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Research Centre for Education and the Labour Market
Maastricht University
P.O. Box 616, 6200 MD Maastricht, The Netherlands
T +31 43 3883647

secretary-roa-sbe@maastrichtuniversity.nl
www.roa.nl

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Abstract

Can student aid policy alter spatial inequality in university enrolment? Evidence from a policy reform in the Netherlands*

Distance can form a barrier to enrolment in a university programme, particularly when it requires a student to move out of the parental home. Many high-income countries offer an additional student grant to students living away from the parental home to partly compensate them for their higher financial costs. However, it is unclear whether such a financially oriented policy reduces the role of distance in university choice and how it compares to a similar but less costly policy offering student loans instead of grants. This paper addresses this question by looking at a reform of the Dutch governmental student aid programme after which new cohorts of students living outside the parental home no longer received an additional student grant but kept access to student loans. Using administrative data, we compare cohorts of graduates of secondary education before and after the reform in their choices on (1) enrolment in higher education, (2) field of study, and (3) university location. Using multinomial logistic regression, our results confirm that distance plays a role in each of the three educational decisions. However, the deterrent impact of distance does not differ between the pre- and post-reform cohorts for any of our outcomes. Moreover, while students from high-income families are generally less deterred by distance than those from low- and middle-income families, this gap did not increase after the reform.

JEL classification: R23, I22,I23, I24, O15
Keywords: student aid, policy reform, university enrolment, field of study, spatial inequality, leaving home

Kars van Oosterhout
ROA
Maastricht University
Tongersestraat 49
6211 LM Maastricht
c.vanoosterhout@maastrichtuniversity.nl

Jessie Bakens
ROA
Maastricht University
Tongersestraat 49
6211 LM Maastricht
j.bakens@maastrichtuniversity.nl

Frank Cörvers
ROA
Maastricht University
Tongersestraat 49
6211 LM Maastricht
frank.corvers@maastrichtuniversity.nl

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1. Introduction

For many students, the distance to universities plays an important part in the decision of whether, where, and in which field of study to enrol. While moving out of the parental home to attend a distant university is traditionally seen as an integral part of the university experience (Christie, 2007; Mulder & Clark, 2002; Thissen et al., 2010), many students are deterred by the associated travel, housing, psychological or information costs (Cullinan & Flannery, 2022; Denzler & Wolter, 2011; Gibbons & Vignoles, 2012; Sá et al., 2004). This results in spatial inequalities, that is, students growing up far from a university are less likely to enrol in a university than those growing up near a university (Card, 1993; Frenette, 2006, 2009; Hango et al., 2021; Sá et al., 2006; Spiess & Wrohlich, 2010). Spatial inequalities are also evident in subsequent enrolment decisions, as distance influences the choice of the field of study (Denzler & Wolter, 2011; Hango et al., 2021; Kelchtermans & Verboven, 2010; Suhonen, 2014) and the specific university to attend (Gibbons & Vignoles, 2012; Sá et al., 2012). These findings, across many different countries, show a general pattern that distance is a deterrent to enrolment. In this paper, we explore whether this pattern is influenced by the type of governmental assistance (student loans or additional student grants) offered to students who move out of their parental home.

Depending on the country and city, living outside the parental home can double the total expenses of a university student compared to living in the parental home (Barr-Telford et al., 2003; Denzler & Wolter, 2011; van der Werf et al., 2017). The decision to enrol in university therefore depends on a student's financial ability to move out of the parental home.[1] To prevent students, especially those from low-income households, foregoing university education or a specific field of study because it is not within commuting distance, many governmental student aid programmes provide additional aid to students living outside the parental home. Most of these high-income countries provide an additional non-repayable student grant for this group of students.[2] The costs of such additional grants can form a substantial part of the overall student aid budget in higher education. In the Netherlands, historically, about 16% of the overall student aid budget was spent on this type of grants, which cost around €450 million per annum.[3] Other countries opt for offering student loans to students living outside the parental home, a less costly form of student aid as the majority of the loan amount will be paid back (Finnie, 2002).

In general, student aid matters in university enrolment decisions (Finnie, 2002; Jacobs & van der Ploeg, 2006). However, the effect of student aid can vary by the instrument that is offered – i.e. grants or loans – and

[1] Previous research on distance costs in higher education has recognised the non-financial costs of studying at a distance, such as psychosocial costs and information costs (Cullinan & Flannery, 2022; Denzler & Wolter, 2011; Gibbons & Vignoles, 2012; Sá et al., 2004). The psychosocial costs relate to the loss of contact with family and/or friends when moving away to study. Information costs relate to the relative ease of acquiring information about universities and student life near the parental home compared to the costs of obtaining such information regarding universities in distant cities.

[2] Based on Government of Canada (2021), Kaiser et al. (2001), Vossensteyn (2004), and Vossensteyn et al. (2013), the following countries provide (or recently provided) additional student grants for students not living with their parents: Australia, Belgium (Flanders only), Canada, Denmark, France, Finland, Germany, Ireland, New Zealand, Norway, Portugal, and the United Kingdom. Some countries provide(d) a higher student loan to this group of students: Belgium (Flanders only) and the United Kingdom. Other, mainly Southern and Eastern European, countries provide housing benefits such as cheap campus dormitories or rent assistance, which act as a subsidy for students living outside the parental home.

[3] Annual costs of 2013. The percentage of annual cost was stable at 16% between 2009 and 2013. Own calculations based on Ministry of Education (2014) data.

between students depending on the financial position of the student and their parents (Canton & de Jong, 2005; Dynarski & Scott-Clayton, 2013). We expect that student loans will only be used by a limited group of students, that is, those who benefit from studying at a distance from the parental home but who lack the financial resources to cover the costs. As debt aversion is relatively common among university students, particularly among students with low financial resources, this could further limit the uptake of student loans (Cunningham & Santiago, 2008; Field, 2009; van den Broek et al., 2020). In contrast, we expect that student grants will be used by more students to study at a distance. First, because grants are less affected by debt aversion than loans (van den Broek et al., 2020) and, secondly, student grants can be seen as a 'subsidy' that offers an incentive to move out of the parental home regardless of financial resources (Jacobs & van der Ploeg, 2006). We contribute to the ongoing discussion on the effects of the type of student aid – loan or grant – on educational choices by providing the first empirical evidence of the extent to which spatial inequality in university enrolment depends on the type of additional student aid offered to students living outside the parental home.

A student aid reform in 2015 in the Netherlands offers a unique opportunity to compare a loan-based versus a grant-based system on university enrolment decisions. As part of the reform, the additional grant for students living away from the parental home that had existed for decades was abolished. Students in post-reform cohorts still have access to student loans, thereby changing the financial instrument but leaving the total amount of aid that students can receive unchanged. The reform lowered the incentive for students to live outside the parental home by no longer giving students living away from the parental home preferential treatment compared to students living in the parental home. Although the effects of the overall reform on university enrolment have been studied (de Gendre & Kabatek, 2021; Kuijpers et al., 2020; van den Berg & van Gaalen, 2021), we focus on the spatial component of enrolment and possible inequalities in opportunity as the distance students across the country have to travel to attend university and a specific field of study differs.

We compare full cohorts of students in the academic track of secondary education before and after the reform in their choices on enrolment in higher education, field of study, and university location. By comparing the effect of distance on these outcomes between cohorts of students before and after the reform, we aim to establish to what extent the policy reform altered spatial inequality in these educational choices. As the switch from a grant-based to a loan-based system could depend on financial resources available to students, our analyses include tests for a heterogeneous effect by parental income.

In line with previous studies (see e.g. Denzler & Wolter, 2011; Frenette, 2006; Gibbons & Vignoles, 2012; Sá et al., 2004, 2006, 2012), we find that distance affects enrolment decisions in higher education. Students growing up close to a university are more likely to enrol in a university compared to a university of applied sciences and are less likely not to enrol in higher education at all. The specific fields of study offered in the proximity of the parental home have a clear but moderate influence on the field of study in which students enrol at university. In addition, in their choice of university, students attach great importance to distance and are more likely to attend a university located closer to them. For the latter two outcomes, the role of distance is more pronounced for students whose parents have a relatively low income, suggesting they hold different preferences and/or that liquidity constraints play a role.

Our main research question is whether the reform of 2015 increased the deterrent effect of distance in students' decision-making. This paper shows that for our three outcomes, the reform had little to no effect on the role of distance in enrolment decisions. The effect of distance on university enrolment, field of study, and university location did not differ between pre- and post-reform cohorts; this holds for students from all socioeconomic backgrounds. We, therefore, do not find any evidence that the provision of an additional student grant contributed to lower spatial inequality in university enrolment compared to the new loan-based policy.

The remainder of this article is structured as follows. In the next section, we discuss the Dutch education system and provide an overview of the 2015 reform. Section 3 includes a description of the data used in this study. In Section 4, we discuss the method and models used in our analyses. The results of our analysis are presented in Section 5, followed by a discussion of the main findings, limitations, and policy implications of our study in Section 6.

