a student loan went from 32% in the academic year 2014-2015 to 59% in the academic year 2015-2016. The survey also indicates that students started borrowing larger amounts of money and confirms that students did not respond to the reform by increasing their labour supply. Details are provided in **Appendix Section D.9**.

8. Robustness and threats to identification

Our study uses an event-study design, which is necessitated by the nation-wide announcement and implementation of the student finance reform. All students were exposed to the information shocks at the same time, leaving us with no obvious control group other than the past cohorts of students. This means that the identifying variation comes from year-on-year changes in choices made by subsequent cohorts of students, conditional on their observable characteristics and underlying time trend. The identifying assumption that is implicit to this design is that the conditional changes of students' behaviours during the reform period are attributable to the reform and not to other unobserved processes.

This identification strategy is subject to two main types of identification threats: mis-specified time trends, and omitted variables correlated with the timing of the reform shocks. First, we consider the specification of time trends. For our principal model of Grade 10 track enrolments, we assume that the underlying time trends are linear. This is motivated by the apparent linearity of time trends observed over the pre-announcement period (2005-2009, as shown in **Figure 1**). It is also supported by the aggregate education time trends observed in comparable European countries (see **Appendix Figure F7**). In order to assess the sensitivity of our findings to the linearity assumption, we have estimated a model specification with quadratic time trends, which yielded estimates of the reform effects that were comparable to our principal specification.[14] We have also estimated a model specification that does not extend the linear time trends beyond the pre-announcement period. This means that, in the absence of the reform, the conditional track shares would remain roughly at their 2009 levels. The results corresponding to this model are presented in **Appendix Table E1**. While this adjustment necessarily affects the magnitudes of

[14] Details available upon request.

the reform effects, the qualitative results remain largely consistent with our conceptual framework: academic track shares are observed to decline throughout the reform announcement period and vocational track shares start rising after the second announcement. The share of enrolments in the general track remains slightly above the 2009 baseline, which implies that the number of students moving from the academic to the general track is greater than the number of students moving from the general to the vocational track. While this is theoretically possible, realistic parameterizations of our theoretical model would predict the opposite pattern. This, together with the linearity of national and international education trends reinforces our conviction that our principal model specification is appropriate. The remaining tables in **Appendix E** focus on the other outcomes of interest (Grade 10 subject specialization, Grade 11 switching of track and subject specialization), listing estimates of the reform effects under alternative time trend specifications.

Second, we consider omitted variables correlated with the timing of the reform shocks. These variables pose another potential threat to identification of our models. In **Appendix F**, we explore multitude of candidate confounding factors. We analyse the dynamics of these factors over the period of observation, looking for trend breaks that would coincide with the timing of the reform. We consider the following factors: 1) earnings of new graduates by education type, 2) employment rates of new graduates by education type, 3) minimum wage rates, 4) youth unemployment, 5) high school graduation rates, 6) average time to graduation in post-secondary education, 7) costs of attending post-secondary education, 8) parental unemployment, 9) school capacity constraints, and 10) other changes of the Dutch education system. Our exploration of these factors did not yield any trend breaks or policy changes which could plausibly invalidate our empirical findings.

9. Conclusions

In 2015, the Dutch government implemented a major reform of post-secondary student finance system. The reform eliminated a universal study subsidy for higher education students and replaced it by a low-interest loan. This change raised the costs of a 4-year bachelor's degree by roughly €5,000 to €14,000. The reform was revealed in two stages. In 2010, the government announced its intention to scale down student finance, thus creating uncertainty regarding the future availability of study subsidies. In 2012, the exact contents and timing of the reform were revealed, and students learned about the costs of their post-secondary education options.

We analysed the effect of this reform and its announcements on students' decision making, focusing on the choices made by secondary school students. Our primary outcome of interest is students' choice of secondary school track, which is instrumental for students' subsequent educational and professional pathways. We showed that students' track choices are contingent on the prospective regime of student financing. In line with our conceptual framework, students who were informed about the reform became less likely to choose tracks which prepare them for higher education, and more likely to choose the track which prepares them for post-secondary vocational education. We showed that these effects emerged already in the period of policy uncertainty following the first reform announcement and that they grew larger over the announcement period. The reform announcements were also found to induce a short-lived surge of older students switching to lower education tracks, thereby correcting the choices they had made before learning about the reform. We showed that each of these effects was stronger among the groups of students who were more affected by the reform.

We also explored several additional choices made by secondary and post-secondary school students. We showed that the reform raised the number of academic and general track students specializing in STEM and Medicine subjects. This suggests that students incorporated the increased costs of higher education into their decision making and refocused their attention towards fields which have higher earnings prospects. Similar changes were observed when analysing students' decisions to abandon the STEM and Medicine specialization and focus on Social Sciences and Humanities instead. Of note, the subject specialization responses were driven largely by female students who are relatively under-represented in STEM fields. Next, we showed that first-year students enrolled in higher education programs responded to the reform by changing their living arrangements. Following the reform implementation, they became much less likely to live on their own, preferring to cohabit with their parents and commute to school on a daily basis. By avoiding the costs of rental housing, they lowered their expenditures and reduced the need for additional financing through loans.

Our findings highlight that changes to the mode of higher education financing can have far-reaching consequences for students' decision making. The 2015 reform and its announcements led to a substantial resorting of secondary school students, reducing the demand for academic education, and increasing the demand for vocational education. In the proximate future, this resorting is likely to translate into large changes in the demand for post-secondary degrees and it is also likely to alter the characteristics of the prospective cohorts of labour market entrants.

Methodologically, our contributions are twofold. The first contribution is to show that Dutch secondary school students are aware of the incentives embedded in the higher education system, and they respond to these incentives well-ahead of their high-school graduation. The incentives shape students' interests and effort levels throughout secondary school, which suggests that early salience of financial aid information is crucial for informed decision making about students' preferred education pathways. Our results imply that students and their families should be informed about college financial aid as early as in the beginning of secondary school.

The second contribution is to show that uncertainty about the receipt of financial aid is sufficient to dissuade many students from pursuing education pathways that lead to higher education programs. This uncertainty alone can widen the achievement gaps between advantaged and disadvantaged students, with the negative effects being disproportionately born by female students (likely because of their higher risk aversion).

It is worth reiterating that the negative effects of losing the universal study subsidy were partially offset by higher award rates of the means-tested subsidy for low -income students. However, a sizable number of low-income students were still observed to shy away from college-preparing tracks, which was likely driven by the fact that their prospective receipt of the means-tested subsidy and its effective amount remained, by design, uncertain.

Many effects of the 2015 reform are yet to be ascertained. We are so far unaware whether the 2015 reform affected the effort levels of students enrolled in higher education, for example through changing the average time to graduation or the likelihood of dropout. We also do not know the extent of the effects on prospective labour market entrants and the economy at large. The decrease in demand for academic education may eventually lead to shortages in some high-skill sectors of the economy, whereas the increase in take-up of STEM subjects may boost other high-skill sectors and improve national R&D indicators. In addition, the increase in demand for vocational education may suppress other white-collar sectors, but it may address some vocational shortages on the Dutch labour market. These are all important avenues for future research.

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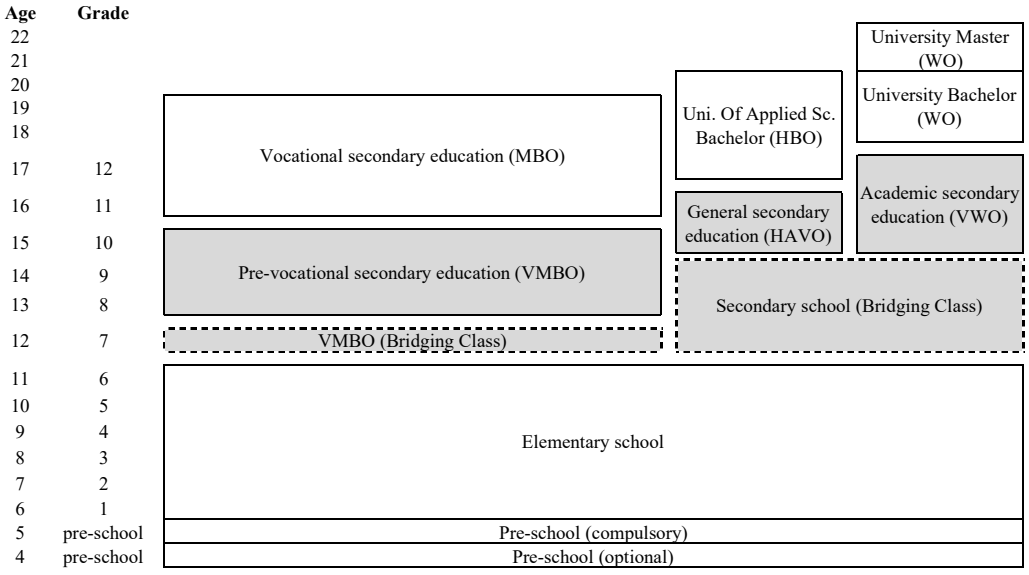
APPENDIX

A Institutional background

A.1 Details on Dutch education

In Figure A1, we present a graphical overview of the Dutch education system. Education in the Netherlands is compulsory from age 5 until age 18. Most children enter kindergarten at age 4 and start attending primary school two years later, in Grade 1. Primary school takes six years to complete and ends with a standardized test.

Figure A1. The Dutch education system (simplified)



The most common type of standardized test is CITO, which is taken by approximately 80% of primary school students. CITO test covers mathematics, language and general learning ability, and the test scores are intended to help students and their parents in choosing the appropriate education track for their secondary schooling.

The CITO test scores range from 501 to 550 points and are normalized so that the national annual average is 535 points. Based on the test scores, the students are issued the following track recommendations:

- 501-532: Vocational track
- 533-536: Vocational or General track
- 537-539: General track
- 540-544: General or Academic track
- 545-550: Academic track

The students also receive a recommendation from their head teacher, who uses his or her observations of the pupils in class to suggest an appropriate education track.

At the end of Grade 6, students choose which secondary school they would like to enter at the start of the next academic year. Most secondary schools offer all three education tracks to their students, which means that the secondary school choice is not necessarily driven by the aforementioned track recommendations. After enrolling into secondary school, students spend one to three years studying a common (non-tracked) curriculum. This period is referred to as the "bridging years".[15] Following the bridging years, students choose their preferred track. The academic track (VWO) ends in Grade 12 (six years after entering the secondary school) and a diploma from the academic track constitutes the minimum requirement for enrolling into a university (WO). The general track (HAVO) ends one year earlier (Grade 11) and prepares students for professionally oriented higher education. A general track diploma constitutes the minimum requirement for enrolling into professional higher education programs (HBO), but does not make students eligible for university education. The vocational track (VMBO) ends in Grade 10 and prepares students for a vocational post-secondary education program (MBO). The academic track is usually considered to be more difficult than the general track, which is usually considered to be more difficult than the vocational track.

At the end of Grade 9, academic and general track students choose their subject specialization. This denotes the pool of focal subjects for the remaining years of secondary school (two years for the general track, and three years for the academic track). Students can choose among the following options: 1) Nature and Technology (*Natuur en Techniek*), 2) Nature and health (*Natuur en Gezondheid*), 3) Economy and society (*Economie en Maatschappij*) and 4) Culture and society (*Cultuur en Maatschappij*). Apart from choosing a single curriculum, students can also combine two curricula. Our data shows that the combinations are relatively rare, being restricted almost exclusively to the combinations of the two STEM curricula (1 and 2), or the two non-STEM curricula (3 and 4). In this study, we consider a simplified choice of subject specialization, bundling together the STEM and Medicine (curriculum 1, curriculum 2, and their combination), and the Social Science and Humanities (curriculum 3, curriculum 4, or any remaining combinations).

[15] Korthals (2015) shows that approximately 20% of students follow one bridging year, 60% follow two bridging years, and 2.5% follow three bridging years. 17.5% of students do not follow any bridging years and choose their track straight away.

In the last year of secondary school, students apply to post-secondary institutions. The admission process is largely non-selective, allowing students to enrol into any school and program available for their education track diploma and subject specialization. Selective admissions are maintained only by a small subset of oversubscribed programs, such as medicine and medical sciences. All applications are submitted through a unified online platform, where students also apply for student finance.

