Present and Future Costs of Education and International Students.

Evidence from a Natural Experiment in Germany

Master Thesis

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Abstract: The number of students studying outside their home country has constantly increased in the past two decades. Thus, government policies need to arbitrate between the positive and negative externalities of the phenomenon. Tuition fees and integration policy are tools used by the governments to mitigate the negative effects of international education. In 2005 the German Federal constitutional court declared that the law banning the German *Länder* to introduce tuition fees for Higher Education was not conform to the constitution. As a consequence, seven *Länder* introduced tuition fees between the Winter Semester 2006-2007 and the Winter Semester 2007-2008. Using this event as a natural experiment we show that the introduction of tuition fees tend to have a negative effect on the number of students. Moreover, we show that the effect seems greater for the foreign students than the German students. We also study the effect of the immigration legislation using, a law passed in April 2012 in Germany which facilitated the process of recognition of the qualifications obtained abroad. Here, we find mixed evidence and cannot conclude on the effect of the integration legislation on the number of students.

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Contents

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[1]Part of this section is inspired by the work I did for (Garcia-Penalosa and Wasmer, 2016)

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Introduction:

The *circulaire Guéant* promulgated the 31st May 2011 aimed to reduce the number of non-EEA/EU students starting a career in France. The *circulaire* ordered to the *préfets*, who are in charge of the immigration policy at the local level, that the procedure of the visas status change from foreign students to foreign worker necessitated a "torough control" [2]. This text was widely criticized by important bodies in the French Higher Education landscape, such as the *Conférence des présidents d'universités*(CPU)[3] and the *Conférence des Grandes Ecoles*(CGE)[4]. The *circulaire* was one of the controversial topics during the presidential campaign in 2012 and was abrogated by François Hollande's government on May 31st 2012. One of the main critics against the *circulaire*, was that it could have harmed the attractiveness of the French Heigher education institutions (HEI).

There exist no economic study on the effect of this piece of regulation, and as the time of its implementation was short (one year), the effect are likely to have been small. Nevertheless, such event raises the question of the impact of the corpus of law and regulations on the attractiveness of the country. The government faces, here, a phenomenon that causes both positive and negative externalities. Indeed, having a diverse student body undoubtedly increases the intellectual openness of the national students and this is a crucial competency in the globalization. Nevertheless, a massive student immigration in a context of almost free education [5], is a substantial weight on the public finances. Moreover, if migrant student stay in the country once they have completed their education they can also have positive and negative effects on the local labor markets. Thus, the immigration legislation can be viewed as an arbitrage between these two consequences of immigration.

Meanwhile, in 2011, the government of Sweden decided to introduce tuition fees for foreign students studying in Swedish universities[6]. The Swedish and EU/EEA[7] students were exempt from fees, while students from third countries had to pay high tuition fees around 100 000 SEK (10 900€). The introduction of tuition fees had an important effect on the number of non-EU/EEA students. Indeed, the number of students from countries outside the EU/EEA area starting a program in Sweden dropped from more than 8 000 in 2010/2011 to around 1 600 in 2011/2012, while the number of non-Swedish EU/EEA students starting a program raised by 26% during the same period[8]. However, soon after the initial drop, the number of non-EU/EEA students started to raise again at a good pace. Indeed, in 2014-2015, the number of non-EU/EEA student was 3 000, while the number of students from European countries had remained stable.

A key justification of the Swedish policy was that introducing tuition fees would provide better financing to the Swedish HEI, whose quality would in turn be enhanced. Meanwhile, the government also introduced a series of measures to improve the recruitment of foreign students, such as new scholarship programs. This policy introduced also a shift in the way Swedish universities had to compete with other international foreign

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[2] Circulaire du 31 Mai 2011, author's translation

[3] The CPU is an association which gather the directors of the French Universities and some other public schools.

[4] The CGE is a body gathering the directors of many French "*Grandes Ecoles*" which are mainly engineering and business schools.