2. The Dutch context

2.1. The Dutch education system

The Dutch education system is highly stratified, with three main tracks in secondary education that channel students towards different levels of post-secondary education. We focus on the six-year academic track that is followed by 22% of secondary school students and is the only track providing access to universities.[4] At graduation, students of this academic track are typically 18 years old, and a large majority continue their education at university. Aside universities, Dutch higher education also includes universities of applied sciences. As second level of higher education, universities of applied sciences are mainly focused on teaching and cater to graduates from the five-year track in secondary education and vocational education. Nonetheless, a small group of graduates from the academic track enrol at a university of applied sciences. Both universities and universities of applied sciences generally offer a wide range of programmes, although some institutions have one area of expertise (e.g. technology or agriculture). In contrast to other countries, differences in teaching quality between Dutch universities are negligible and do not play an important role in the enrolment decisions of students (Sá et al., 2004). In the labour market, there exist substantial differences in wages depending on the level of higher education and the field of study (de Mooij et al., 2011; Dijksman et al., 2021; Jacobs, 2002). All universities in the Netherlands are not-for-profit institutions funded by the Dutch state, with subsidised tuition fees set at approximately €2,000 a year.[5] The total expenses for a Dutch university student have been estimated at €7,000 a year when living with their parents and almost double – €13,000 a year – for students not living with their parents (van der Werf et al., 2017). Traditionally, about half of students leave the parental home within their first academic year.[6] Students are generally free to enrol in the programme and higher education institution of their choice, as long as they follow relevant subjects in secondary education. In only a limited number of bachelor

[4] Throughout the text, we use the term 'university' specifically for universities and 'university of applied sciences' – sometimes abbreviated as UAS – for the second type of higher education institutions.
[5] The remaining costs of providing education, on average about €6,000 per year, are carried by the state. A very limited number of programmes are allowed to set higher tuition fees. Additionally, since the academic year of 2018–2019, students pay only half the tuition fee for their first year in higher education.
[6] See Appendix A1.

programmes in which demand exceeds the supply of study places do universities select students through a programme-specific selection procedure that assesses grades, a motivation letter, and/or admission tests.[7] Due to its small geographical size and past policies encouraging geographic decentralisation, spatial accessibility of higher education in the Netherlands is relatively high (Sá et al., 2004). University education is offered at 15 locations in 14 municipalities, while 54 locations in 33 municipalities offer programmes at the level of universities of applied sciences. In our data section, we provide more information on their locations and the spatial inequality in access to higher education.

2.2. The 2015 Dutch student aid reform

The Dutch student aid programme consists of various grants, an optional student loan, and a free public transport card.[8] Students in Dutch higher education can apply for the different components depending on their parental income and living situation. Figure 1 and Table 1 show the changes in student aid related to the reform in 2015. Before the reform, every student received a basic grant of €1,233 per year that was supplemented with a means-tested grant of up to €2,944 per year depending on parental income.[9] In addition, students living outside the parental home were eligible for a grant of between €2,201 and €2,457 per year to offset higher costs of living compared to students living with their parents.[10] All grants were conditional and if a student does not obtain a higher education degree within ten years of student aid uptake, the grant is turned into student debt. The grants were generally not enough to cover all expenses and students often supplemented their income through a part-time job, parental contributions, and/or a governmental student loan (van der Werf et al., 2017).[11] Additionally, students were provided a public transport card that allowed them to use public transport for free on either weekdays or weekends. In principle, the sum of the student aid, grant(s), optional loan, and transport card allowed students to cover all expenses regardless of their living situation.

Announced in 2012, a large reform of the student aid system took effect for students starting their higher education studies in the academic year 2015–2016 and onwards.[12] The 2015 reform included the abolishment of the basic grant of €1,233, while the means-tested grant was increased by €1,595 to a maximum of €4,593 a year. This led to a combined change in the grant value of between **–**€1,233 and +€362 depending on parental income. A second aspect of the reform, and the focus of this study, was the abolishment of the grant for students not living with their parents (ranging between €2,201 and €2,457 per year). To keep higher

[7] Such selection procedures mainly take place for highly popular programmes, such as medicine, psychology, and engineering, programmes with specific requisites, such as art programmes, or honour programmes, such as university colleges. Before the academic year of 2017–2018, some programmes employed a different selection procedure using a stratified lottery based on exam grades in secondary education. From the academic year 2017–2018 onwards, such exceptions were eliminated and since then all selection procedures are conducted as described in the main text.

[8] See Marchand (2014) and Vossensteyn (2002) for a historic overview of the Dutch governmental student aid programme.

[9] Students also qualify for a higher means-tested grant if they are a child of a single parent, their parents are themselves repaying their student loans, or they have siblings above 12 years old who are following secondary or higher education.

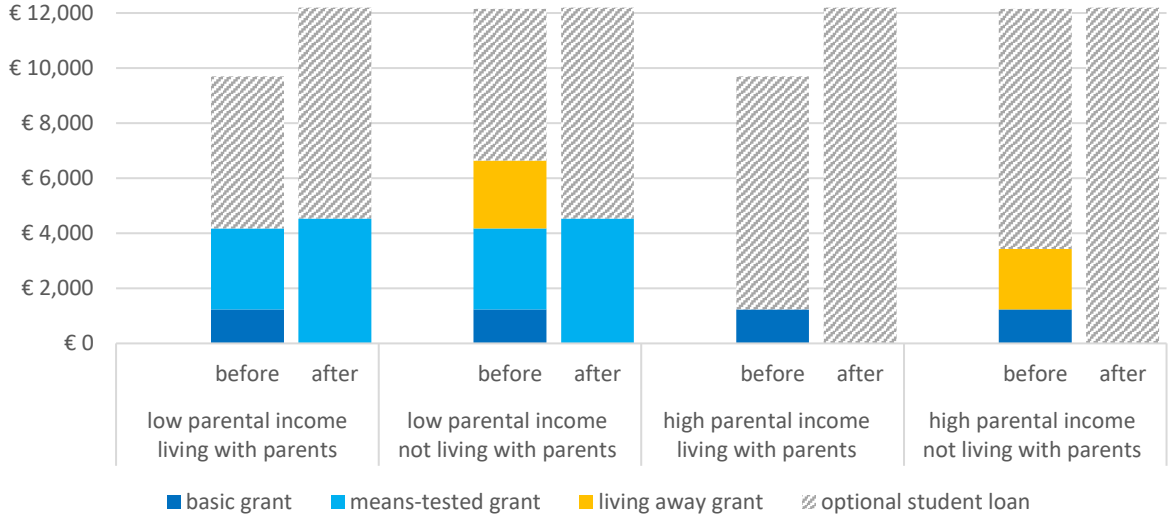
[10] The requirement for this grant was for students to be registered at a different address than their judicial parents according to the official Dutch registration.

[11] The conditions of governmental student loans are favourable compared to commercial loans. Repayment of student loans only takes place if the student makes more than 120% (144% after the reform) of the minimum wage in annual income, with expected repayments of 12% of income above this threshold (4% after the reform) with repayment spread over a maximum of 15 years (35 years after the reform). See the explanatory memorandum to the law stipulating the reform (Government of the Netherlands, 2014), 'Wet studievoorschot hoger onderwijs' in Dutch.

[12] Initially, the reform was planned to be implemented at the start of the academic year 2014–2015 but, in the summer of 2013, the implementation was postponed until the academic year 2015–2016.

education accessible, students kept access to their public transport card and the maximum amount of student loans was raised while the conditions were made more favourable. As such, every student could receive at least the same amount of student aid from the Dutch government after the reform as they could have received before the reform, although in most cases the aid now consisted of a larger part, or in its entirety, of student loans instead of grants (see Figure 1).

Figure 1: Annual student aid before and after the reform



Source: Dutch government regulation on student aid 'Regeling normen WSF 2000, WTOS en WSF BES' (Government of the Netherlands, 2021).

Table 1: Overview of financial aid before and after the reform (in euros per year)

	Low parental income			Low parental income			High parental income			High parental income		
	Living with parents			Not living with parents			Living with parents			Not living with parents		
	before	after	change	before	after	change	before	after	change	before	after	change
Basic grant	1,233	0	−1,233	1,233	0	−1,233	1,233	0	−1,233	1,233	0	−1,233
Means-tested grant	2,944	4,539	1,595	2,944	4,539	−1,595	0	0	0	0	0	0
Living away grant	0	0	0	2,457	0	−2,457	0	0	0	2,201	0	−2,201
Total grant	4,177	4,539	+362	6,634	4,539	−2,096	1,233	0	−1,233	3,434	0	−3,434

Source: Dutch government regulation on student aid 'Regeling normen WSF 2000, WTOS en WSF BES' (Government of the Netherlands, 2021). Comparison between the student aid before and after the reform (1-9-2015). Low parental income refers to students who qualify for the full means-tested grant (combined parental income below €35,857 a year (2015 threshold)). High parental income refers to students who do not qualify for any means-tested grant (combined parental income above €47,781 a year (2015 threshold)). Students whose parents earn between these two income thresholds receive a partial means-tested grant proportional to parental income.

Multiple evaluation studies indicate that the total reform had little influence on overall participation in higher education and did not increase inequality of access to education by socioeconomic background (Kuijpers et al., 2020; van den Berg & van Gaalen, 2021; van den Broek et al., 2020). Research shows that to compensate for the loss in student grants, students in post-reform cohorts increased their reliance on student loans compared to students in pre-reform cohorts (Kuijpers et al., 2020). Most evaluation studies highlight the change from grants

to loans as an instrument of student aid but do not focus on the consequences of the abolishment of the 'living away grant'. An exception is van den Berg (2020), who looked into whether the changed incentives for students to live outside the parental home affected their timing of moving out of the parental home. She found a strong reaction to the 2015 reform, with students in post-reform cohorts less likely to move out of the parental home during their first year of study.[13] Before the reform, the decision to move out of the parental home had a strong connection with education decisions (Sá et al., 2012). Therefore, in this article, we document the relationship between distance, as an indicator of the necessity to move out, and the decisions of whether, where, and in which field to study. Our main interest is whether the changed incentives to move out of the parental home result in post-reform cohorts without access to the 'living away grant' attaching greater importance to distance in their educational choices than students in the pre-reform era.