A.2 Details on the Dutch system of student finance prior to 2015

Prior to the 2015 reform, the Dutch system of student finance offered three types of financing. The first type was a basic, unconditional subsidy paid monthly to post-secondary students for up to four years. The subsidy was intended to cover students' living expenses, and it was awarded at two rates, depending on students' living arrangements. The rates were set by a decree every calendar year, and they mirrored the gradual growth of tuition fees. The second type of financing was a means-tested subsidy awarded to students from disadvantaged backgrounds. The awarded amount was determined by the Dutch authorities based on students' living arrangements, taxable income of both parents, and household composition. The third type of financing was a low-interest loan. The loan was provided by a government agency which guaranteed loan financing at below-market rates.[16] Students who took up the loan were expected to repay it over the period of 15 years following graduation in fixed monthly instalments. If a student's post-graduation income was below full-time minimum wage, then the repayment was put on hold, and the residual amount due after 15 years was forgiven. All Dutch students were also eligible for a free public transport card.

Tables A1 and A2 list student finance amounts and take-up rates for years 2005-2018. Panel A of **Table A1** corresponds to the students of higher education programs, Panel B corresponds to the students of vocational post-secondary programs. **Table A2** lists the eligibility thresholds for means-tested subsidies and loan repayment conditions.

[16] There were three types of loans: 1) A basic loan depending on individual needs, 2) a loan to smooth payment of tuition fees expenses ("college tuition credit"), and 3) a loan to increase the duration of coverage of living expenses. The loan repayment amount was automatically adjusted by the tax office, so that the amount never exceeded 12% of taxable income.

Table A1. Financial Aid Amounts and Take-Up Rates, 2005-2018

Panel A. Higher education: University (WO) and University of Applied Sciences (HBO)

	Basic subsidy (per month)				*Means-tested subsidy (maximum rate per month)*			*Loans*				
Year	*Take-up rate*	Living with parents (in €)	Living Indep. (in €)	*Pub. trans. Card* (value in €)	*Take-up rate*	Living with parents (in €)	Living Indep. (in €)	Basic Loan max/mth. (in €)	*Take-up rate*	Tuition credit (in €)	*Take-up rate*	Extra Loan max./mth. (in €)
2005	94%	75.7	233.1	76.5	22%	221.4	239.8	258.7	31%	1,496	N/A	787.02
2006	96%	89.2	248.5	78.4	25%	207.3	225.9	266.0	29%	1,519	N/A	796.31
2007	96%	90.8	252.7	80.0	19%	204.7	223.6	276.5	29%	1,538	8%	809.93
2008	92%	91.8	255.6	78.2	23%	208.6	227.8	279.7	18%	1,565	11%	819.24
2009	96%	93.3	259.8	80.3	23%	212.0	231.4	284.2	20%	1,620	10%	832.43
2010	94%	95.6	266.2	84.0	23%	219.2	239.1	289.4	19%	1,672	12%	853.16
2011	98%	95.6	266.2	82.3	25%	221.0	240.9	287.5	22%	1,713	11%	853.16
2012	98%	95.6	266.2	91.2	23%	222.8	242.8	285.7	27%	1,771	16%	853.16
2013	88%	97.9	272.5	98.8	21%	229.9	250.3	290.5	30%	1,835	14%	873.12
2014	N/A	100.3	279.1	102.3	N/A	237.5	258.4	295.7	N/A	1,903	N/A	894.51
2015	N/A	0	0	98.1	N/A	378.2		475.9	N/A	1,951	N/A	916.96
2016	N/A	0	0	99.7	N/A	381.9		480.6	N/A	1,984	N/A	925.95
2017	N/A	0	0	89.1	N/A	386.1		481.6	N/A	2,006	N/A	931.51
2018	N/A	0	0	91.7	N/A	389.2		481.3	N/A	2,060	N/A	934.49

Table A1. Financial Aid Amounts and Take-Up Rates, 2005-2018 **(Continued)**

Panel B. Post-secondary vocational education (MBO)

	Basic subsidy (per month)				*Means-tested subsidy (maximum rate per month)*			*Loans*				
Year	*Take-up rate*	Living with parents (in €)	Living Indep. (in €)	*Pub. trans. Card* (value in €)	*Take-up rate*	Living with parents (in €)	Living Indep. (in €)	Basic Loan max/mth. (in €)	*Take-up rate*	Tuition credit (in €)	*Take-up rate*	Extra Loan max./mth. (in €)
2005	90%	57.1	214.4	76.5	22%	221.4	239.8	141.5	24%	1,496	N/A	787.0
2006	99%	70.4	229.6	78.4	25%	207.3	225.9	147.4	27%	1,519	N/A	796.3
2007	99%	71.6	233.5	80.0	19%	204.7	223.6	155.9	29%	1,538	10%	809.9
2008	99%	72.4	236.2	78.2	23%	208.6	227.8	157.7	22%	1,565	9%	819.2
2009	83%	73.6	240.0	80.3	23%	212.0	231.4	160.2	16%	1,620	9%	832.4
2010	86%	75.4	246.0	84.0	23%	219.2	239.1	164.2	15%	1,672	8%	853.2
2011	86%	75.4	246.0	82.3	25%	221.0	240.9	164.2	16%	1,713	11%	853.2
2012	90%	75.4	246.0	91.2	23%	222.8	242.8	164.2	18%	1,771	13%	853.2
2013	90%	77.2	251.8	98.8	21%	229.9	250.3	168.1	23%	1,835	14%	873.1
2014	N/A	79.0	257.9	102.3	N/A	237.5	258.4	172.2	N/A	1,903	N/A	894.5
2015	N/A	81.0	264.4	98.1	N/A	239.1	260.5	176.5	N/A	1,951	N/A	917.0
2016	N/A	81.8	267.0	99.7	N/A	241.5	263.1	178.2	N/A	1,984	N/A	926.0
2017	N/A	82.3	268.6	89.1	N/A	337.7	359.4	179.3	N/A	2,006	N/A	931.5
2018	N/A	82.6	269.5	91.7	N/A	338.5	360.3	179.9	N/A	2,060	N/A	934.5

Note: Financial aid rates applicable at the start of the academic year (September) for years 2005 to 2018. Diverse sources. Take-up rates are based on the authors' calculations based on *Studenten Monitor* survey, 2005-2015. Financial aid amounts and structure are taken from *Rijksoverkeid* and *DUO* archives and Dutch Statistical Yearbooks over 2005-2018. N/A denotes unavailable data.

Table A2. Eligibility Thresholds and Loan Repayment Conditions, 2005-2018

	Family income eligibility thresholds for means-tested subsidy				Loan repayment interest rate
	Higher education (WO & HBO)		Vocational education (MBO)		
Year	2-parent households	Single-parent households	2-parent households	Single-parent households	
2005	29,711.7	38,200.7	14,855.8	19,100.4	N/A
2006	30,551.3	39,093.9	15,275.7	19,546.9	2.74%
2007	31,008.5	39,497.5	15,504.2	19,748.8	3.70%
2008	31,856.3	40,398.8	15,928.2	20,199.4	4.17%
2009	33,638.9	42,659.5	16,819.5	21,329.7	3.58%
2010	33,775.3	42,832.5	16,887.7	21,416.2	2.39%
2011	34,515.0	43,770.5	17,257.5	21,885.3	1.50%
2012	34,898.1	44,256.4	17,449.1	22,128.2	1.39%
2013	35,337.9	44,814.0	17,668.9	22,407.0	0.60%
2014	35,857.3	45,472.8	17,928.7	22,736.4	0.81%
2015	33,781.2	42,799.0	16,890.6	21,399.5	0.12%
2016	34,105.5	43,209.9	17,052.8	21,605.0	0.01%
2017	34,658.0	43,909.9	17,329.0	21,955.0	0.00%
2018	35,243.8	44,652.0	17,621.9	22,326.0	0.00%

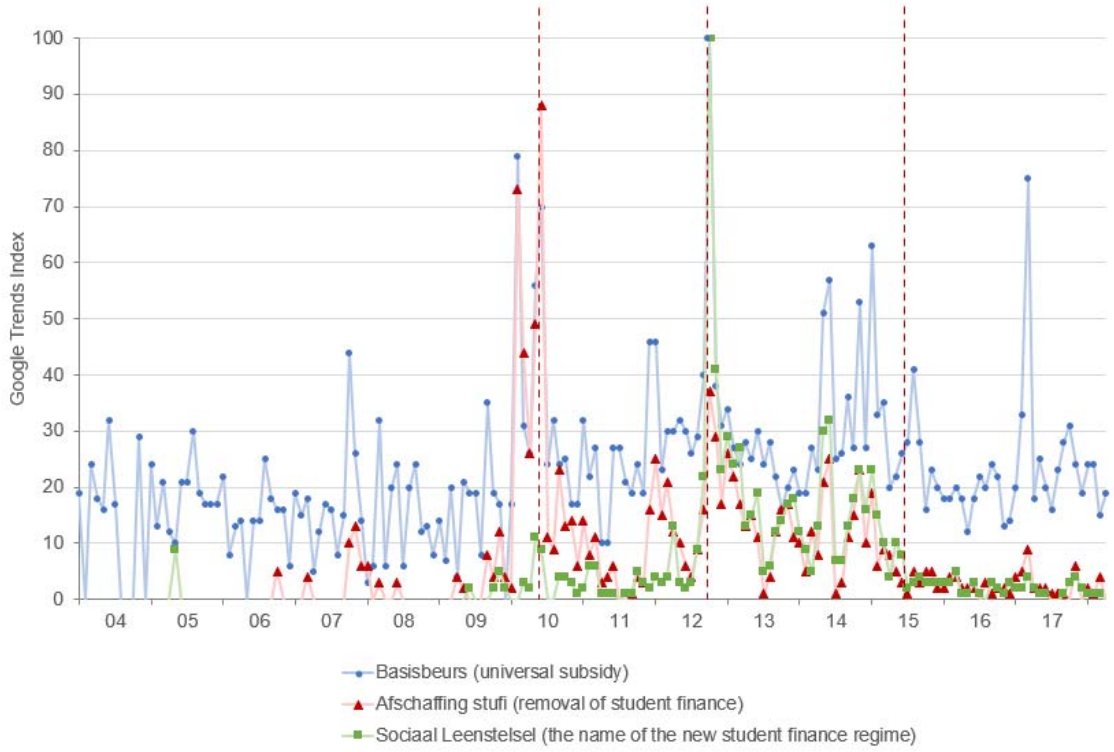
Note: Data collected from *Rijksoverkeid* and *DUO* archives and Dutch Statistical Yearbooks over 2005-2018. N/A denotes unavailable data.

A.3 Additional information on the 2015 reform

The 2015 reform is discussed in detail in **Section 2**. Here, we present empirical evidence of the information shocks that were caused by the student finance reform. **Figure A2** shows Google trends for key queries related to the reform. The query "*Basisbeurs*" (*i.e.,* universal subsidy) is relatively stable, with three main peaks in January 2010, June 2010, and October 2012. In January 2010, student unions organized large national demonstration against the education budget cuts that were proposed by VVD during the election campaign. June 2010 and October 2012 correspond to the post-election reform announcements. We also observe higher search intensity for this query in years 2014 and 2015, with the queries being particularly frequent around May 2014 and January 2015. In May 2014, the government announced that the reform would be postponed by one year, until September 2015. In January 2015, the first cohort of students affected by the reform started filing their post-secondary education applications.

The query for "*Sociaal leenstelsel*" (*i.e.,* new student finance system) becomes relevant after October 2012, which is the point at which the details of the new system were revealed to the public. The search intensity of this query subsides after the implementation of the reform in September 2015. The query "*Afschaffing stufi*" (*i.e.,* removal of student finance) is a synthetic index constructed by averaging queries on related terms ("*Afschaffing studiefianciering*", "*Afschaffing studiebeurs*", etc.). This index peaks in January 2010 and June 2010, when the timing of the reform and its details were most uncertain. These queries were relatively common throughout the two announcement periods, subsiding only after the implementation of the reform in September 2015.

Figure A2. Google Trends of Reform-Related Search Queries



Note: This figure plots the Google Trend indices for queries related to the student finance reform. Indices correspond to national monthly Google searches in the Netherlands, normalized by the highest observed search frequency. The "*Afschaffing stufi*" (removal of student finance) is a synthetic index constructed by averaging indices for the terms associated with the removal of student finance, which we collected from news clippings. All markers corresponding to zero monthly searches were removed from the figure.

B Theoretical framework

In this section, we derive comparative statics from our theoretical framework.