[5] The universities' tuition fees in France ranges from 184€ for a Bachelor student to 391€ for a PhD, which is very low compared to international standards. Some specific diploma (engineer, ...) are more expensive, but rarely exceed 1 000€ per academic year. Note that the private sector not negligible in France. However, most of the foreign students study in the university.

[6] Only for first and second cycles programms, no-tuition fees was introduced for research programms.

[7] The European Union legislation prevents charging different fees for national students and students from the EU area

[8] *Data source: Antal nybörjare (inresande utbytestudenter och freemover-studenter) per lärosäte läsåren 2005/2006–2014/2015.* [Number of new students (incoming exchange students and freemover students) per university academic years 2005-2005 – 2014/2015]. Available at: http://www.uka.se/statistik–uppfoljning/statistikdatabas-om-hogskolan/internationell-mobilitet.html

HEI. Rather than joining Swedish universities because they are free, foreign students would choose Sweden because of the quality of its HEI, which would in turn benefit to Swedish students as well (EMN, 2012). The Swedish experience illustrates the key impact of the student mobility on the public finances. On the other hand, there is an ethical issue on whether it is fair to make foreign students pay an higher price than local students for the same level of service. The Swedish example suggests that introducing tuition fees might be detrimental to the diversity of the student population in a country. On the other hand the Swedish experience also suggests that tuition fees might increase the quality of the local HEI.

These two introductory examples emphasize that current (tuition fees and cost of living) and future cost of education (for instance the impossibility to stay in the country in which one studied) are key determinants of the student mobility. The individual location choice for the study is influenced by the direct cost of it, the tuition fees as illustrated by the Swedish example. Obviously the cost of living is another direct cost of education. Future costs matters also as the circulaire guéant seems to suggest. The aim of this master thesis is to assess the relative weight of both factors using a natural experiment in Germany.

The paper is structured as follows. A first section provides some empirical insights on the studied phenomenon. Section 2 introduces the natural experiment in Germany. The third chapter is a short literature review on the determinants of the choices of education and its relation to the brain drain litterature. Section 4 presents a short model to support our empirical estimation. Section 5 presents the data and section 6 the empirical estimations. Section 6 concludes.

1   Context: More Students, Increasing Costs   [9]

In the two last decades, the number of students studying outside their home country have constantly increased. Higher education in Europe has long been considered as a public good and was provided for free by the government. Thus, in this context, the globalization of education pressures the public finances.

1.1   The Globalization of Education

Students demand international experience for various range of reasons, including the fact that employers value international experience. For instance, a survey conducted in more than hundred countries indicated that 60 % of the employers actively seek or value international experience in their hiring process (Molony et al., 2011). In parallel, international cooperation in tertiary education has also improved in the past two decades. The deepest degree of international cooperation has been realized by the different components of the Bologna process since 1999. The harmonization of the university curriculum into 3 cycles (Bachelor, Master and PhD) across the different European states was a key achievement of the process that permitted a better recognition of European diploma across Europe. In addition, the Erasmus program initiated in 1987 is a flagship program in the international student mobility across Europe. Indeed, in 2012-2013, more than 260 000 European students benefited from an Erasmus exchange, which is more than the total of foreign students in France. Higher education is in addition a tool of development cooperation. In particular, in a decision of December 2008[10], the European Commission reminds that the Erasmus Mundus programs[11] aims to enhance "the quality of European higher education, promoting understanding between peoples as well as contributing to the sustainable development of higher education in third countries". Thus, the institutional framework has been adapted to favor international mobility in higher education.