3. Data

3.1. Sample

In our study, we look at the university enrolment decisions of secondary education students in the six-year academic track. As the reform was announced almost three years before the implementation in 2015, students had some leeway in timing their entrance into higher education and entering under pre-reform conditions. Previous research finds that among students en route to graduating secondary school in 2014, grade retention and gap years occurred less than usual, while students on track to graduate in 2015 were more likely to switch to a lower track in order to graduate secondary school a year early and start higher education in 2014 (de Gendre & Kabatek, 2021). A simple comparison in enrolment decisions between graduate cohorts just before and after the reform would therefore be biased by announcement and selection effects (de Gendre & Kabatek, 2021; Kuijpers et al., 2020). Therefore, we form cohorts based on when students enter the six-year academic track, which is in the fourth year of secondary school, i.e. three years ahead of graduation. Both cohorts entering the academic track in the fourth year of secondary education in 2011 and 2012 were unaware of the upcoming reform, but the cohorts had drastic different probabilities of entering higher education under the new loan-based system. The cohort starting their fourth year of secondary education in 2011 would normally be expected to graduate in 2014 and be the last cohort to study in higher education under the old grant-based system. Students from the 2012 cohort would not graduate and enter higher education before 2015 when the new loan-based system was implemented.[14] To show our results are not driven by short-term fluctuations and remain stable over time, we extend our sample to include cohorts between 2010 and 2015.[15] Throughout the article,

[13] See also Appendix A1.

[14] Of the students in the 2011 cohort who entered higher education within five years of starting the fourth year of secondary school, 80.5% enrolled under the pre-reform student aid system while 19.5% enrolled under the post-reform system. This latter group had no financial incentive to strategically enrol in the financially less favourable post-reform student aid system and were more likely to encounter grade retention or take a gap year. Of the students in the 2012 cohort who entered higher education within five years of starting the fourth grade of secondary school, 97.4% enrolled under the post-reform student aid system while 2.6% enrolled under the pre-reform system. Taken together, this indicates that our classification of pre-reform and post-reform cohorts based on the year of entering the fourth year of secondary school is strongly predictive of the student aid system that students encounter in higher education. Moreover, it shows that our classification is only very mildly influenced by selection effects, as only 2.6% of students classified as being in the post-reform cohort enrolled in higher education under the financially more favourable pre-reform student aid system.

[15] These cohorts are unlikely to exhibit any announcement or selection effect. Being at least two years from the implementation year of the reform, they had virtually no leeway to time the start of their higher education studies to be under the pre-reform or post-reform rules.

we refer to the 2011 and earlier cohort(s) as pre-reform cohorts and the 2012 and later cohorts as post-reform cohorts.

3.2. Education and background variables

Data on students are derived from the system of administrative social statistical datasets of Statistics Netherlands (Bakker et al., 2014). This allows us to track students over time and use rich administrative data on students' education trajectory, residential location, parental income, and background characteristics. Column A of Table 2 presents the descriptive statistics of our full sample. Each of the six cohorts from 2010 to 2015 contains about 40,000 students, resulting in a full sample size of 237,163.[16] A relatively small percentage of students (0.3%) were excluded from our analysis because of missing data of essential variables.[17, 18] Column B of Table 2 displays the descriptive statistics only for students enrolled in a university. We use this subsample for the analysis of the field of study and location choices.[19] For all students, we gathered data on their first enrolment in higher education, including the level of education, field of study, and location.[20] The variable *level of higher education* has three categories: 'university', 'university of applied sciences', and 'not in higher education'. Among students enrolling in higher education, a large majority enrol in a university with a smaller but substantial group of students continuing their education at a university of applied sciences (69.6% versus 20.0% of all students). The category 'not in higher education' consists of the 10.4% of students in our dataset who did not enter higher education within five years after we started tracking them in the fourth year of secondary school, which would normally be three years ahead of graduation.[21] For students enrolled in a university, we determined their *field of study* according to the main Dutch classification system (in Dutch: CROHO-onderdelen) consisting of nine broad fields of study: multidisciplinary, agriculture and natural environment, nature, science, healthcare, economics, law, behavioural and social sciences, and linguistic and cultural sciences. The *location* of enrolment refers to one of the 15 university locations included in our dataset.[22] Appendices A5 and A6 map the regional differences in enrolment in higher education and the field of study.

An important variable in our analysis is *parental income*. Parental income serves as a broad indication of students' social class and of the financial support they could expect during their studies. Moreover, the income of the parents also serves as the primary input for determining the eligibility for the means-tested student grant (see Section 2.2. on student aid). The eligibility for and the amount of the means-tested student grant are determined by the annual combined income of students' parents as registered by the tax authorities

[16] See Appendices A3 and A4 for descriptive statistics for pre-reform and post-reform cohorts separately.
[17] Students with missing information on parental income (4.6%) were not dropped from the analysis but form an additional 'parental income unknown' category for the parental income variable.
[18] We also exclude a small percentage of students (<0.1%) who grew up on one of the five island municipalities in the north of the Netherlands because these students often stay on the mainland during school weeks while in secondary school making it difficult to determine their living address during the fourth year of secondary school.
[19] Students who enrol at a university location with an annual intake of fewer than 20 students or who enrol in a field of study with an average intake of fewer than 20 students at their chosen location are not included in the subsample.
[20] If a student started multiple study programmes at once when entering higher education, we randomly select one enrolment.
[21] Also included in the category 'not in higher education' are those students enrolling in one of the very small specialised higher education institutions that on average enrol fewer than 20 students per year (see section 3.3).
[22] While the data provided by Statistics Netherlands includes detailed information on the higher education institutions including their location, the names of the higher education institutions cannot be presented due to the non-disclosure rules of Statistics Netherlands.

two years ahead of graduation.[23,24] In our study, we use this measure of parental income and, for each year cohort, divide the students into four quantiles.[25] The thresholds between the quantiles were, respectively, around €55,000, €80,000, and €110,000 a year. For 4.6% of students, the tax authorities did not have data on parental income. We include these students in our analysis by creating a fifth category of 'no data on parental income'.

The transition to higher education is influenced by many student and neighbourhood characteristics (de Graaf & Wolbers, 2003; Kloosterman, 2010; Sá et al., 2006). Students with characteristics that favour university enrolment do not necessarily grow up in the same places as students with unfavourable characteristics. For example, Gibbons and Vignoles (2012) show that, in England, ethnic minorities and students from low-income families are much more likely to live in cities and therefore enjoy a relatively high spatial accessibility to higher education. In our analysis, we control for important student and neighbourhood characteristics to ensure that they do not confound the relationship between spatial accessibility and university enrolment.[26] Students' *migration background* is included through five dummy variables indicating whether students have no international migration background, or are a first-generation Western migrant, second-generation Western migrant, first-generation non-Western migrant, or second-generation non-Western migrant.[27] We also include students' *sex* (male/female) and *age* (years old when entering the fourth year of secondary school) because these play an important role in university enrolment decisions and regional variations in these characteristics could influence our estimates. Population density is strongly correlated with spatial accessibility but has been found to have an independent effect on education decisions (van Maarseveen, 2021; White & Lee, 2020). We therefore include a measure of the population density of the municipality of the parental household during the fourth year of secondary school. Following Statistics Netherlands' general classification of population density, we include five categories that differ in address density within a one-km radius.

3.3. Distance variables

We include a number of different measures of spatial accessibility to university education, which are presented in Table 3. Spatial accessibility is operationalised as the distance between the parental home of the student and the university. For students, we take the address during the fourth year of secondary education, in almost all cases the parental home. For universities, we use the population centroid of the municipality in which they are located. As we are interested in spatial accessibility, we also calculate distances to branch locations that operate in a different municipality than the main location. We exclude any main or branch location that has an average annual intake of below 20 students per year in our dataset, as the average student does not recognise them as a relevant option.[28] This results in 15 university locations operating in 14 different municipalities. The variable

[23] We do not have information on the exact amount of grants or loans received by students.
[24] In line with the tax authorities, we look at the income of the students' judicial parents.
[25] We measure parental income in the year after entering the fourth year of secondary school. For students with standard progression, this is equivalent to the parental income two years ahead of graduation.
[26] In line with previous research (Denzler & Wolter, 2011; Weßling & Bechler, 2019), we find that models that do not control for background characteristics and regional fixed effects result in substantially different and often larger effects of spatial accessibility on educational decisions than models that include control variables.
[27] We follow the commonly used Dutch classification system of Statistics Netherlands (Alders, 2001).
[28] The small universities are mostly specialised in theology and together enrol less than 0.2% of the students in our sample. Including them in our analysis would, first, violate the assumption of our estimation method that students would be aware of all alternatives and, second,

distance to nearest university is the Euclidian distance in kilometres to the nearest location of a university. As reported in Table 3, these distances are small in the Netherlands, with a mean distance to the nearest university of 19.60 km. Figure 2 shows the regional variation in distance to the nearest university throughout the Netherlands.