We can express θ_A^* and θ_G^* as a function of the lifetime payoff functions, using the equilibrium conditions presented in **Section 3**. θ_G^* solves $R_i^G(\theta_G^*) = R_i^V(\theta_G^*)$, and with $R_i^V(\theta_i)$ normalized to 0, we can show analytically that:

$$\theta_G^* = 1 - \frac{1}{\kappa_G(t_G+1) - t_V\kappa_V} \times \left\{ \sum_{k=t_G+1}^{T-t_G} E(\Pi_t^G) - (1+b)\left[(t_G - t_V + 1)\left[F_G - (1-p_{0G})s^0 - (1-p_{1G})s^1\mathbf{1}_{\{elig\}}\right] - t_V(F_G - F_V)\right] - \sum_{t=t_V+1}^{t_G} E(Y_t^V) \right\}$$

θ_G^* is increasing in κ_G, illustrating that the harder is general education relative to vocational education, the higher is the ability level of the student who is indifferent between these two options. θ_G^* is also increasing in the net financial costs of attending general education over vocational education, as well as in the costs of borrowing b, and in the opportunity costs represented by the counterfactual wage a student would receive after graduating from vocational education. Lastly, θ_G^* is decreasing in the expected premium from general education: increasing the premium from general education over vocational education increases the share of students in general education.

Similarly, θ_A^* solves $R_i^A(\theta_A^*) = R_i^G(\theta_A^*)$, which eventually leads to:

$$\theta_A^* = 1 - \frac{1}{\kappa_A t_A - \kappa_G(t_G+1)} \times \left\{ -(1+b)[F_A t_A - F_G(t_G+1) - (t_G - t_V + 1)(s^0(p_{0A} - p_{0G}) + s^1(p_{1A} - p_{1G})) + (t_A - t_G + 1)(s^0(1 - p_{0A}) + s^1(1-p_{1A}))] + \sum_{k=t_A+1}^{T-t_A} E_t(Y_t^A - Y_t^G) - \sum_{t=t_G+1}^{t_A} E(Y_t^G) \right\}$$

θ_A^* has a similar expression to that of θ_G^*, except that for the student who is indifferent between general and academic education, the relevant counterfactual is general education, such that *i)* the counterfactual net cost of attending academic education is attending general education, and *ii)*

the opportunity cost from attending academic education is now the premium from general education.

Comparative Statics

Charles, Hurst and Notowidigdo (2018) show that the impact of a policy shock S on sorting, *i.e.*, on equilibrium ability thresholds of θ_A^* and θ_G^*, can occur through four distinct channels. Specifically, a policy shock can affect θ_G^* by either: 1) shifting students' expectations about the wage premium of general over vocational education; 2) changing the cost of borrowing to cover the additional costs of attending general education over vocational education; 3) affecting the net costs of attending general versus vocational education, which can be driven by changes to various elements of costs – tuition fees, unconditional financial aid, means-tested financial aid, or the probabilities of having to repay financial aid, and 4) by changing the opportunity cost of attending general over vocational education, i.e. an increase in the outside wage level students would receive if they were to attend vocational education instead of general education. The relative importance of each of these channels is weighted by the relative difficulty and duration of both options under consideration; the harder and longer it is to attend general education compared to vocational education, the less one should expect *S* to affect sorting.

Importantly, at fixed level of financial aid s^0, an increase in the repayment probability p_0 induced by the shock S shifts the equilibrium ability thresholds *upwards*. This means that the weakest students in the general track will sort into the vocational track.

Thus, a shock S is expected to affect sorting through potentially four different types of channels running through changes in the lifetime expected payoff of each education type, the overall sign and magnitude of the effect being the sum of these distinct types of effect. In the absence of any other channels, a shock affecting *only* repayment uncertainty by increasing p_0 and p_1 would lower θ_G^* and θ_A^*.

C Empirical Strategy: Functional Forms and Assumptions

C.1 Model of Grade 10 track enrolment

Secondary school students can choose among three separate education tracks. That is why we model students' Grade 10 track enrolments in a multinomial logit framework,

$$P[Y_i = j^* \mid \mathbf{x}_i, \boldsymbol{\beta}] = \frac{\exp(\mathbf{x}_i \boldsymbol{\beta}_{j^*})}{\sum_{j=1}^{3} \exp(\mathbf{x}_i \boldsymbol{\beta}_j)},$$

where i indexes students and j indexes secondary school tracks. Y is the choice variable, j^* is the selected track, $\mathbf{x}$ is a vector of covariates, and $\boldsymbol{\beta}$ is a set of choice-specific parameter vectors, such that

$$\mathbf{x}_i \boldsymbol{\beta}_j = \beta_{1j} + \beta_{2j} f(t_i) + \sum_{y=2010}^{2017} \beta_{3yj} \mathbf{1}(t_i = y) + \mathbf{z}_i \boldsymbol{\beta}_{4j},$$

The vector of covariates contains a time trend, a set of eight yearly dummies covering the periods of reform announcements and reform implementation, and a vector of student's observable characteristics $\mathbf{z}$, including dummies for gender, immigration and ethnic background and residential characteristics (urbanization level and province of residence). The model uses a linear time trend which runs throughout the period of observation, $f(t_i) = t_i$. The same time trend specification is used by the model of Grade 10 subject specialization (**Table D5**).

The reform effects are captured by the set of dummies covering the periods of reform announcements and reform implementation. The set of yearly reform dummies accounts for the staggered announcement which made the reform and its details more salient to the later cohorts of students. Indeed, students who began their studies later had more time to adjust to the new student finance regime, which would imply stronger reform effects among the later cohorts.

Throughout the paper, the reform effects are presented in the form of average marginal effects corresponding to three composite coefficients which represent the period of first announcement (γ_{FA}), second announcement (γ_{SA}), and the reform implementation (γ_{RI}). These are constructed by applying linear transformations to the regression coefficients β_{3y} corresponding to the individual reform dummies (for simplicity, here we omit the choice subscript, j),

$$\gamma_{FA} = \sum_{y=2010}^{2012} \frac{\beta_{3y}}{3}, \qquad \gamma_{SA} = \sum_{y=2013}^{2014} \frac{\beta_{3y}}{2}, \qquad \gamma_{RI} = \sum_{y=2017}^{2015} \frac{\beta_{3y}}{3}.$$

C.2 Model of switching to a lower track in Grade 11

The choice to switch to a lower track in Grade 11 is a binary choice, which is why we model it in the standard binary logistic framework,

$$P[Y_i = 1 \mid \mathbf{x}_i, \boldsymbol{\beta}] = \frac{1}{1 + \exp(-\mathbf{x}_i \boldsymbol{\beta})}.$$

Y equals to 1 if student i decided to switch to a lower track, and 0 otherwise. As before, $\mathbf{x}$ is a vector of covariates, and $\boldsymbol{\beta}$ is a parameter vector. The set of covariates mirrors the set corresponding to the Grade 10 track enrolment model, with one exception. The time trend is specified as $f(t_i) = t_i \cdot \mathbf{1}(t_i < 2010)$, which means that the linear trend stops in year 2009 and it is not extrapolated further. This is to account for the lack of a clear pre-announcement trend in track switching (**Figure 2**). The same time trend specification is also used in the Grade 11 model of leaving the STEM and Medicine specialization (**Table D6**), and an alternative specification for the Grade 10 track enrolment model (**Table E1**). An alternative specification of the Grade 11 track switching model which uses a continuous linear time trend is presented in **Table E2.**

D Further results and supporting evidence

D.1 Heterogeneity in track enrolment responses with respect to family income

To explore whether low-income students responded to the reform differently than high-income students, we split the students into three groups separated by terciles of the cohort-specific distributions of parental income. Our preferred parental income measure is joint parental income (combining annual labour earnings and business revenues of both parents), which is averaged over the five years preceding the point of observation. We average over five years to smooth out any transitory income shocks. We use joint parental irrespective of parents' actual living arrangements, which is in line with the income test that is applied for the means-tested study subsidy.

Having students split into the three income groups, we estimate the model of Grade 10 track choice, and the model of Grade 11 track switching separately for each of the three groups. The model specifications used for this exercise are the same as the specifications presented in Tables 3 and 4. The reform effects corresponding to these models are presented in Tables B1 and B2. As before, we present the reform responses both in absolute terms (Panel A) and in relative terms (Panel B).

Table D1. Average marginal effects of the 2015 reform on Grade 10 track enrollment, by parental income terciles

Panel A. Absolute effects (in percentage points)

Track	Income group:	Pre-ann. shares (2009, within income terciles)	Uncertainty	Uncertainty resolution	Post-implementation
			(2010-2012)	(2013-2014)	(2015-2017)
Academic	Low	10%	-0.61***	-1.48***	-2.20***
	Medium	18%	-1.18***	-2.54***	-4.09***
	High	33.5%	-1.73***	-3.35***	-5.11***
General	Low	22%	-1.56***	-3.13***	-5.37***
	Medium	28%	-1.11**	-2.64***	-4.97***
	High	33.5%	0.83***	0.64*	0.15
Vocational	Low	68%	2.17***	4.61***	7.56***
	Medium	54%	2.29***	5.18***	9.06***
	High	33%	0.90***	2.71***	4.96***

Panel B. Relative effects (in percent)

Track	Income group:	Uncertainty	Uncertainty resolution	Post-implementation
Academic	Low	-5.68***	-13.74***	-20.45***
	Medium	-7.03***	-15.14***	-24.39***
	High	-5.26***	-10.19***	-15.57***
General	Low	-6.89***	-13.84***	-23.72***
	Medium	-3.83**	-9.07***	-17.09***
	High	2.46***	1.90*	0.44
Vocational	Low	3.33***	7.07***	11.60***
	Medium	4.30***	9.69***	16.97***
	High	2.82***	8.42***	15.41***

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the multinomial logit model of Grade 10 high school track enrollment. The models are split by parental income terciles and use respectively 877,855; 889,294; and 898,283 observations over years 2005-2017. Controls: Age, gender, migration status, ethnic background, parental income and employment status, linear trend, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

Table D2. Average marginal effects of the 2015 reform on switching to a lower track in Grade 11, by parental income terciles

Panel A. Absolute effects (in percentage points)

Outcome	Income group:	Pre-announcement shares (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Switching to a lower track	Low	4.8%	1.70***	1.41**	-0.02
	Medium	4.8%	1.18***	1.27***	-0.22*
	High	3.4%	1.08***	0.89***	0.01

Panel B. Relative effects (in percent)

Outcome	Income group:	Uncertainty	Uncertainty resolution	Post-implementation
Switching to a lower track	Low	33.22***	27.48**	-0.45
	Medium	24.19***	26.07***	-4.55*
	High	29.73***	24.36***	0.21

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit models of Grade 11 high school track switching. The models are split by parental income terciles and use respectively 198,914; 296,780; and 458,403 observations over years 2006-2017. Controls: Age, gender, migration status, ethnic background, parental income, employment status, linear pre-trend covering the period 2006-2009, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

D.2 Heterogeneity in track enrolment responses with respect to gender

Next, we explore whether male students responded to the reform differently than female students. The reform effects corresponding to the gendered models of Grade 10 track choice and Grade 11 track switching are presented in Tables B3 and B4.

Table D3. Average marginal effects of the 2015 reform on Grade 10 track enrolment, by gender

Panel A. Absolute effects (in percentage points)

Track	Gender	Pre-announcement shares (2009)	Uncertainty	Uncertainty resolution	Post-implementation
			(2010-2012)	(2013-2014)	(2015-2017)
Academic	Male	21.5%	-0.37***	-1.41***	-2.60***
	Female	18.5%	-1.77***	-3.19***	-4.54***
General	Male	28.5%	-0.52*	-1.67****	-3.44***
	Female	27.5%	-0.57***	-1.53***	-3.02***
Vocational	Male	50.0%	0.89***	3.08***	6.04***
	Female	54.0%	2.34***	4.72***	7.57***

Panel B. Relative effects (in percent)

Track	Gender	Uncertainty	Uncertainty resolution	Post-implementation
Academic	Male	-2.02***	-7.69***	-14.18***
	Female	-8.32***	-15.03***	-21.46***
General	Male	-1.87	-6.01**	-12.38***
	Female	-2.03*	-5.41***	-10.67***
Vocational	Male	1.73***	5.99***	11.73***
	Female	4.89***	9.85***	15.79***

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the multinomial logit model of Grade 10 high school track enrolment. The models are split by gender and use respectively 1,354,293 and 1,338,730 observations over years 2005-2017. Controls: Age, gender, migration status, ethnic background, parental income and employment status, linear trend, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

Table D4. Average marginal effects of the 2015 reform on switching to a lower track in Grade 11, by gender

Panel A. Absolute effects (in percentage points)

Outcome	Gender	Pre-announcement shares (2009)	Uncertainty	Uncertainty resolution	Post-implementation
			(2010-2012)	(2013-2014)	(2015-2017)
Switching to a lower track	Male	4.0%	1.81***	2.27***	2.08***
	Female	4.6%	1.16***	0.94*	-0.47

Panel B. Relative effects (in percent)

Outcome	Gender	Uncertainty	Uncertainty resolution	Post-implementation
Switching to a lower track	Male	44.98***	56.37***	51.56***
	Female	25.35***	20.47*	-10.25