Figure 1: Evolution in the Number of Foreign Students in height OECD Countries [12]
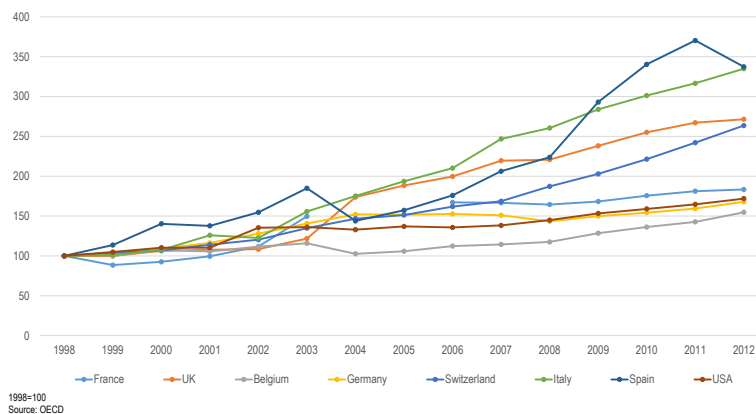
Consequently, the number of students studying outside their home country raised since the beginning of the century. For instance, in France, the number of international students almost doubled from 1999 to 2015. At the global scale the number of students studying abroad has also dramatically surged. Among the

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[9]Part of this section is inspired by the work I did for (Garcia-Penalosa and Wasmer, 2016)

[10]Decision N°1298/2008/EC

[11]The Erasmus Mundus program is now a part of the Erasmus + program. It aims at creating masters managed by different consortia of European Universities. It also has a development cooperation goal, since each of the master is endowed with a given number of scholarships (full tuition and living expenses) for students from developed countries.

8 countries presented in figure 1, all of them experienced an increase by at least 50% of the number of foreign students between 1998 and 2012. In Spain and Italy, the number of foreign student in their universities was even multiplied by more than 3 in the same period.

Thus, a global education market has been created and the competition to attract the best and the brightest has become tougher. Education policies regarding migrant students have to adapt in order to deal with the consequences of this migration wave, without isolating the country. As in the Swedish case presented in introduction, several countries in Europe (UK, Denmark . . .) have introduced differentiated tuition fees policies for EU/EEA students and for international students.

1.2 International Higher Education: what Quantity for what Quality ?

Student migration has policy implications at the level of the receiving countries. A first key question is the cost at which to provide education to foreign students. Many European countries provide free or cheap education to their citizens, and there are economic grounds that justify such policies. Indeed, a better educated population is more productive, will earn more and then pay more taxes which make the budget of the policy balanced. On the contrary, if a student studies at a low cost in a country and then migrates to another, the country which has provided the education loses its investment while the other gain from the arrival of the new talent. European countries are not allowed to charge different tuition fees for foreign students from EU/EEA countries and national students. As a consequence, and as these countries do not have a full return on investment, the economic theory suggest that the outcome should not be optimal, meaning that European countries tend to under-invest in education.

As a consequence, many European countries have introduced tuition fees for all the students. Many of which have a differentiated pricing policy for national and EU/EEA students on one side and students from third countries on the other side. A document established for the European Commission states two hypothesis on student response to an increase of the private part (payed by the student) in the funding of higher education. An increase in tuition fees might impact the number of students deciding to enter higher education. Moreover, students might still choose to study, but will change the way they study (part-time study, sectors, when to study). Studying nine case-study, the report finds no general evidence of a decrease in enrollments after an increase in the tuition fees and small evidence of a change in the study pattern (Orr et al., 2014). However, in a national context with closed economy, as it is assumed in the report, the demand for education might be very inelastic, which might explains the absence of price responsiveness from the students. In an international context however, students arbitrate between different countries who do not coordinate extensively their education strategy. Consequently, an increase in the fees payed by international students, might simply shift the flow of migrating student from one country to another. Here again, the evidences are mixed. The Swedish case provided evidence that tuition fees might influence a lot the number of foreign students in a country. On the contrary, the change in pricing policy in UK in 1998, 2006 and 2012 do not seem to have harmed the competitiveness of universities, even momentarily. This might be linked to the presence of more British universities in the traditional university rankings.

Finally, governments face a trade-off between quantity and quality. Free education tend to attract international students seeking cheap education. Providing free education will obviously attract a more diverse audience to the university, but the cost of education in the public finances will consequently increase. This will result in a decrease in the quality of education provided in the country, which would in the long term affect the country attractiveness and reputation. A solution, here is thus to increase the cost sharing of education. The cost sharing determines the part of the price of education which is actually paid for by

the student. An admitted goal of the already presented tuition fees reform policies was indeed to force the universities to develop a marketing strategy towards international students in order to get more funds. As a consequence, universities have to improve the quality of education they provide.