Table 2: Descriptive statistics of education and background variables

	A: Full sample (all students)		B: Subsample (only students transitioning to university)	
	N	% / Mean	N	% / Mean
Cohort (fourth year in secondary school)				
2010 (pre-reform)	39,849	16.8	26,746	16.3
2011 (pre-reform)	38,978	16.4	26,402	16.1
2012 (post-reform)	39,037	16.5	27,079	16.5
2013 (post-reform)	39,158	16.5	27,549	16.8
2014 (post-reform)	39,748	16.8	28,218	17.2
2015 (post-reform)	40,392	17.0	28,405	17.3
Transition to:				
University	165,073	69.6	164.399[a]	100.0
University of applied sciences	47,460	20.0		
No higher education	24,629	10.4		
Field of study at university				
Multidisciplinary	6,857	2.9	6,857	4.2
Agriculture and natural environment	6,931	2.9	6,931	4.2
Nature	20,375	8.6	20,375	12.4
Science	27,903	11.8	27,903	17.1
Healthcare	21,970	9.3	21,970	13.4
Economics	25,961	10.9	25,961	15.8
Law	15,039	6.3	15,039	9.1
Behaviour and social sciences	25,882	10.9	25,882	15.7
Linguistics and culture sciences	13,481	5.6	13,481	8.2
Not in university	72,763[a]	30.7		
Annual income of parents				
1st quantile (below €55k)	56,544	23.8	34,801	21.2
2nd quantile (between €55k and €80k)	56,542	23.8	37,283	22.7
3rd quantile (between €80k and €110k)	56,539	23.8	40,678	24.7
4th quantile (above €110k)	56,538	23.8	44,762	27.2
Parental income unknown	10,999	4.6	6,875	4.2
Sex				
Female	127,003	53.6	85,804	52.2
Male	110,159	46.4	78,595	47.8
Age (in years at the start of the fourth year of secondary school)	237,162	15.38	164,399	15.34
Migration background				
None	197,439	83.3	137,301	83.5
1st-gen Western	3,261	1.4	2,058	1.3
1st-gen non-Western	3,026	1.3	1,869	1.1
2nd-gen Western	14,211	6.0	10,004	6.1
2nd-gen non-Western	19,225	8.1	13,167	8.0
Population density				
Very high (>2,500 addresses per km^2)	47,081	19.9	33,748	20.5
High (2,000–2,500)	73,854	31.1	51,585	31.4
Medium (1,000–1,500)	46,230	19.5	32,326	19.7
Low (500–1,000)	51,140	21.6	34,496	21.0
Very low (<500 addresses per km^2)	18,857	8.0	12,244	7.4
N	237,162		164,399	

Source: Own calculations based on microdata Statistics Netherlands.

[a] 647 of the 165,073 students enrolling in university (0.4%) were not included in our subsample because the university location in which they enrolled had a low intake in their chosen field of study and was excluded from our analyses (see footnote 20). These students are listed as 'not in university' in Column A.

The names of the higher education institutions are purposefully not included in the dataset of Statistics Netherlands and descriptive statistics on location choice can therefore not be presented.

distort our measures of spatial accessibility to university education. Third, including alternatives that are only chosen by a handful of students would lead to segmentation and accompanying estimation problems.

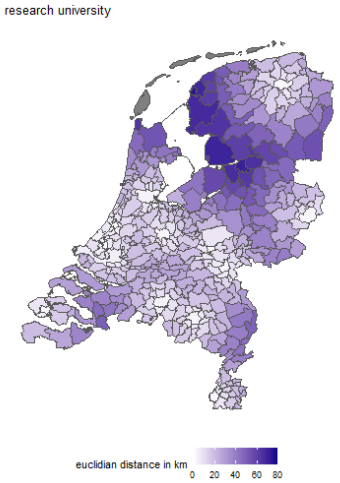
As there are nine fields of study at university, we calculated nine distance measures each indicating the *distance to the nearest university offering the specific field of study* in question. Similar to our calculations of the distance to the nearest university, we only include locations that enrol at least 20 students per year in the field of study in question.[29] Table 3 shows substantial variation in the spatial accessibility of the fields of study and Figure 3 maps the regional differences. The mean distance to the nearest university offering behavioural and social studies is 22.70 km, while students need to travel on average 72.39 km from their parental home to the nearest location offering agricultural studies. For our analysis of location choice, we include the distance to each of the 15 university locations.[30]

Table 3: Distance to nearest university and those offering particular fields of study

	Full sample (all students)		Subsample (transitioning to university)	
	Mean	S.D.	Mean	S.D.
Level of education (distance in km)				
Nearest university	19.60	15.91	19.04	15.59
Field of study (subsample) (distance in km)				
Nearest multidisciplinary programme	38.29	39.37	37.31	38.93
Nearest agriculture programme	72.39	33.70	71.53	33.43
Nearest nature programme	35.18	26.50	34.08	26.16
Nearest science programme	43.16	23.36	42.84	23.20
Nearest healthcare programme	25.43	19.07	24.77	18.83
Nearest economics programme	24.33	16.98	23.78	16.63
Nearest law programme	25.95	21.09	25.19	20.74
Nearest behaviour and social studies programme	22.70	17.76	22.05	17.42
Nearest linguistics and culture studies programme	28.93	24.54	27.96	24.07
N	237,162		164,399	

Source: Own calculations based on microdata Statistics Netherlands.[31]

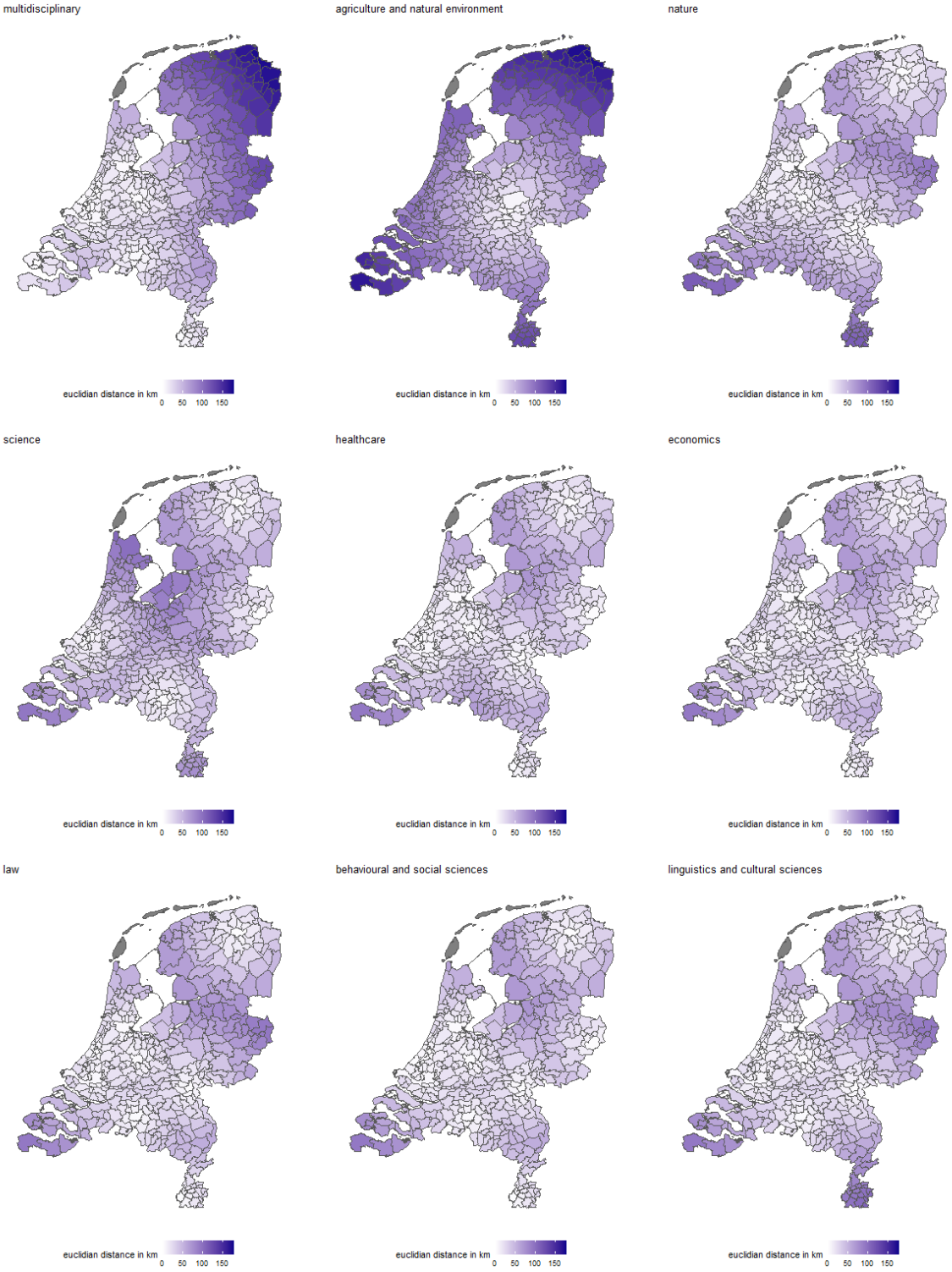
Figure 2: Distance to the nearest location offering university education by municipality in km



Source: Own calculations based on microdata Statistics Netherlands. Distance is calculated for 383 Dutch municipalities. The five island municipalities are displayed as grey as we do not include them in our analysis (see footnote 19).

[29] Similar to our calculations of the distance to the nearest university, we calculate distances to universities that on average enrol at least 20 students a year out of our sample in the field of study in question. The excluded locations enrolled 674 of the university students in our sample (0.4%). These students were included in our full sample but excluded from the subsample.
[30] As part of our working agreement with Statistics Netherlands, we cannot disclose the distance to specific universities.
[31] In our analyses, the distance variable relates to the effect of distance per 100 km to ease interpretation.

Figure 3: Distance to the nearest locations offering each field of study by municipality



Source: Own calculations based on microdata Statistics Netherlands. Distance is calculated for 383 Dutch municipalities. The five island municipalities are displayed as grey as we do not include them in our analysis (see footnote 19).

4. Method

In our analyses, we employ multinomial logistic regression models to estimate the relation between distance and education choices and to test whether these spatial patterns change when the reform was enacted (see

Cullinan & Flannery, 2022; Gibbons & Vignoles, 2012; Sá et al., 2012; Suhonen, 2014). We use separate estimations for our three categorical outcomes: the level of education, the field of study, and the specific university of enrolment.[32] In line with the random utility framework, we assume that each student graduating from the academic track of secondary school will consider a number of different relevant education alternatives depending on the outcome in question. With regard to our first outcome (level of education), we consider the following alternatives: studying at a university, studying at a university of applied sciences, and not enrolling in Dutch higher education. For our analysis of the choice of field of study, the relevant alternatives are the nine fields of study. For our analysis of location choice, the alternatives are the 15 university locations.[33] For each of the three decisions, we expect students to weigh the costs and benefits of each alternative and assign them a latent unobserved utility score. This utility score can vary across student characteristics (e.g. sex or age) and the characteristics that depend on the alternatives (e.g. the distance between the parental home and the alternative). The main utility function is specified as follows:

$$U_{sla} = \beta_1 D_{sa} + \beta_2 R_s + \beta_3 PI_s + \beta_4 C_s + \beta_5 FE_l + \varepsilon_{sla} \quad \text{(Eq. 1)}$$

where the utility U of student s living in labour market region l for alternative a is determined by the distance D between the parental home of student s and location of alternative a.[34] The dummy variable R indicates whether the student belongs to a pre-reform or post-reform cohort of students. Next, the variable PI indicates the parental income of the student. We also include a vector of control variables C, regional fixed effects FE depending on the labour market region l of the parental home, and a Gumbel distributed error term ε.