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit models of Grade 11 high school track switching. The models are split by gender and use respectively 1,354,293 and 1,338,730 observations over years 2006-2017. Controls: Age, gender, migration status, ethnic background, parental income, employment status, linear pre-trend covering the period 2006-2009, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

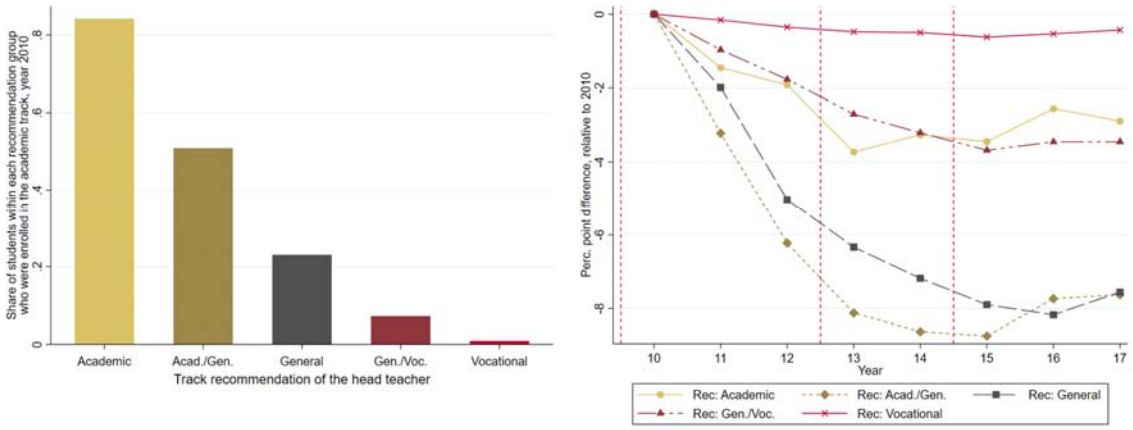
D.3 Heterogeneity in track enrolment responses with respect to ability

Analysing whether low-ability students responded to the reform differently than high-ability students is complicated by several factors. First, our preferred measure of student ability (Grade 6 track recommendations made by the head teacher) is available only from year 2010 onwards. Second, just like the students' decisions, the teachers' track recommendations may be also affected by the reform announcements (further evidence on this can be found in **Figure F3**). This means that the reform may have distorted our preferred measure of student ability. For these two reasons, we abstain from fitting any regression models that group students by their abilities, and instead we resort to a descriptive analysis.

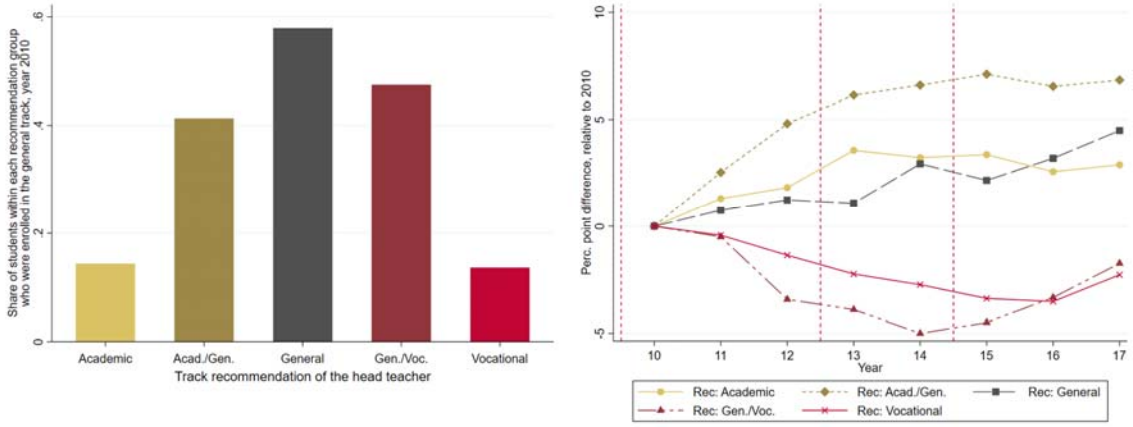
In **Figure D1,** we split Grade 10 students into five ability groups based on their Grade 6 teacher's recommendations, and we quantify how many students within these groups enrolled into the academic, general, and vocational tracks over the period of observation (Panels A, B and C, respectively). Each panel contains two graphs, the first one showing the within-group track shares recorded in 2010, and the second one showing how these shares evolved over the period of observation. In contrast to **Figure 1**, the changes are specified in absolute terms (percentage points), which facilitates comparisons across the five groups.

Figure D1. Grade 10 track shares, years 2010-2017, by the recommendations of the head teacher

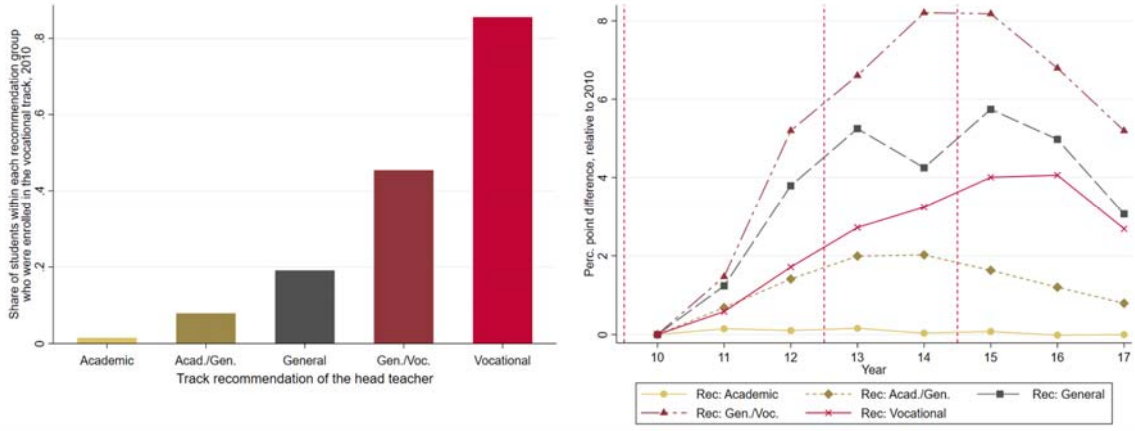
Panel A. Academic track shares recorded in 2010 and percentage point differences of academic track shares recorded in the subsequent years



Panel B. General track shares recorded in 2010 and percentage point differences of general track shares recorded in the subsequent years



Panel C. Vocational track shares recorded in 2010 and percentage point differences of vocational track shares recorded in the subsequent years



Note: Authors' calculations of Grade 10 track shares split by Grade 6 track recommendations of the head teacher. Charts on the left plot the within-group track shares attained in 2010, and charts on the right track the changes of track shares among the next seven student cohorts, taking the 2010 cohort as the point of reference. Dutch education register data, years 2010-2017.

The overall takeaway from these plots is that the reform made students less likely to choose education tracks which were above their Grade 6 track recommendations. This is perhaps most evident in the graphs corresponding to the academic track enrolments (Panel A). We see that, among students whose track recommendation was 'General', the share enrolled in the academic track dropped from 23% in 2010 to 15% in 2015. Similarly, the share of students whose track recommendation was 'academic/general' dropped from 51% in 2010 to 42% in 2015. In line with the predictions of our theoretical model, this suggests that the student finance reform made the academic track more selective and homogenous in terms of students' abilities.

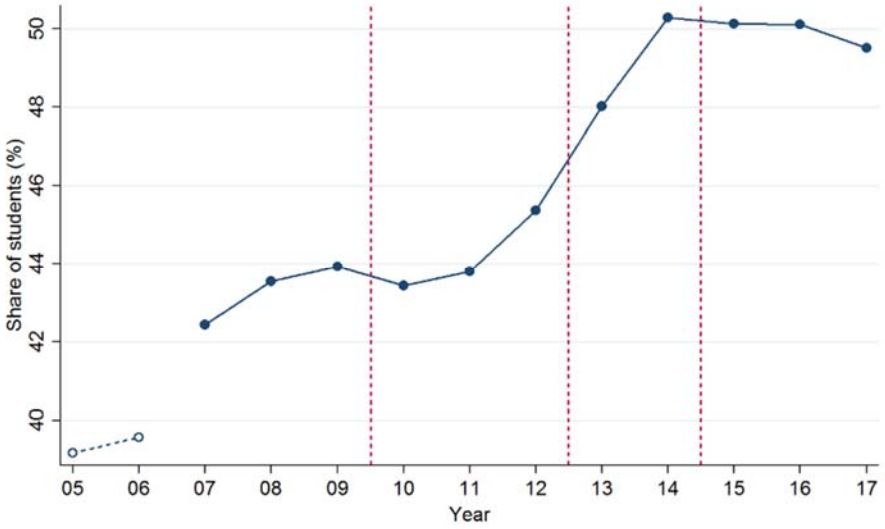
The general track (Panel B) experienced an inflow of students with higher recommendations, and an outflow of students with lower recommendations. This suggests that the pool of general track students also became more selective in terms of students' abilities, although it is not clear whether it became more homogenous as well.

The vocational track (Panel C) experienced an inflow of students with higher recommendations. The largest responses were recorded among students whose recommendations were 'general' and 'general/vocational'. Meaningful responses were recorded even among those with the recommendation 'academic/general'. Accordingly, the pool of vocational track students likely improved in terms of the average student abilities and it also became more heterogenous in this respect.

D.4 Grade 10 subject specialization responses

Besides influencing the track choice, the student finance reform could also affect students' choices of subject specialization. To investigate the subject specialization responses, we first look at the raw shares of Grade 10 academic and general track students who chose the STEM and Medicine specialization (as opposed to Humanities and Social Sciences) over the period observation (**Figure D2)**. We note that the student shares observed in 2005 and 2006 are not readily comparable with the shares observed later, which is due to a change of classification rules for secondary school curricula which took place in 2007. Nevertheless, the overall pattern does suggest that the subject specialization choices were affected by the reform. The share of students choosing STEM and Medicine grew from 44% in 2010 to 50% in 2014. This growth levelled off in the subsequent years, which is consistent with the timing of the reform announcements (from the 2014 cohort onwards, students knew about the reform ahead of entering secondary school and fostering specific subject preferences).

Figure D2. Shares of academic and general track students choosing STEM and Medicine in Grade 10, years 2005-2017.



Note: Authors' calculations of the choice of STEM and Medicine specialization in Grade 10 over the period of observation. STEM and Medicine specialization corresponds to one of the following curricula: Nature and Technology, Nature and Health, and the combination thereof. Other curricula include Economy and Society, Culture and Society, and all other possible combinations. The line between years 2005-06 is dashed to highlight different curriculum classification rules which were in place during this period. Dutch education register data for Grade 10 secondary school students who were enrolled in either an academic or a general track in Grade 10, years 2005 to 2017

Next, we estimate a logistic regression model of Grade 10 subject specialization choice, with the outcome variable equal to 1 if the student chose STEM and Medicine, and equal to 0 if the student chose Social Sciences and Humanities. The set of control variables mirrors the model of Grade 10 track enrolments. We also include an additional dummy variable representing years 2005-2006, which accounts for the aforementioned 2007 classification change. We control for linear time trend because the share of students choosing the STEM and Medicine specialization was increasing throughout the pre-announcement period, and because similar trends have been observed in other countries as well (see **Figure F8**).

Table D5. Average marginal effects of the 2015 reform on Grade 10 choice of subject specialization

Panel A. Absolute effects (in percentage points)

Outcome	Pre-announcement share (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Choosing STEM and Medicine	44%	-0.56	2.28***	3.00***
		(0.44)	(0.73)	(1.17)

Panel B. Relative effects (in percent)

Outcome	Uncertainty	Uncertainty resolution	Post-implementation
Choosing STEM and Medicine	-0.99	4.02***	5.27**
	(0.77)	(1.28)	(2.06)

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit model of Grade 10 of subject specialization. The model uses 549,640 observations over years 2005-2017. Controls: Age, gender, migration status, ethnic background, parental income and employment status, linear trend, region fixed effects, an urbanization index, and a dummy for the differently-classified period 2005-2006. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

Table D5 reports the corresponding reform effects. Reflecting the dynamics plotted in **Figure D2**, The share of STEM and Medicine students remained stable during the period of policy uncertainty, rose after the resolution of policy uncertainty in 2012, and peaked after the reform implementation.