Having evaluated all alternatives, we expect each student to maximise their utility by enrolling in the alternative with the highest expected utility.[35] This leads to:

$$U_{sla} > U_{slk} \text{ for all } a \neq k \quad \text{(Eq. 2)}$$

where student s will enrol in alternative a only if the expected utility U for this alternative is higher than each of the expected utilities U of all other alternatives k.

In equation 1, β_1 is the coefficient of interest, as it shows how distance is related to the utility assigned to the different alternatives. It is expected that the sign of this coefficient is negative, as a longer distance makes

[32] We performed our main analysis in R using the 'mlogit'-package.

[33] Our analyses of the field of study and location choice are based on the subsample of students enrolling in university. It is possible that the reform in student aid altered the composition of the student population enrolling in university that form our subsample, possibly creating a bias. Therefore, we performed a robustness check using nested multinomial logistic regression models with two branches: 'University' and 'other' with the respective alternatives for the field of study and location choice nested within the 'University' branch (and the other branch consisting of a single alternative). This allowed us to include our full sample, although because of computational demand, analyses were performed on 10% of the cases. The results of this nested model do not substantially differ from the outcomes presented in the main text.

[34] Our analysis of the field of study and location choice are conditional multinomial logistic regression models, with distance as the alternative-specific variable. In our analysis of the level of education, we employ a regular multinomial logistic regression model with distance to the nearest university as a student-specific variable, as distances to the other alternatives are not included.

[35] In our study, we observe and analyse the actual enrolment decisions of students, not their preferences. In the Dutch context (see Section 2.1), a large majority of students can enrol in their preferred choice. In some cases, students are rejected by the education programme of their first choice. These students have to opt for a different alternative, but in many cases enrol in a programme that is similar in the level of education, field of study, and/or university location as their first preference.

it a less attractive choice compared to the alternatives. By including student background characteristics and regional fixed effects, we address possible biases in our distance coefficient caused by spatial differences in student composition or regional characteristics.

We use the reform in Dutch student aid policy to test how a similar group of students is affected in their study choices by differences in the type of student aid provided to students living outside the parental home. Therefore, we estimate the following specification:

$$U_{sla} = \beta_1 D_{sa} + \beta_2 R_s + \beta_3 PI_s + \beta_4 C_s + \beta_5 FE_l + \beta_6 D_{sa} R_s + \varepsilon_{sla} \quad \text{(Eq. 3)}$$

The interpretation of this equation is the same as equation 1, except that coefficient β_1 now indicates the distance effect for pre-cohort students. Coefficient β_6 shows the change in distance effect between the pre-reform cohorts and the post-reform cohorts. We attribute any change in the distance effect to the reform, as we are not aware of any event in or around 2015 that could provide a credible alternative explanation of a sudden change in the effect of distance on these educational choices.

Next, we estimate the heterogeneous effect of parental income using the following estimations:

$$U_{sla} = \beta_1 D_{sa} + \beta_2 R_s + \beta_3 PI_s + \beta_4 C_s + \beta_5 FE_l + \beta_6 D_{sa} PI_s + \varepsilon_{sla} \quad \text{(Eq. 4)}$$

and

$$U_{sla} = \beta_1 D_{sa} + \beta_2 R_s + \beta_3 PI_s + \beta_4 C_s + \beta_5 FE_l + \beta_6 D_{sa} R_s + \beta_7 D_{sa} PI_s + \beta_8 R_s PI_s + \beta_9 D_{sa} R_s PI_s + \varepsilon_{sla} \quad \text{(Eq. 5)}$$

Equation 4 allows for a heterogeneous effect of distance by parental income through the interaction term with coefficient β_6. This allows us to test the assumption that distance plays a stronger role in university enrolment decisions for students whose parents have a relatively low income compared to students with high-earning parents. In equation 5, we extend this model with a three-way interaction between distance, the reform, and parental income. As such, coefficient β_9 allows heterogeneity by parental income in the change in distance effect between cohorts before and after the reform.

5. Results

5.1. Level of higher education

The results of our analyses of the level of education are presented in Tables 4a and 4b, with the choice for enrolment in a university as the reference category. The coefficients concern the log odds of choosing an alternative other than enrolment in a university, i.e. enrolment in a university of applied sciences or no enrolment in higher education depending on the column. As expected, model 1 shows the larger the distance to the nearest university, the more likely students are to enrol in a university of applied sciences or to not continue their schooling in higher education. Regardless of distance, post-reform cohorts show lower enrolment in universities of applied sciences and higher non-enrolment. According to model 2 (equation 3), the effect of distance does not significantly differ between pre-reform and post-reform cohorts as the interaction variable is

not statistically significant. Model 3 (equation 4), presented in Table 4b, looks at whether the distance effect differs by parental income across the entire study period. In general, this does not appear to be the case. Only for students with parental income in the second quartile does distance have a significantly weaker effect on the choice of a university of applied sciences over a university. Lastly, model 4 (equation 5) allows us to see whether the reform might have had a different effect due to parental income. Here, we see that there are no statistically significant differences in the change in the distance coefficient depending on parental income.

Table 4a: Multinomial logistic regression on the level of higher education (model 1 and model 2) with university as the reference category

	Model 1:				Model 2:			
	UAS		No HE		UAS		No HE	
Variable	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
Intercept	−1.258***	0.032	−1.222***	0.034	−1.258***	0.032	−1.220***	0.034
Distance nearest Uni	0.859***	0.074	0.394***	0.100	0.909***	0.085	0.463***	0.118
Reform								
Pre-reform	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Post-reform	−0.237***	0.011	0.090***	0.015	−0.238***	0.011	0.088***	0.015
Distance Uni*Reform								
Distance Uni*Pre-reform					Ref.	Ref.	Ref.	Ref.
Distance Uni*Post-reform					−0.079	0.067	−0.102	0.092
Region fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Background characteristics	yes	yes	yes	yes	yes	yes	yes	yes

Source: Own calculations based on microdata Statistics Netherlands. N = 237,162. *** p < 0.001, ** p < 0.01, * p < 0.05.
UAS refers to university of applied sciences while 'No HE' refers to 'no higher education'. The reported coefficient for distance relates to the effect per 100 km.

5.2. University field of study

Table 5 summarises the results of our analysis of the field of study choice. For each student in our subsample of university students, the model takes into account the nine fields of study and the distance to the nearest university offering that field of study. We constrain the model so that the effect of distance is equal for all fields of study, resulting in a single distance coefficient indicating the general effect of distance in the choice between the fields of study.[36] In model 1, the distance indicator has a value of −0.568, indicating that an increase in distance to a specific field of study has a negative effect on choosing this field of study relative to choosing any of the other eight fields of study. Model 2 shows that the post-reform cohorts were not more likely to enrol in fields of study closer to home. In line with our expectations, model 3 confirms that distance deterrence differs depending on parental income and is stronger the lower the parental income. While students from the lowest income quadrant have a distance effect of −0.656, those with high-income parents have a distance effect of only −0.445 (= −0.656 + 0.211). However, from model 4, we see that the triple interaction between distance, the reform dummy, and parental income does not lead to any significant coefficients. We therefore conclude that

[36] Without this constraint, the model would calculate a separate distance effect for each alternative. Such an approach with a multitude of distance coefficients is not feasible for this study as we interact distance with a number of other variables in Models 2 to 4.

regardless of parental income, we do not find evidence that the cohorts after the reform changed their enrolment patterns to fields of study that are closer to the parental home.

Table 4b: Multinomial logistic regression on the type of higher education (model 3 and model 4) with university as the reference category

	Model 3:				Model 4:			
	UAS		No HE		UAS		No HE	
Variable	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
Intercept	−1.256***	0.032	−1.218***	0.034	−1.259***	0.034	−1.214***	0.038
Distance Uni	0.915***	0.089	0.425***	0.117	0.946***	0.118	0.412*	0.161
Reform								
Pre-reform	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Post-reform	−0.237***	0.011	0.089***	0.015	−0.233***	0.021	0.082**	0.028
Distance Uni*Reform								
Distance Uni*Pre-reform					Ref.	Ref.	Ref.	Ref.
Distance Uni*Post-reform					−0.048	0.122	0.017	0.160
Distance Uni*Parental Income								
Distance Uni*Q1 (lowest)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Distance Uni*Q2	−0.230**	0.085	−0.165	0.114	−0.173	0.141	−0.050	0.204
Distance Uni*Q3	−0.039	0.091	−0.028	0.123	0.112	0.149	−0.034	0.223
Distance Uni*Q4 (highest)	0.173	0.104	−0.104	0.134	−0.010	0.170	0.140	0.233
Distance Uni*missing data	−0.130	0.169	0.405*	0.176	−0.225	0.283	0.616*	0.311
Distance Uni*Reform*Parental income								
D Uni*Post-reform*Q1 (lowest)					Ref.	Ref.	Ref.	Ref.
D Uni*Post-reform*Q2					−0.088	0.177	−0.165	0.246
D Uni*Post-reform*Q3					−0.244	0.188	0.007	0.267
D Uni*Post-reform*Q4 (highest)					0.296	0.214	−0.364	0.284
D Uni*Post-reform*missing data					0.153	0.352	−0.309	0.377
Region fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Background characteristics	yes	yes	yes	yes	yes	yes	yes	Yes

Source: Own calculations based on microdata Statistics Netherlands. N = 237,162. *** p < 0.001, ** p < 0.01, * p < 0.05.
UAS refers to university of applied sciences while 'No HE' refers to 'no higher education'. In the triple interaction, 'Distance Uni' is abbreviated as 'D Uni'. The reported coefficient for distance relates to the effect per 100 km.