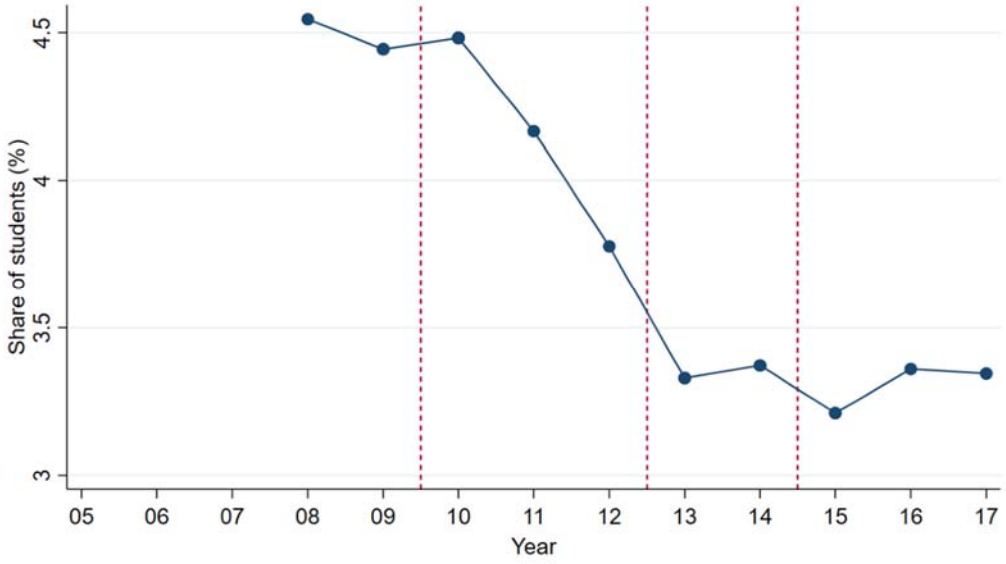
It needs to be acknowledged that the presented results could be influenced by the student outflow from academic and general tracks. The increase of the share of STEM and Medicine students could be a consequence of an outflow of students interested in humanities and social sciences into the vocational track. To explore the extent of this selection, we analyse the field of study choices of students who switched to the vocational track in Grade 11. Assuming that the 2.5% of Grade 10 students who decided not to pursue the general or academic track in response to the reform would have chosen the same specialization as the students who switched tracks in Grade 11, we calculate that this would account for a 1 p.p. change of the STEM and Medicine share, leaving 2 p.p. attributable to the changing preferences for subject specialization.

D.5 Decision to abandon the STEM and Medicine specialization in Grade 11

Next, we analyse the responses in terms of students' decisions to abandon the STEM and Medicine subject specialization in Grade 11 and take up Social Science and Humanities instead. Our focus is one-sided because switches in the opposite direction are extremely rare. **Figure D3** shows the shares of academic and general track students who decided to abandon the STEM and Medicine specialization between years 2008 and 2017. Earlier years are not plotted due to the 2007 curriculum change. The shares of Grade 11 students abandoning STEM and Medicine are comparable to the shares of students switching to a lower track in Grade 11. Similar to the initial choices of subject specialization, we observe that the shares of students leaving STEM and Medicine dropped in the period covering the reform announcements, from 4.5% in 2010 to 3.3% in 2013, at which point they stabilized again.

Table D6 reports the reform effects on the decision to leave STEM and Medicine in Grade 11. The results show that the share of students leaving the STEM and Medicine curriculum decreased by 0.30 percentage points after the 2010 announcement, further decreasing to -1.12 percentage points after the uncertainty was resolved, and stabilizing at -1.21 percentage points after reform implementation in 2015.

Figure D3. Share of students abandoning STEM and Medicine in Grade 11



Note: Authors' calculations of the choice to switch from STEM specialization to a non-STEM specialization in Grade 11 over the period of observation. STEM specialization corresponds to the following curricula: Nature and Technology, Nature and Health, and the combination thereof. Other curricula include Economy and Society, Culture and Society, and all other possible combinations. Dutch education register data for Grade 11 academic or general track high school students who chose the STEM specialization in Grade 10, years 2008 to 2017

Table D6. Average marginal effects of the 2015 reform on the decision to abandon the STEM and Medicine specialization in Grade 11

Panel A. Absolute effects (in percentage points)

Outcome	Pre-announcement share (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
STEM and Medicine dropout	4.5%	-0.30*** (<0.01)	-1.12*** (<0.01)	-1.21*** (<0.01)

Panel B. Relative effects (in percent)

Outcome	Uncertainty	Uncertainty resolution	Post-implementation
STEM and Medicine dropout	-7.93*** (0.04)	-29.95*** (0.08)	-32.21*** (0.11)

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit models of Grade 11 choice to switch from STEM and Medicine to another subject specialization. The model uses 451,512 observations over years 2008-2017. Controls: Age, gender, migration status, ethnic background, parental income, employment status, linear pre-trend covering the period 2008-2009, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

D.6 Heterogeneity in subject specialization responses

Table D7 presents heterogeneity in subject specialization responses with respect to family income. Similar to the track choice responses presented in **Table D1**, the largest responses were recorded among middle income students.

Table D8 presents heterogeneity in subject specialization responses with respect to students' gender. The results show that the subject specialization responses were driven entirely by female students. At the baseline, the take-up of STEM and Medicine was considerably lower among girls than among boys (38% compared to 50%). The student finance reform narrowed this gap by a considerable margin, with 43% of girls taking up STEM and Medicine after the reform implementation (the boys' share remained unchanged). This suggests that one unanticipated consequence of the student finance reform could be a higher proportion of women in STEM fields and Medicine.

Table D7. Average marginal effects of the 2015 reform on Grade 10 choice of subject specialization, by income terciles

Panel A. Absolute effects (in percentage points)

Outcome	Income tercile:	Pre-announcement share (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Choosing STEM and Medicine	Low	41.3%	-0.80	1.52**	1.16
	Medium	43.6%	0.54	3.02***	5.43***
	High	47.0%	-1.17	2.00**	2.09

Panel B. Relative effects (in percent)

Outcome	Income tercile:	Uncertainty	Uncertainty resolution	Post-implementation
Choosing STEM and Medicine	Low	-1.45	2.78**	2.12
	Medium	0.97	5.44***	9.79***
	High	-2.01	3.45**	3.60

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit model of Grade 10 of subject specialization. The dataset is split by parental income terciles and uses respectively 96,694; 150,621; and 299,946 individual observations over years 2006-17. Controls: Age, gender, migration status, ethnic background, parental income and employment status, linear trend, region fixed effects, an urbanization index, and a dummy for the differently-classified period 2005-2006. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

Table D8. Average marginal effects of the 2015 reform on Grade 10 choice of subject specialization, by gender

Panel A. Absolute effects (in percentage points)

Outcome	Gender:	Pre-announcement share (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Choosing STEM and Medicine	Male	50.3%	-1.18	1.31	-0.13
	Female	38.0%	-0.35	2.77***	5.22***

Panel B. Relative effects (in percent)

Outcome	Gender:	Uncertainty	Uncertainty resolution	Post-implementation
Choosing STEM and Medicine	Male	-1.91	2.12	-0.21
	Female	-0.67	5.30***	9.98***

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit model of Grade 10 of subject specialization. The models are split by gender and use respectively 257,338 and 292,302 individual observations over years 2005-17. Controls: Age, gender, migration status, ethnic background, parental income and employment status, linear trend, region fixed effects, an urbanization index, and a dummy for the period 2005-2006. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

Table D9 presents income heterogeneity in the decisions to abandon STEM and Medicine subject specialization in Grade 11. According to these results, low-income students were driving the overall reform response presented in **Table D6**. We note, however, that these models may be splitting the data too finely, and they could be distorted by very low incidences of the studied outcome.

Table D9. Average marginal effects of the 2015 reform on the decision to abandon the STEM and Medicine specialization in Grade 11, by income terciles

Panel A. Absolute effects (in percentage points)

Outcome	Income tercile:	Pre-announcement share (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Choosing STEM and Medicine	Low	5.5%	-2.07***	-3.43***	-5.38***
	Medium	4.0%	0.46***	0.38***	0.79***
	High	4.2%	0.33***	-0.40***	0.57***

Panel B. Relative effects (in percent)

Outcome	Income tercile:	Uncertainty	Uncertainty resolution	Post-implementation
Choosing STEM and Medicine	Low	-48.08***	-79.7***	-125.01***
	Medium	13.14***	11.03***	22.69***
	High	9.01***	-10.74***	15.58***

Note: Authors' estimates of three reform coefficients from a logit model of Grade 11 choice to switch from STEM and Medicine to another subject specialization, assuming a continued linear pre-trend beyond 2009. The dataset is split by parental income terciles and uses respectively 96,693; 138,489; and 218,330 individual observations over years 2006-17. Controls: Age, gender, migration status, ethnic background, parental income and employment status, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

D.7 Living arrangements of students in post-secondary education programs

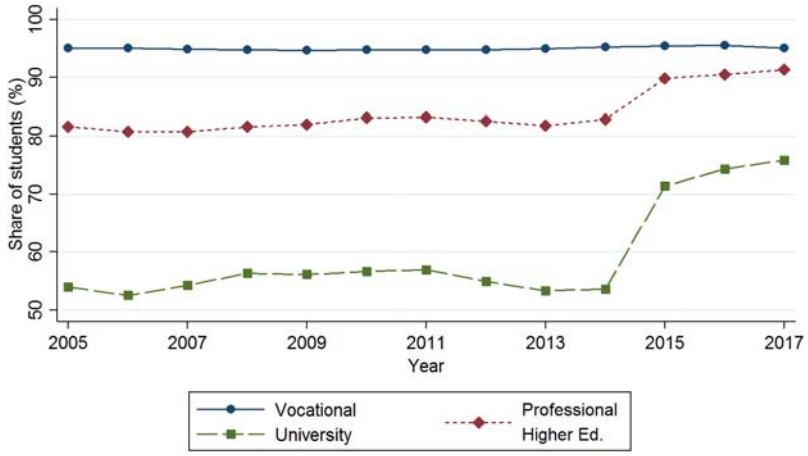
Next, we explore the short-run reform responses of students in post-secondary education programs. Instead of incurring debts, post-secondary students may choose to lower their living expenditures. Opting to live with their parents (as opposed to moving to an apartment or a dormitory that is closer to the university) is one way to do so. In **Figure D4**, we plot relevant statistics pertaining to the living arrangements and commuting distances of freshman post-secondary students in years 2005-2017.[17]

[17] Freshman students are students attending the first year of post-secondary education.

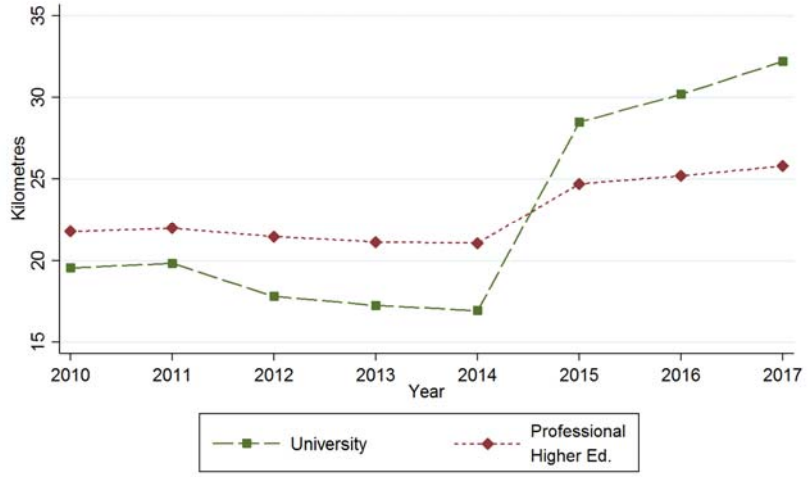
Panel A shows that, starting in 2015, substantially larger shares of university and professional higher education freshmen opted to live with their parents. The timing of this discontinuity is in line with the timing of the reform, since the 2015 freshman cohort was the first cohort affected by the new student finance regime. The shares of cohabiting students in the vocational track remained constant, which is in line with their retention of the original subsidy scheme. Panel B shows that these changes led to an increase in the mean commuting times, with new university and professional higher education students living further away from their campuses. Panel C completes this picture by showing that the changes in living arrangements did not affect the location of the studied programs – the schools chosen by post-secondary students after the reform were just as far from their parents' home as the schools chosen prior to the reform.

Figure D4. Living arrangements and commuting distances of freshman post-secondary education students, years 2005-2017

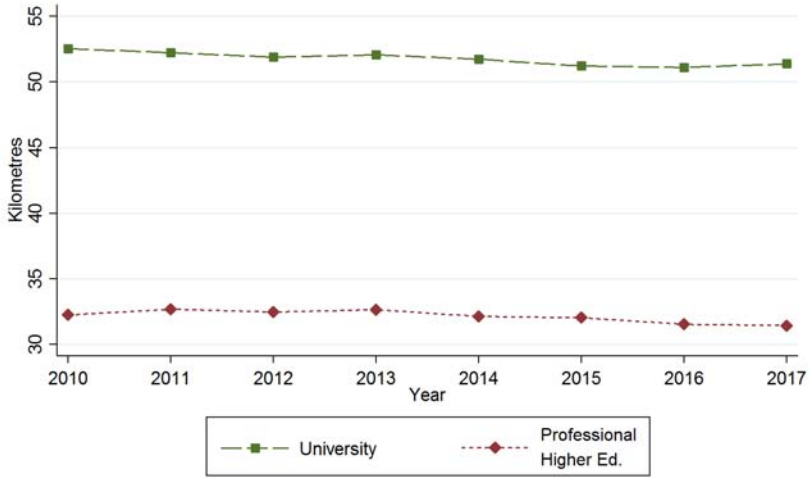
Panel A. Share of students living with their parents



Panel B. Distance to campus from the place of residence



Panel C. Distance to campus from parents' residential address

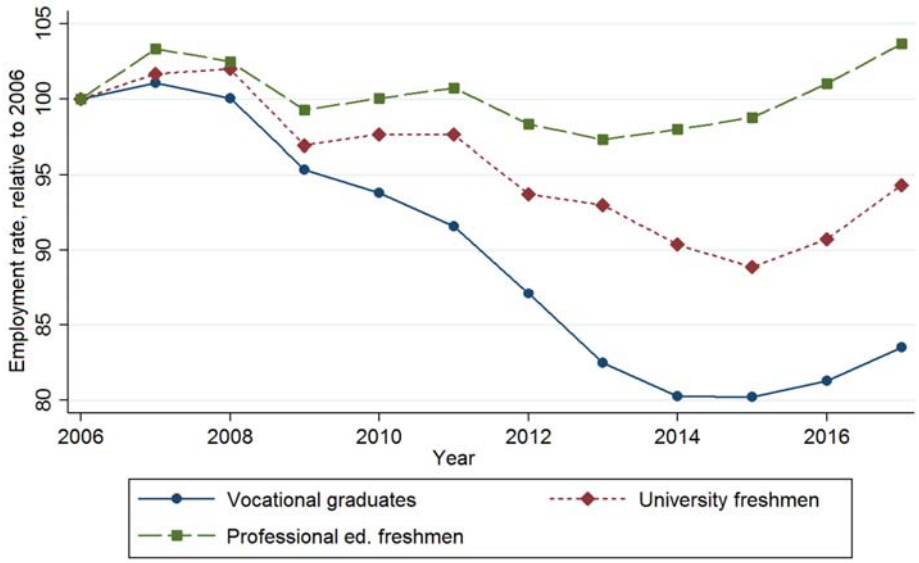


Note: Living arrangements are retrieved at the end of the first semester; students are classified as living with their parents if parents are registered at the same residential address. The distance measure corresponds to Euclidean distance metric between the place of residence and the institution attended. Dutch education register and municipal register data for first year students enrolled in vocational and higher education institutions, years 2005 to 2017.

D.8 Labour supply of students in higher education programs

Another margin of adjustment for post-secondary students is their labour supply. **Figure D5** compares the employment rates of freshman university students, freshman professional higher education students, and the most recent cohort of graduates from the vocational track (who may or may not be enrolled in a post-secondary vocational education program). While there are differences in the baseline employment rates recorded among the three groups, we see that each group of young adults has been subject to similar employment dynamics over the period of observation. Accordingly, it is unlikely that labour supply was a primary margin of adjustment for university and professional higher education freshmen.

Figure D5 Employment rates of young adults, years 2006-2017.



Note: Authors' calculations of the employment rates among vocational-school graduates and freshmen enrolled in higher education institutions over the period of observation. Employment is recorded if the young adult was recorded to work within the span of the corresponding academic year. Dutch education register and tax register data for young adults, years 2006-17.

D.9 Take-up of student finance by students in higher-education programs

To explore the likely consequences of the reform on the actual take-up of student finance, we analyse *Studenten Monitor* data presented in van den Broek et al. (2017). *Studenten Monitor* is a longitudinal survey of a representative sample of university and professional education students (roughly 20,000 respondents yearly) collected since 2001 at the initiative of the Dutch Ministry of Education, Culture and Science. The survey contains a battery of questions on students' perceptions and beliefs about student finance, and it also contains information on the sources of income and budgeting choices made by higher education students.

The *Studenten Monitor* data show several interesting patterns. First, the share of freshman students taking up student loans increased from 32% in the academic year 2014-2015 to 59% in the academic year 2015-2016. This is a sizable increase, although it is much smaller than the share of students who were receiving the pre-reform subsidy package (90% in the academic year 2014-2015). The average monthly amounts borrowed per student loan also increased, from €286 to €448 per month (an increase of € 162 per month). Second, the share of students who prefer to work instead of taking up student loans fell from 19% in the academic year 2014-15 to 15% in

the academic year 2015-16. This is a further evidence that higher-education students did not respond to the reform by increasing their labour supply. There is also an indication that students who were subject to the new system received more money from their parents – the students who decided not to take up any student loans became more likely to state that they receive sufficient funds from their parents. However, since this statement is conditional on the student's decision to avoid taking any student loans, it may be distorted by the large reform-induced changes in the pool of students who fall into this category.

E Results under alternative time trend specifications

Table E1. Average marginal effects of the 2015 reform on Grade 10 track enrolment, alternative specification with a linear pre-trend stopping in 2009.

Panel A. Absolute effects (in percentage points)

Track	Pre-announcement track shares (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Academic	20.9%	-0.39***	-0.94***	-1.21***
		(0.03)	(0.03)	(0.03)
General	28.9%	0.57***	0.62***	0.65***
		(0.14)	(0.14)	(0.14)
Vocational	50.2%	-0.18	0.32*	0.56***
		(0.17)	(0.17)	(0.17)

Panel B. Relative effects (in percent)

Track	Uncertainty	Uncertainty resolution	Post-implementation
Academic	-1.92***	-4.67***	-6.00***
	(0.18)	(0.17)	(0.17)
General	1.98***	2.16***	2.24***
	(0.49)	(0.49)	(0.50)
Vocational	-0.34	0.66*	1.14***
	(0.33)	(0.33)	(0.34)

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the multinomial logit model of Grade 10 high school track enrollment. The model uses 2,693,023 individual observations over years 2005-17. Controls: Age, gender, migration status, ethnic background, parental income and employment status, linear pre-trend covering the period 2005-2009, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

Table E2. Average marginal effects of the 2015 reform on Grade 11 switching to a lower track, alternative specification with a linear time trend.

Panel A. Absolute effects (in percentage points)

Outcome	Pre-announcement share (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Switching to a lower track	4.1%	1.46*** (0.33)	1.55*** (0.50)	0.71 (0.76)

Panel B. Relative effects (in percent)

Outcome	Uncertainty	Uncertainty resolution	Post-implementation
Switching to a lower track	33.78*** (7.55)	35.83*** (11.47)	16.37% (17.50)

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit model of Grade 11 high school track switching. The model uses 958,512 individual observations over years 2006-17. Controls: Age, gender, migration status, ethnic background, parental income, employment status, linear time trend, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

Table E3. Average marginal effects of the 2015 reform on Grade 10 choice of subject specialization, alternative specification with a linear pre-trend stopping in 2009.

Panel A. Absolute effects (in percentage points)

Outcome	Pre-announcement share (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
Choosing STEM and Medicine	44%	-0.56 (0.44)	2.28*** (0.73)	3.00*** (1.17)

Panel B. Relative effects (in percent)

Outcome	Uncertainty	Uncertainty resolution	Post-implementation
Choosing STEM and Medicine	-0.99 (0.77)	4.02*** (1.28)	5.27** (2.06)

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit model of Grade 10 of subject specialization. The model uses 549,640 observations over years 2005-2017. Controls: Age, gender, migration status, ethnic background, parental income and employment status, linear trend, region fixed effects, an urbanization index, and a dummy for the differently-classified period 2005-2006. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

Table E4. Average marginal effects of the 2015 reform on Grade 11 dropout from the STEM and Medicine specialization, alternative specification with a linear time trend

Panel A. Absolute effects (in percentage points)

Outcome	Pre-announcement share (2009)	Uncertainty (2010-2012)	Uncertainty resolution (2013-2014)	Post-implementation (2015-2017)
STEM and Medicine dropout	4.5%	-0.12***	-0.77***	-0.60***
		(0.01)	(0.01)	(0.02)

Panel B. Relative effects (in percent)

Outcome	Uncertainty	Uncertainty resolution	Post-implementation
STEM and Medicine dropout	-3.25***	-20.60***	-15.94***
	(0.15)	(0.28)	(0.42)

Note: Authors' estimates of average marginal effects of the 2015 student finance reform from the logit models of Grade 11 choice to switch from STEM and Medicine to another subject specialization. The model uses 451,512 observations over years 2008-2017. Controls: Age, gender, migration status, ethnic background, parental income, employment status, linear pre-trend covering the period 2008-2009, region fixed effects and an urbanization index. *** = 0.01 significance level, ** = 0.05 significance level, * = 0.1 significance level.

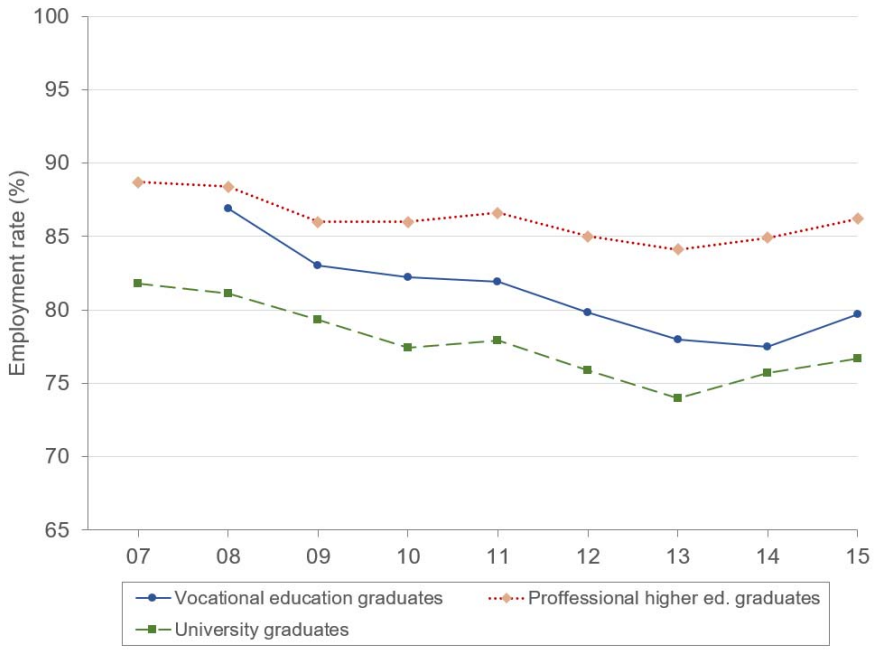
F Threats to identification

In this section, we investigate a range of potential confounders that could distort the reliability of our estimates.

F.1 Labor market returns

First, we evaluate the stability of track-specific labour market returns. Using the Dutch administrative data, Van den Berge (2018) shows that the wage premia of graduates from Dutch universities and professional higher education institutions have been almost constant from the over the last twenty years. The track-specific employment rates of young graduates have also followed similar trends over the period of observation (see **Figure F1).**

Figure F1. Employment rates of post-secondary education graduates, years 2007-2015



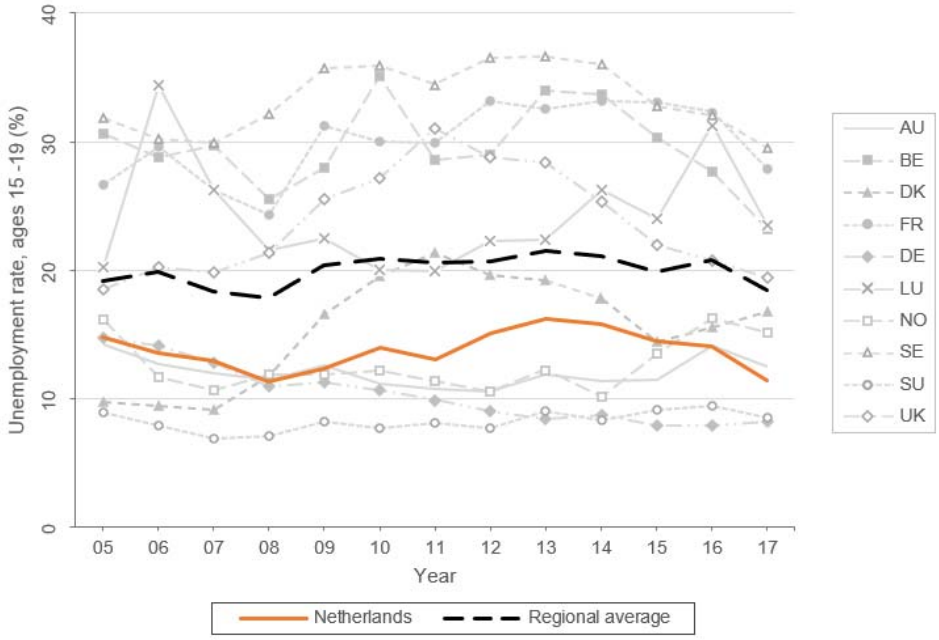
Note: Employment rates of graduates from the three post-secondary education tracks, recorded in the first year following their graduation. Aggregate data retrieved from https://www.onderwijsincijfers.nl

While we cannot observe students' labour market expectations, a growing body of work on the formation of beliefs (see, *e.g.,* Delavande and Zafar, 2019) shows that students' expectations are realistic. Given the lack of divergent trends observed in the data, it is unlikely that the reform effects presented in this paper could be driven by changing expectations about track-specific wage premia and employment probabilities.