Table 5: Multinomial logistic regression on the field of study

	Model 1:		Model 2:		Model 3:		Model 4:	
Variable	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
Distance	−0.568***	0.057	−0.548***	0.062	−0.656***	0.065	−0.568***	0.084
Distance*Reform								
Distance*Pre-reform			Ref.	Ref.			Ref.	Ref.
Distance*Post-reform			0.029	0.036			−0.128	0.078
Distance*Parental Income								
Distance*Q1 (lowest)					Ref.	Ref.	Ref.	Ref.
Distance*Q2					0.013	0.050	−0.072	0.090
Distance*Q3					0.100*	0.049	0.072	0.087
Distance*Q4 (highest)					0.211***	0.049	0.106	0.087
Distance*missing data					0.106	0.091	−0.225	0.166
Distance*Reform*Parental income								
D*Post-reform*Q1 (lowest)							Ref.	Ref.
D*Post-reform*Q2							0.122	0.108
D*Post-reform*Q3							0.042	0.106
D*Post-reform*Q4 (highest)							0.153	0.105
D*Post-reform*missing data							0.480*	0.199
Region fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Background characteristics	yes	yes	yes	yes	yes	yes	yes	yes

Source: Own calculations based on microdata Statistics Netherlands. N = 164,399. *** p < 0.001, ** p < 0.01, * p < 0.05.
The reported coefficient for distance relates to the effect distance to the nearest university offering that specific field of study per 100 km.
In the triple interaction, distance is abbreviated as D. The reported coefficient for distance relates to the effect per 100 km.

5.3. Multinomial models: University location choice

Students enrolling in university have the choice between 15 different locations. The results of the analysis of location choice are presented in Table 6. Similar to the analysis of the field of study, we constrain the distance effect to be equal for all university locations. Model 1 shows a strong negative effect of distance, indicating that distance has an influential role in the decision between different university locations with nearby locations being far more likely to be chosen. Model 2 shows that there is no meaningful change in the effect of distance between the pre-reform and post-reform cohorts. In model 3, we include an interaction between distance and parental income. Whereas the distance effect is −1.477 (= −2.027 + 0.550) for the quartile of students with the highest parental income, it is −2.027 for students with the lowest earning parents. In addition, in model 4, the reform did not change the distance effect for any of the four quartiles stratified by parental income. We can therefore conclude that the reform did not increase the deterrent effect of distance for any of the three outcomes.

Table 6: Multinomial logistic regression on the location choice

	Model 1:		Model 2:		Model 3:		Model 4:	
Variable	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
Distance	−1.815***	0.038	−1.806***	0.039	−2.027***	0.040	−1.989***	0.046
Distance*Reform								
Distance*Pre-reform			Ref.	Ref.			Ref.	Ref.
Distance*Post-reform			−0.013	0.014			−0.056	0.033
Distance*Parental Income								
Distance*Q1 (lowest)					Ref.	Ref.	Ref.	Ref.
Distance*Q2					0.023	0.022	0.004	0.037
Distance*Q3					0.230***	0.021	0.194***	0.036
Distance*Q4 (highest)					0.550***	0.020	0.514***	0.035
Distance*missing data					0.299***	0.037	0.205**	0.064
Distance*Reform*Parental income								
D*Post-reform*Q1 (lowest)							Ref.	Ref.
D*Post-reform*Q2							0.040	0.046
D*Post-reform*Q3							0.050	0.044
D*Post-reform*Q4 (highest)							0.052	0.042
D*Post-reform*missing data							0.139	0.078
Regional fixed effects	yes	yes	yes	yes	Yes	yes	yes	yes
Background characteristics	yes	yes	yes	yes	Yes	yes	yes	yes

Source: Own calculations based on microdata Statistics Netherlands. N = 164,399. *** p < 0.001, ** p < 0.01, * p < 0.05.
The reported coefficient for distance relates to the effect distance to a specific university location per 100 km.
In the triple interaction, distance is abbreviated as D. The reported coefficient for distance relates to the effect per 100 km.

6. Discussion

In this article, we examine whether students' educational choices are affected by the financial instrument of additional student aid offered to students living outside the parental home. After a reform in the Dutch student aid programme in 2015, students living outside the parental home no longer received an additional student grant but could take up student loans. We used this event to compare pre-reform and post-reform cohorts of students graduating from the academic track of secondary education. We model and estimate their three most important educational decisions: whether to enrol in higher education, field of study, and university location.

Our study builds on a growing literature that shows the importance of spatial accessibility for university enrolment patterns in the Netherlands and elsewhere (Cullinan & Flannery, 2022; Gibbons & Vignoles, 2012; Hillman, 2016; Sá et al., 2006, 2012). Our results confirm previous findings that distance costs influence enrolment decisions, which remains consistent when we control for confounding variables at the student and regional levels. We find that the larger the distance to the nearest university, the larger the chance that a student will enrol in a university of applied sciences or not enrol in higher education at all. Among students enrolling in a university, spatial accessibility also influences their field of study choice and has a strong effect on the chosen university location as most students enrol in a university close to the parental home.

Our main interest is in whether the type of additional student aid offered to students not living with their parents influences the negative effect of distance. In our multinomial analysis, we find that the negative effect of distance did not change between pre-reform cohorts receiving an additional student grant and post-reform cohorts under the new loan-based system for any of our three outcomes. Our results also did not indicate any difference in response to the reform depending on parental income. As such, our study finds that providing an additional student grant to those students living outside their parental home – a feature of many governmental student aid programmes – has no impact on spatial inequalities in university enrolment compared to offering student loans in the Netherlands. Connecting our findings to those of earlier studies on the Dutch student aid reform gives two additional spatial insights. First, Van den Berg (2020) shows that after the reform, fewer students moved out of the parental home. As we find no difference between the pre-reform and post-reform cohorts in distance to the chosen university, this means that post-reform cohorts have longer commuting distances. Secondly, for students growing up at a distance from universities, leaving the parental home is hardly a choice but a necessity to attend university or their preferred field of study. For them, the reform meant that they now fully bear the costs of living away from the parental home, with previous research suggesting many increased their student loans to replace student grants (Kuijpers et al., 2020). As such, the reform towards loan-based student aid meant a general increase in study debt, likely especially for those students who move out of the parental home.

The results of our study are stable across different models and outcomes. Nonetheless, some limitations have to be kept in mind when considering our findings. While our study is one of the first to look at changes in distance effects over time while including an exogenous shock, data limitations restrict our time frame to six years of cohorts, which is a relatively short window. A longer period would allow us to better control for time trends irrespective of the reform and focus on longer-term effects. Our comparison between pre- and post-reform cohorts could also be distorted if there were events in addition to the reform that affected the educational decisions of the students in our sample. We are not aware of such events and believe that the educational reform in 2015 forms the only credible explanation for changes between the pre-reform and post-reform cohorts. A research design involving a control group of students unaffected by the reform would have provided empirical evidence of this assumption, but a suitable control group could not be formed as the reform affects all students entering higher education since 2015. Our dataset incorporates detailed information on the student locations, including the residential location during secondary school, allowing us to calculate the Euclidean distance to all universities for each student. The distance measured as travel time by different travel modes would better reflect the possibilities of each student commuting to university, although this likely would not have altered our results as different operationalisations of distance have strong correlations within a small, flat, and well-connected country like the Netherlands (Rietveld et al., 1999). Unfortunately, our dataset did not include information on the actual student aid received by students. Such data would allow a better look at who made use of the different types of student aid available before and after the reform.

While the main focus of our article is the impact of the reform, our study also contributes to the literature on distance costs in higher education in other ways. By including three educational outcomes, we are one of the first studies on spatial accessibility that contrasts its importance across educational outcomes. In line

with Gibbons and Vignoles (2012), who also looked at the effects of spatial accessibility on multiple educational outcomes, we find that the impact of distance depends on the outcome that is considered. Distance has a relatively small effect on the overall decision to enrol in higher education but is more influential in the choice of the field of study and the specific university to attend. This makes sense considering the future labour market returns of each decision, as discussed in Section 2.1. Because of the high labour market returns of university study, students are relatively price-insensitive to the costs of studying at a university (CPB, 2012) and therefore not much influenced by distance and the costs of living outside the parental home (Kelchtermans & Verboven, 2010; Long, 2004). In contrast, moving out to enrol in a distant university location compared to commuting to a nearby university from the parental home results in higher living costs but in Dutch context generally would not result in higher future wages. As a consequence, many Dutch students enrol in a university near their parental home, which is reflected in the relatively high influence of distance on university location choice. This holds even for a small country such as the Netherlands with, at most, about 400 km between the parental home and the university, as well as relatively good public transport connections between most of the regions.

Paying attention to the inequality in educational outcomes due to spatial accessibility does not have to reduce attention to other forms of educational inequality. As found in previous studies, we find that especially students whose parents have a relatively low socioeconomic background, are deterred by distance in their choices of study location and field of study (Cullinan & Flannery, 2022; Denzler & Wolter, 2011; Frenette, 2006, 2009; Gibbons & Vignoles, 2012). In the Dutch context, the students with the lowest parental income, who receive a means-tested grant regardless of living situation, did not behave much differently than those students in the second quartile of parental income who do not receive the means-tested grant. This is in line with recent Dutch studies that point out that the position of 'middle class' students who do not qualify for means-tested student aid is similar to the position of students coming from low-income households who do qualify for means-tested student aid (Kuijpers et al., 2020; van den Broek et al., 2020).