F.2 Other labour market trends and policies

We do not observe any substantive changes in outside options to studying. The Dutch youth unemployment rate (plotted in **Figure F2** together with the rates corresponding to other European countries) has been fairly stable, showing no clear signs of trend breaks between 2000 and 2018, in spite of the Great Recession. Similarly, the Dutch adult minimum wage was not subject to any policy changes over the period of observation. Accordingly, students' responses should not be affected by changes of labour market policies directed towards low-ability workers.

Figure F2. Youth unemployment rates, workers aged 15-19, years 2000-2018



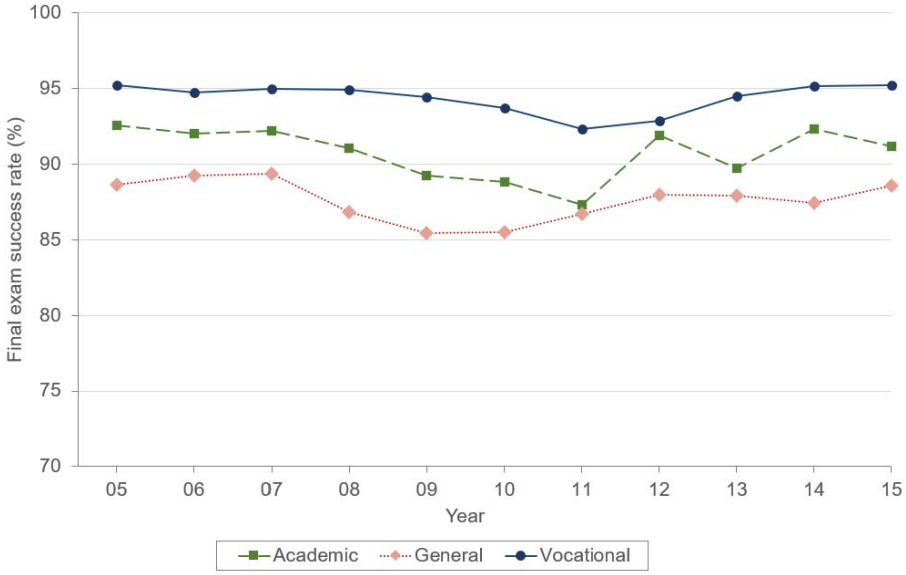
Note: Aggregate data retrieved from the OECD Dataset Labour Force Survey.

F.3 Psychic costs of studying: curriculum difficulty and study duration

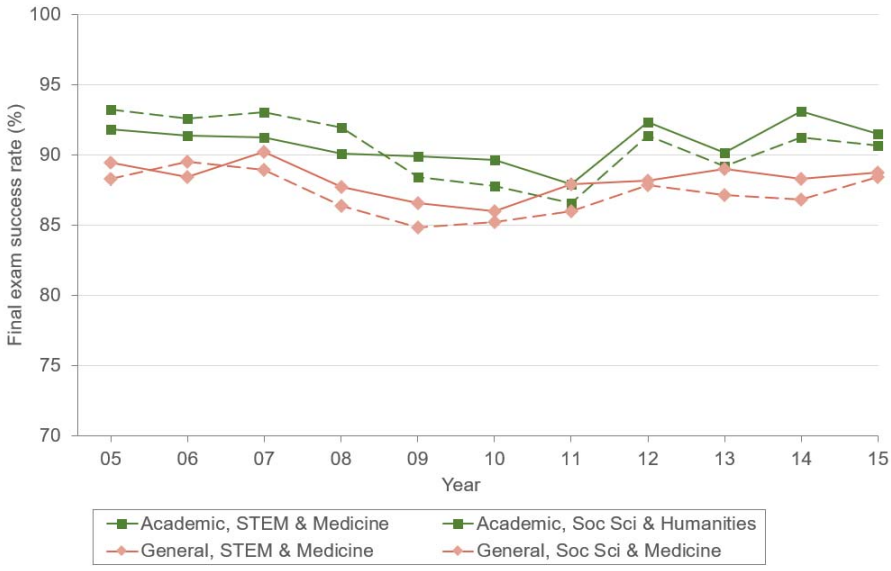
Next, we explore whether the three education tracks changed in terms of their difficulty, or study duration. Panel A of **Figure F3** shows that, over the period of observation, the shares of students passing the final exam in the last year of secondary school followed similar trajectories across the three education tracks. Similar stability is observed when we disaggregate the academic and general track success rates by subject specialization. This is important, because neither track-specific nor specialization-specific dynamics suggest that curriculum difficulty is a viable confounder.

Figure F3. Final exam success rates of secondary school students, years 2005-2018

Panel A. Success rates specific to education tracks



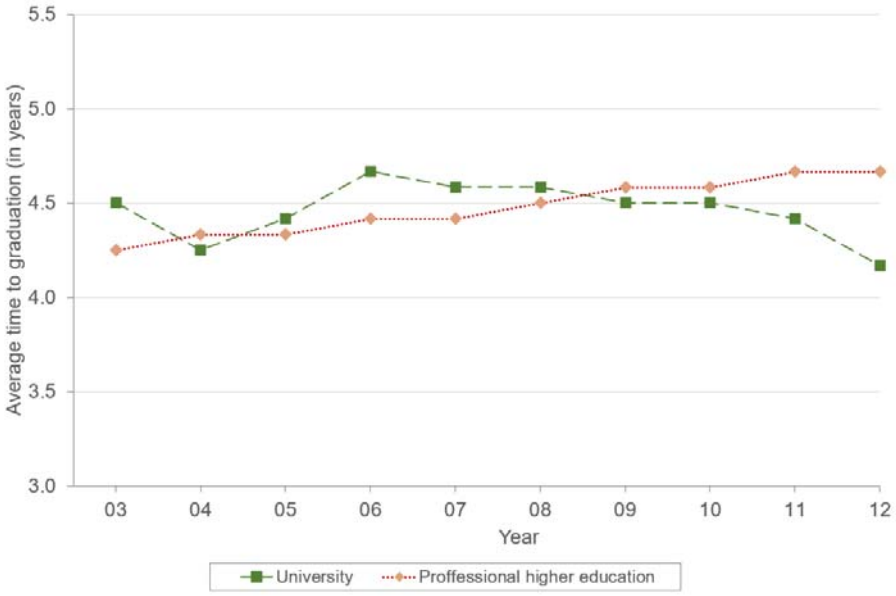
Panel B. Success rates specific to subject specializations



Note: Aggregate data retrieved from CBS Statline.

Another way to think about the psychic costs of studying is to consider the average time to graduation in post-secondary education programs. As shown in **Figure F4**, the average times to graduation for bachelor students follow similar patterns over the period of observation (the data for vocational students are not publicly available). Changes in study durations are therefore also unlikely to confound our results.

Figure F4. Average time to graduation for bachelor students who entered their programs in years 2003-2012.



Note: Aggregate data retrieved from CBS Statline.

F.4 Financial costs of studying

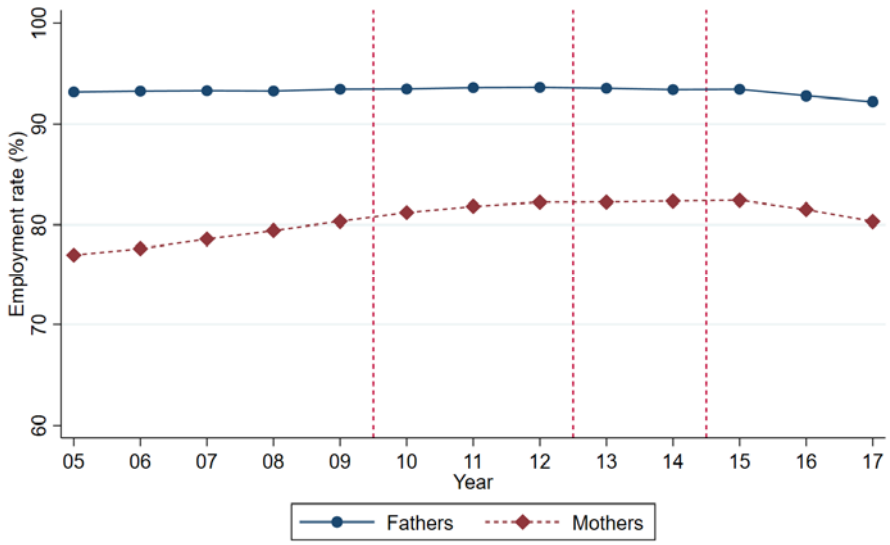
Next, we consider the financial costs of studying. **Tables A1** and **A2** show that none of the parameters of the Dutch student finance system were subject to any meaningful changes over the pre-reform period. Similarly, the tuition fees for post-secondary education have been stable over time (they are indexed to inflation), as well as across education tracks and study majors.

F.5 Parental unemployment and the Great Recession

Another possible confounder may be the Great Recession and its impacts on the students and their families. In particular, the loss of parental employment ahead of 2010 could motivate some students to refocus their attention towards the vocational track, since this track requires less funding and, arguably, leads to more stable employment opportunities with lower variance of earnings.

Yet, **Figure F5.** shows that parental employment rates have been largely stable over the period of observation. There is no clear dip prior to 2010, which suggests that the loss of parental employment is unlikely to confound our results. This supports the aggregate unemployment patterns, which show no spike of unemployment during the period of great recession.

Figure F5. Employment rates of parents of Grade 10 students, years 2005 to 2017.



Note: Authors' calculations of parental employment rates of Grade 10 students, years 2005-2017. The years on the x-axis correspond to the calendar year. Dashed vertical lines indicate the timing of the two reform announcements and the eventual reform implementation. Dutch education register and tax register data, years 2005-2017

F.6 School capacity constraints in secondary and post-secondary education and government education expenditures

Next, we explore school capacity constraints of secondary and post-secondary education institutions in the Netherlands, and government education expenditures. In **Table F3**, we show that the number of secondary and post-secondary education institutions, and the average number of students per institution remained stable over the period covered by the statistical yearbooks. This suggests that changing capacity constraints are unlikely to confound the presented results. Similarly, we show that the shares of government education expenditures remained stable both over time and across the listed types of education spending. Accordingly, the students were unlikely to be influenced by changes to funding pertaining to any specific type of post-secondary schooling.

Table F3. Aggregate statistics corresponding to the Dutch education sector

Academic year	2007	2008	2009	2010	2011	2012	2013
Panel A. Number of institutions							
Secondary	645	647	644	646	646	645	645
Post-secondary vocational ed. (MBO)	61	60	59	58	57	57	57
Prof. higher ed. (HBO)	37	36	36	35	35	35	34
University (WO)	12	12	12	12	12	12	12
Panel B. Average number of students per institution							
Secondary	1404	1391	1401	1406	1421	1440	1458
Post-secondary vocational ed. (MBO)	7821	7994	8239	8438	8396	8269	8195
Prof. higher ed. (HBO)	9888	10413	10942	11629	11835	11769	12639
University (WO)	17222	17833	18842	19528	19736	19369	20010
Panel C. Disaggregated shares of government education expenditures (the missing category is elementary education)							
Secondary	23%	22%	22%	20%	19%	19%	18%
Post-secondary vocational ed. (MBO)	12%	12%	12%	12%	12%	12%	11%
Prof. higher ed. (HBO)	8%	8%	8%	8%	8%	8%	8%
University (WO)	13%	13%	13%	13%	13%	13%	13%
Student finance	12%	13%	11%	11%	12%	11%	11%

Note: Aggregate data retrieved from statistical yearbooks of *Rijksoverheid* and Ministry of Education.