Our study makes clear that despite offering student loans or substantial student grants specifically to students living outside the parental home, distance remains an influential factor for Dutch students in their educational choices. It begs the question: how much of this distance effect is due to financial costs such as the higher costs of living when living outside the parental home? The literature on spatial accessibility and higher education enrolment recognises that the preference of studying close to home could relate to non-financial factors (Denzler & Wolter, 2011; Gibbons & Vignoles, 2012; Sá et al., 2004) but most of these have only been explored in small-scale qualitative studies (Christie, 2007; Forsberg, 2019). There is a need for large-scale quantitative research to address whether factors such as local social ties or a lack of information regarding distant universities play a role in the decisions of especially low socioeconomic status students to refrain from enrolling in education opportunities further away from the parental home.

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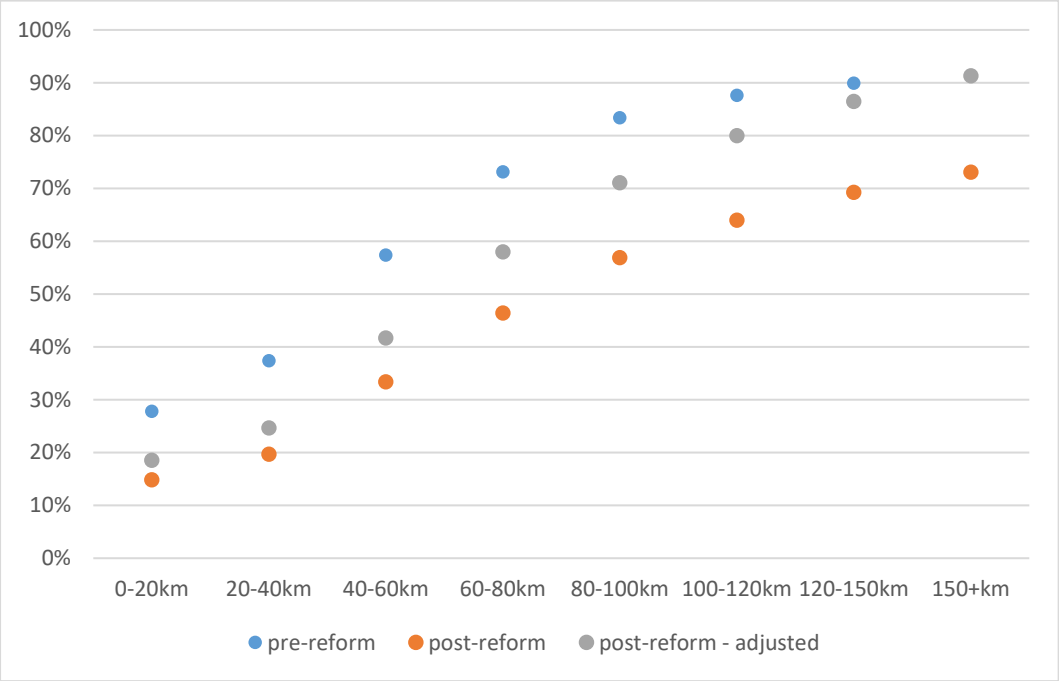
8. Appendix

Table A1: Living situation at the end of the first academic year of enrolment in university by cohort

Cohort	% living outside the parental home	% living outside the parental home (adjusted)
2010 (pre-reform)	55.0	55.0
2011 (pre-reform)	52.0	52.0
2012 (post-reform)	37.4	46.7
2013 (post-reform)	34.9	43.5
2014 (post-reform)	32.5	40.6
2015 (post-reform)	29.2	36.5

Source: Own calculations based on microdata Statistics Netherlands.
Calculations are performed on the subsample of students enrolling in university. Cohort refers to the year of entry into the fourth year of the six-year academic track in secondary education. A student is classified as living outside the parental home when they were registered at a different address than both their judicial parents at the end of their first academic year in university. The column with adjusted statistics on the percentage of students living outside the parental home takes into account that the percentage of students living outside the parental home is underreported in administrative statistics for cohorts after the reform (see Figure A2).

Figure A2: Share of students living outside the parental home by distance to chosen university location



Source: Own calculations based on microdata Statistics Netherlands.
Calculations are performed on the subsample of students enrolling in university. Categories on the x-axis refer to the Euclidean distance in kilometres between the address of the student in the fourth year of secondary school and the centre of the municipality of the chosen university location. A student is classified as living outside the parental home when registered at a different address than both their judicial parents at the end of their first academic year in university.

We perform an adjustment to the post-reform data because the reform lowered the financial incentives for students to administratively register their new living location after moving out of the parental home. We assume that both before and after the reform students with more than 150 km between their parental home in the fourth year of secondary school and their chosen university location lived outside the parental home. For the pre-reform cohorts, this is largely confirmed, with 91.8% of students in this category registered at a different address than their parents at the end of their first year of university studies. The remaining 8.2% could be students who by the end of the first year dropped out of university and moved back to the parental home or whose parents moved closer to the university after the fourth year of secondary school. In the post-reform cohorts, the percentage of students registered as living outside the parental home dropped to 73.1%. This difference between the cohorts before and after the reform illustrates the increase in students who moved out of the parental home but did not administratively register their new address. We therefore provide adjusted statistics for the post-reform cohort that remove this bias in administrative registration by increasing the percentage of living outside the parental home by 24.9%, the difference between the pre-reform cohorts and post-reform cohorts in the 150+ km category (91.3 / 73.1 = 1.249).

Table A3: Descriptive statistics of education and background variables, full sample differentiated by reform status.

	Full sample Cohorts pre-reform		Full sample Cohorts post-reform	
	N	% / Mean	N	% / Mean
Cohort (fourth year in secondary school)				
2010 (pre-reform)	39,849	50.6		
2011 (pre-reform)	38,978	49.4		
2012 (post-reform)			39,037	24.7
2013 (post-reform)			39,158	24.7
2014 (post-reform)			39,748	25.1
2015 (post-reform)			40,392	25.5
Transition towards				
University	53,339	67.7	111,734	70.6
University of Applied Sciences	17,980	22.8	29,480	18.6
No higher education	7,508	9.5	17,121	10.8
Field of study in University				
Multidisciplinary	1,772	2.2	5,085	3.2
Agriculture and natural environment	1,989	2.5	4,942	3.1
Nature	6,442	8.2	13,933	8.8
Science	8,753	11.1	19,150	12.1
Healthcare	7,034	8.9	14,936	9.4
Economics	8,362	10.6	17,599	11.1
Law	4,850	6.2	10,189	6.4
Behaviour and Social Sciences	9,061	11.5	16,821	10.6
Linguistics and Culture Sciences	4,885	6.2	8,596	5.4
Not in university	25,679[a]	32.6	47,084[a]	29.7
Annual income parents				
1st quantile (below €55k)	18,793	23.8	37,751	23.8
2nd quantile (between €55k and €80k)	18,793	23.8	37,749	23.8
3th quantile (between €80k and €110k)	18,792	23.8	37,747	23.8
4th quantile (above €110k)	18,791	23.8	37,747	23.8
Parental income unknown	3,658	4.6	7,341	4.6
Sex				
Female	42,295	53.7	84,708	53.5
Male	36,532	46.3	73,627	46.5
Age[c] (in years at start fourth year sec. school)	78,827	15.39	158,335	15.37
Migration background[c]				
None	65,828	83.5	131,611	83.1
1st gen Western	1,133	1.4	2,128	1.3
1st gen Non-Western	1,209	1.5	1,817	1.1
2nd gen Western	4,654	5.9	9,557	6.0
2nd gen non-Western	6,003	7.6	13,222	8.4
Population density[c]				
Very high (2.500+ addresses per km2)	15,114	19.2	31,967	20.2
High (2,000-2,500)	24,691	31.3	49,163	31.0
Medium (1,000-1,500)	15,424	19.6	30,806	19.5
Low (500-1,000)	17,305	22.0	33,835	21.4
Very low (<500 addresses per km2)	6,293	8.0	12,564	7.9
Nstudents	78,827		158,335	

Source: Own calculations based on microdata Statistics Netherlands.

[a] 647 of the 165,073 students enrolling in university (0.4%) were not included in our subsample because the university location in which they enrolled had a low intake in their chosen field of study and was excluded from our analyses (see footnote 20). These students are listed as "not in university" in Column A.

[b] The difference in distribution/mean between the pre-reform and post-reform cohorts is statistically significant ($p<0.05$).

[c] The difference in distribution/mean between the pre-reform and post-reform cohorts is statistically significant ($p<0.001$).

The names of the universities are purposefully not included in the dataset of Statistics Netherlands. Descriptive statistics on location choice can therefore not be presented.

Table A4: Descriptive statistics of education and background variables, subsample differentiated by reform status.

	Subsample Cohorts pre-reform		Subsample Cohorts post-reform	
	N	% / Mean	N	% / Mean
Cohort (fourth year in secondary school)				
2010 (pre-reform)	26,746	50.3		
2011 (pre-reform)	26,402	49.7		
2012 (post-reform)			27,079	24.3
2013 (post-reform)			27,549	24.8
2014 (post-reform)			28,218	25.4
2015 (post-reform)			28,405	25.5
Transition towards				
University	53,148[a]	100.0	111,251[a]	100.0
University of Applied Sciences				
No higher education				
Field of study in University				
Multidisciplinary	1,772	3.3	5,085	4.6
Agriculture and natural environment	1,989	3.7	4,942	4.4
Nature	6,442	12.1	13,933	12.5
Science	8,753	16.5	19,150	17.2
Healthcare	7,034	13.2	14,936	13.4
Economics	8,362	15.7	17,599	15.8
Law	4,850	9.1	10,189	9.2
Behaviour and Social Sciences	9,061	17.0	16,821	15.1
Linguistics and Culture Sciences	4,885	9.2	8,596	7.7
Not in university				
Annual income parents[b]				
1st quantile (below €55k)	11,172	21.0	23,629	21.2
2nd quantile (between €55k and €80k)	12,031	22.6	25,252	22.7
3th quantile (between €80k and €110k)	13,077	24.6	27,601	24.8
4th quantile (above €110k)	14,630	27.5	30,132	27.1
Parental income unknown				
Sex[c]				
Female	27,550	51.8	58,254	52.4
Male	25,598	48.2	52,997	47.6
Age (in years at start fourth year sec. school)[c]	53,148	15.35	111,251	15.34
Migration background[c]				
None	44,518	83.8	92,783	83.4
1st gen Western	703	1.3	1,355	1.2
1st gen Non-Western	734	1.4	1,135	1.0
2nd gen Western	3,240	6.1	6,764	6.1
2nd gen non-Western	3,953	7.4	9,214	8.3
Population density[c]				
Very high (2.500+ addresses per km2)	10,608	20.0	23,140	20.8
High (2,000-2,500)	16,777	31.6	34,808	31.3
Medium (1,000-1,500)	10,453	19.7	21,873	19.7
Low (500-1,000)	11,310	21.3	23,186	20.8
Very low (<500 addresses per km2)	4,000	7.5	8,244	7.4
Nstudents	53,148		111,251	

Source: Own calculations based on microdata Statistics Netherlands.

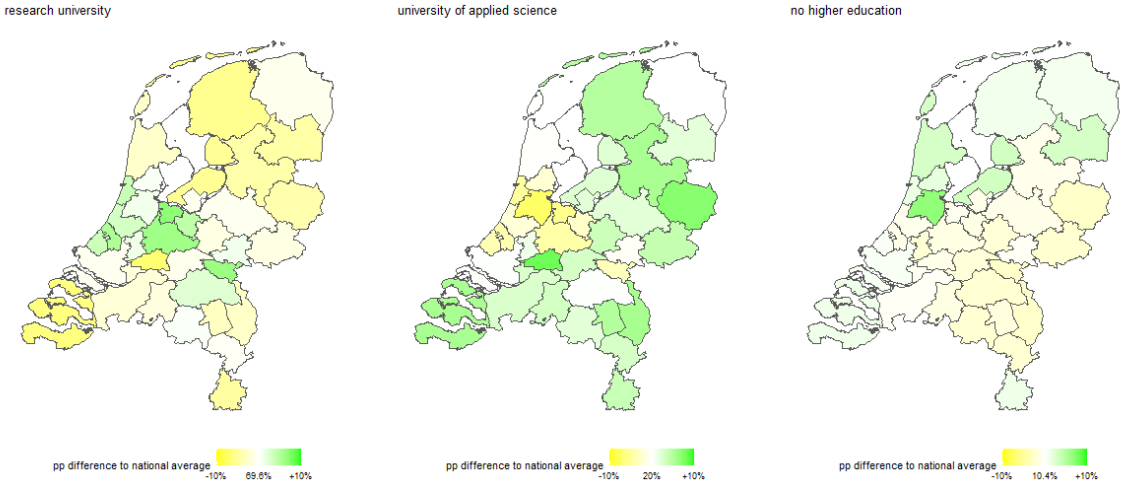
[a] 647 of the 165,073 students enrolling in university (0.4%) were not included in our subsample because the university location in which they enrolled had a low intake in their chosen field of study and was excluded from our analyses (see footnote 20).

The names of the HEIs are purposefully not included in the dataset of Statistics Netherlands. Descriptive statistics on location choice can therefore not be presented.

[b] The difference in distribution/mean between the pre-reform and post-reform cohorts is statistically significant ($p<0.05$).

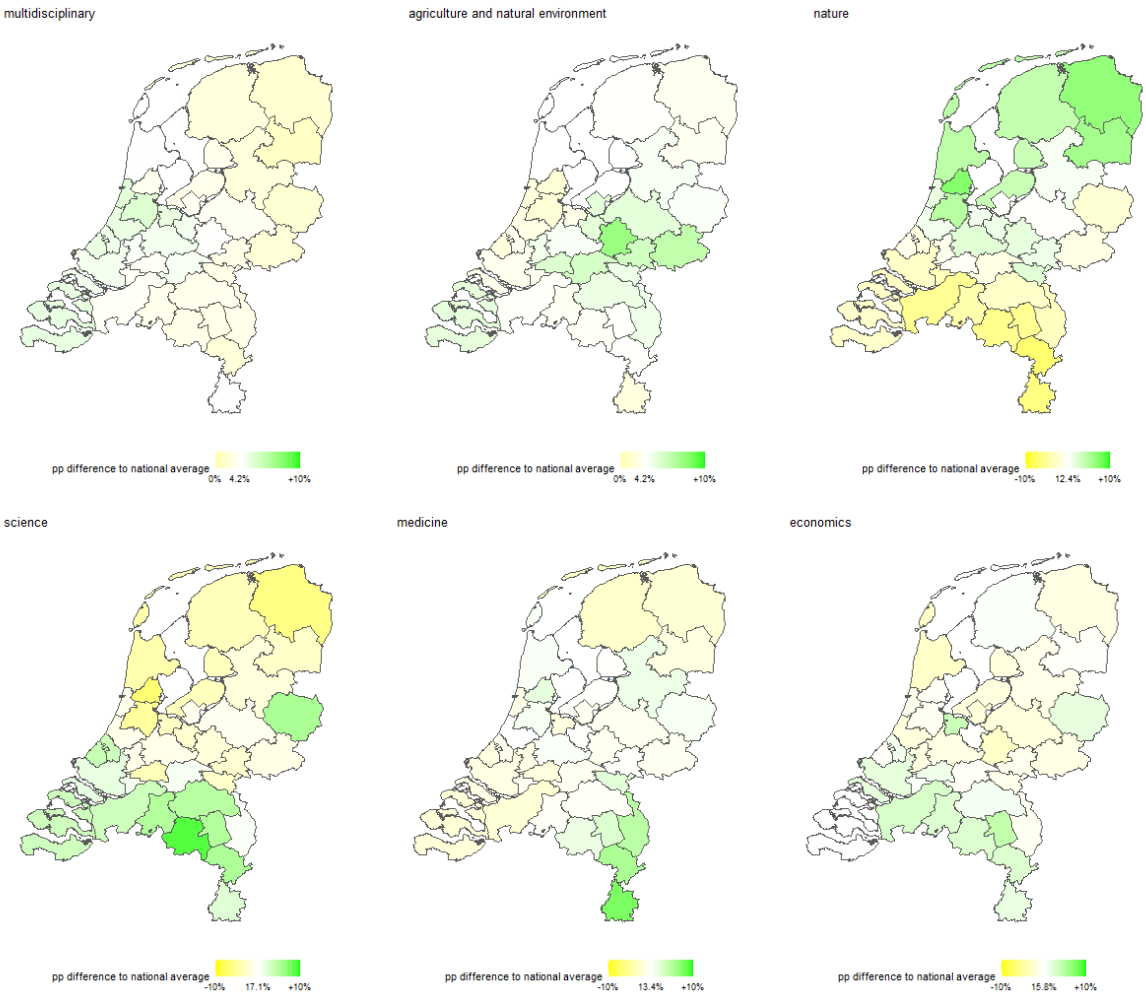
[c] The difference in distribution/mean between the pre-reform and post-reform cohorts is statistically significant ($p<0.001$).

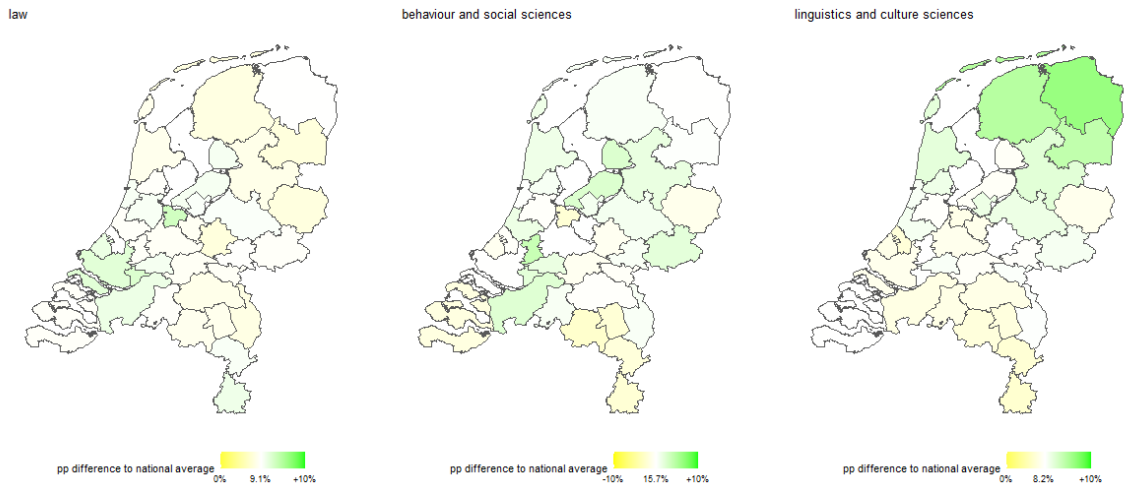
Figure A5: Enrolment in higher education by region



Source: Own calculations based on microdata Statistics Netherlands. Enrolment is calculated for the 35 labour market regions.

Figure A6: Enrolment in field of study by region





Source: Own calculations based on microdata Statistics Netherlands. Enrolment is calculated for the 35 labour market regions.