F.7 Other structural changes to the education system: funding rules, selection rules, other policies

Apart from the reform of student finance, the Netherlands was not subject to any other major reforms of either primary, secondary, or tertiary education over the period of observation. The funding mechanisms for secondary and tertiary schools have not changed since the 1963 *Mammoth Law* of Secondary Education. Similarly, application processes to secondary and post-secondary institutions were not subject to any changes over the period of observation. The same applies for major-specific pre-requisites in nearly all of the Dutch higher education institutions.

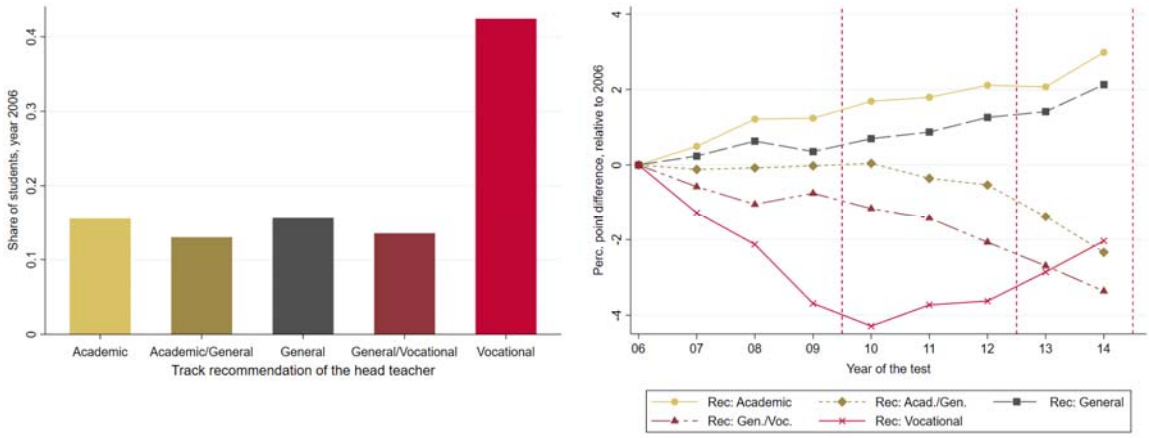
Two minor policy changes should be mentioned. First, there was a debate regarding the relative importance of CITO scores and teacher recommendations in guiding students' secondary school track choices. This debate led to a minor reform which took place in 2014. However, this reform has little relevance for our empirical results, because the first cohort of affected students entered Grade 10 after the very end of our observation period. Second, starting in 2004, there was a broader European push towards increasing students' interests in STEM fields. This push, fostered by the European Commission, led to the creation of national agencies whose role was to inform and incentivize students to study STEM fields. The Dutch agency "Platform Beta-Techniek"

relied mostly on small-scale targeted information interventions. A supplementary analysis of Google queries associated with the agency and their programs showed little evidence of a broader national impact.

F.8 CITO test scores and teacher recommendations

Next, we assess whether the distribution of students' abilities was subject to any meaningful shifts over the period of observation. To this end, we leverage students' Grade 6 CITO scores and the accompanying track recommendations by their head teachers. These records are available from year 2006 onwards, which means that the first cohort of Grade 10 students with fully observable CITO scores and recommendations is the cohort entering Grade 10 in 2010. **Figure F6** presents information corresponding to the recommendations made by the head teachers. In the first panel we show the track recommendation shares among the first cohort of Grade 6 students with observed recommendations (2006). In the second panel, we show how these shares changed over the subsequent years. In contrast to **Figure 1**, the changes are specified in absolute terms (percentage points), which facilitates comparisons across the five track-recommendation groups. We do not plot data past 2014, because the reform of standardized testing distorts the comparability of the corresponding statistics.

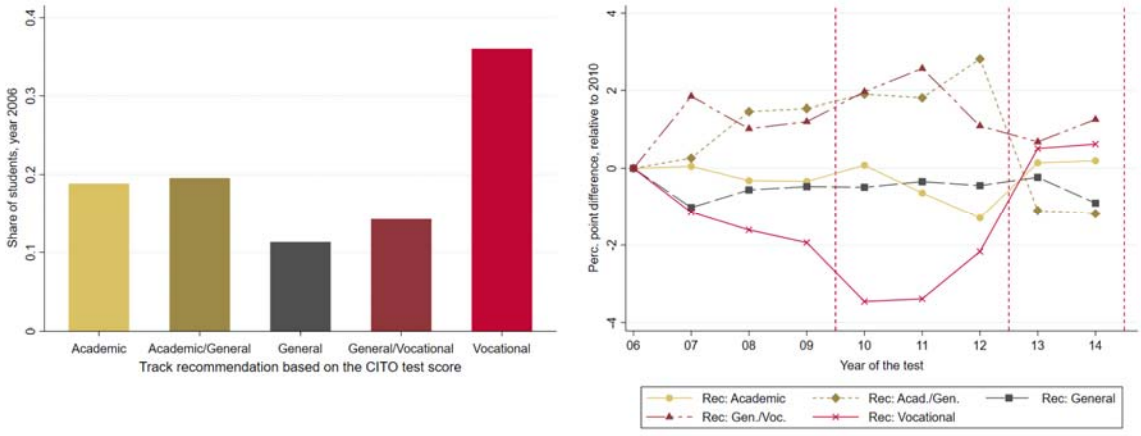
Figure F6. Track recommendations by head teacher, Grade 6 students, years 2006-2014



Note: Authors' calculations of Grade 6 track recommendations by the head teacher. The chart on the left plots the student shares with specific recommendations observed among the 2006 cohort. The chart on the right plots the changes of track recommendation shares across the next eight cohorts of Grade 6 students, taking the 2006 cohort as the point of reference. Dutch education register data, years 2006-2014.

Several patterns are worth discussing. First, the share of Grade 6 students who were recommended to enter the academic track is steadily increasing over the entire period of observation. This suggests that the decline in the Grade 10 academic track enrolments observed between 2010 and 2015 is unlikely to be driven by lower academic abilities of the respective cohorts of students. Second, we see that the first reform announcement was associated with trend breaks for a subset of track recommendations. After the first announcement, the head teachers became less likely to give ambiguous advice (Academic/General, or General/Vocational), and more likely to recommend the vocational track. We note that the pattern of vocational track recommendations is reminiscent of the pattern of Grade 10 vocational track enrolments presented in **Figure 1.** However, it needs to be born in mind that the former pattern does not explain the latter. This is because the students who took the CITO test in 2010 entered Grade 10 only three to four years later.

Figure F6. Track recommendations based on Grade 6 CITO test scores, years 2006-2014



Note: Authors' calculations of Grade 6 track recommendations based on students' CITO test scores. The chart on the left plots the student shares with specific recommendations observed among the 2006 cohort. The chart on the right plots the changes of track recommendation shares across the next eight cohorts of Grade 6 students, taking the 2006 cohort as the point of reference. Dutch education register data, years 2006-2014.

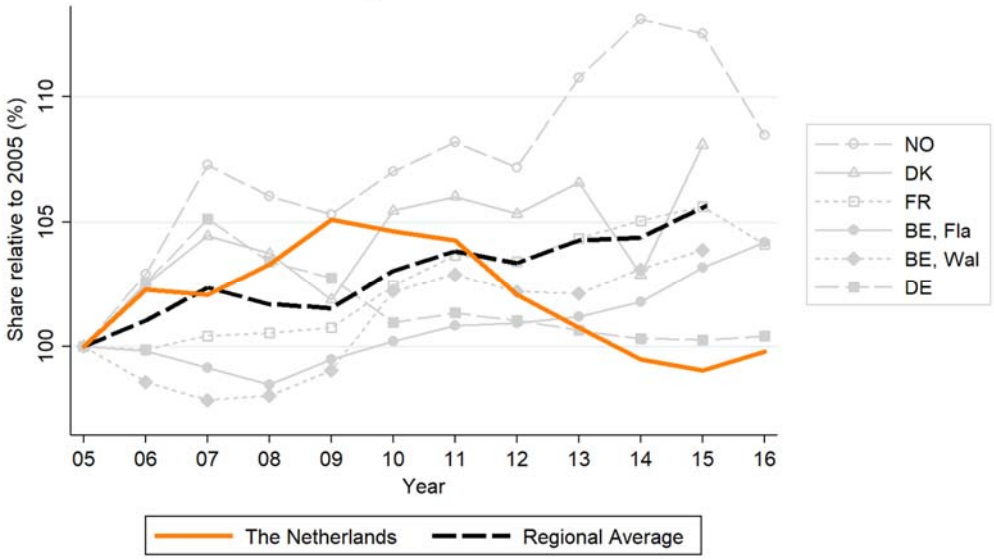
Figure F6 presents information corresponding to the recommendations based on CITO test scores. Here, we use the recommendation cut-off scores presented in **Appendix Section A1**. We observe that the score-based track recommendations follow relatively sustained trends up to the year 2013. This is the first year in which the tested students were fully informed about the upcoming reform. In 2013, we observe that the share of students who attained scores in the Academic and Vocational bands increased, and the share of students who attained scores in the Academic/General band decreased. This suggests that the reform may have altered the effort

levels of Grade 6 students, making some students try harder on the test, and making others flunk the test and opt for the vocational path. This 'effort interpretation' is also supported by **Figure F5**, which shows no clear ability differences between the 2012 and 2013 cohorts of Grade 6 students.

F.9 European education trends

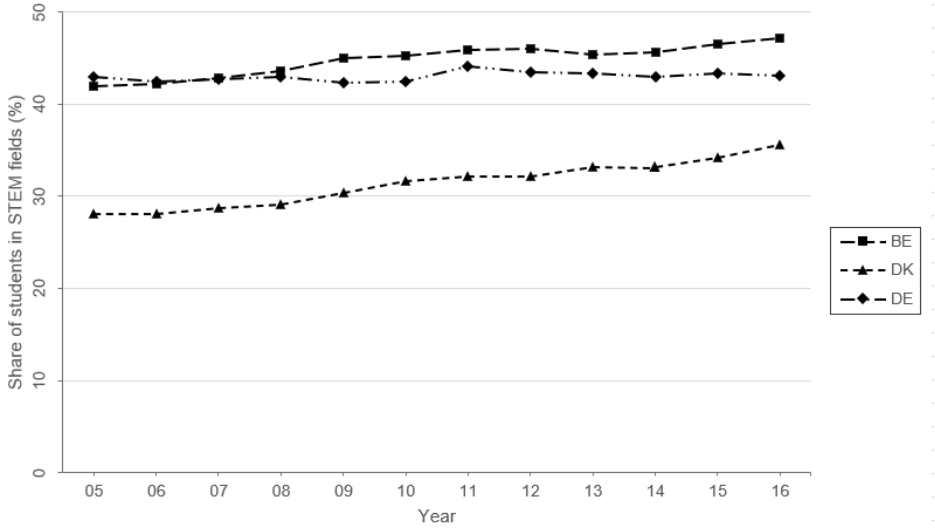
Finally, we show that the dynamics of educational choices in the Netherlands are unlikely to be driven by broader changes of sentiments towards academic education. In **Figure F7**, we show academic secondary school enrolments in the Netherlands as compared to European countries which: 1) are in the proximity of the Netherlands, 2) use comparable systems of secondary education, and 3) publish yearly statistics of secondary school track enrolments since 2005 at least, which we used to construct this figure. The figure plots the trend in the Netherlands against the country-specific trends indicated by grey lines. We also show the arithmetic average of the proximate countries, which is indicated by the black dashed line. From the figure, we see that the dynamics of education choices in the Netherlands clearly deviate from the overall trend in the comparison countries. In most countries, enrolments into academic secondary schools gradually rose over time, following sustained linear trajectories. None of the countries recorded a trend reversal similar to the one we observe in the Netherlands in 2010-2015. In **Figure F8**, we show the shares of first-year higher education students enrolled in STEM and Medicine programs. The focus on higher education programs is necessitated by the lack of data on subject specializations in secondary schools. Although we dispose the information for a small subset of the comparison countries, we do see that the population shares are following stable linear trends. This gives us confidence that the results presented in our paper are not an artifact of broader changes of education sentiments, or socio-economic and geo-political conditions in western Europe.

Figure F7. Shares of secondary education students enrolled in academic tracks, select European countries, 2005-2016.



Note: This figure is based on information from the statistical yearbooks of Belgium (Flanders and Wallonia), Denmark, France, Germany, and Norway.

Figure F8. Shares of first-year higher education students enrolled in STEM and Medicine programs, select European countries, 2005-2016.



Note: This figure is based on information from the statistical yearbooks of Belgium (Wallonia), Denmark and Germany.