While tuition fees policy seems to have an impact on the number and the type of foreign student in a given country, the scholarship policy toward students originating from developing countries is also important in order to mitigate the overall cost of education (tuition fees and cost of living). As such, important tuition fees for foreign students would prevent most students from the poorest countries to acquire education abroad reinforcing the selection effect of migration. Thus, scholarship policy is an important tool for Western countries to attract the best and the brightest. Today, most scholarship awarded to students from third country is counted as foreign aid, which indicates that a part of this investment must benefit to the origin countries. In addition, origin countries might have an interest in encouraging their students to acquire education abroad. Some Latin American countries have scholarship programs that subsidize some nationals while studying abroad. The Brazil's Scientific Mobility Program (BSMP) is one of the flagship program in the region. It funds Brazilian undergraduate and graduate students to study outside Brazil in prestigious universities. The Ministry of Education and the Minsitry of Science and technology both fund the program. The number of Brazilian students studying in US universities rising by more than 50% from 2011 to 2015 is a key achievement of the program(Ortiz, 2015). Thus, the tuition fees policy is also another important aspect of the policy regarding education as it helps to correct the inequalities of access.

Thus the rising number of students implies a full set of policy responses regarding the cost of education from tuition fees policies, to the scholarship policies and a challenge is to be able to anticipate their impact.

1.3   A Methodological Issue : the Impossible Measure of the Impact of Immigration Legislation

A key aspect of the economic studies on mobility is to evaluate the barrier that might restrict the movement of people. There are economic costs associated with migrations such as the cost of travel or the price of the visas. However more arbitrary factors are at play such as the immigration legislation. The measurement of these aspects is key to explain the determinants of the migration.

Measuring immigration legislation imposes to make a numerous assumptions. In Economic History, a -5/+5 scale has been used to study the "Globalization Backlash [13]" in the late 19th century and its effect on the migration policy. The +5 correspond to an active recruitment of immigrants while a -5 indicates a country whose border are closed (Timmer and Williams, 1998). In general, the measurement of migration encompasses two types of regulations: the legislation regulating the number of admissions and the integration policy.

IMPALA (International Migration Policy And Law Analysis) database focuses on the first aspect. The project indeed aims to provide indicators on the immigration policy in six countries [14] over a time frame of 18 years starting in 1990. They focus on *de jure* migration tracks regrouped into 5 categories [15] (Beine et al., 2015). This indicator is particularly interesting since it distinguish student migration and other migration tracks and would enable to account for the sensitivity of the student choice of study location with respect to the different component of the immigration legislation. However, as of 2016 the indicator is not publicly available and the small number of countries is also a handicap to include this indicator in a regression. In

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[13] O'Rourke and Williamson, 2000

[14] Australia, France, Germany, Luxembourg, The Netherlands, and the United States

[15] Economic migration, family reunification, asylum and refugee immigration, students, acquisition and loss of citizenship

addition, the DEMIG (Determinants of Migration) database provide an extensive account of migration data, including legislation related data such as data on inflow of the migrants, for more than 30 countries (DEMIG, 2015). Nevertheless, data are not available year to year and the international comparability being limited, the database is of a little help for our project.

The inspiration for this project was based on the Migrant Integration Policy Index (MIPEX) [16] data which focus on the integration side of the immigration policy. This database focuses on legislation permitting the integration of the migrants. The index is built from 167 indicators, grouped into height policy areas [17] over 38 countries. An intermediary, exploitable index is available for each of the policy areas, which allow differentiating between different aspects of the immigration legislation. In addition qualitative information is often provided for the indicators, which allows examining the explanation for the quantitative changes in the index. Finally the data is available from 2007 to 2014, which allows a comparison across time (Huddleston et al., 2011). This data does not have an indicator for changes in tuition fees paid by foreign students. However, it helped understanding all the body of legislation that might as well impact the student behavior along with the increase in tuition fees.

Although, data on immigration legislation exist and are sometimes internationally comparable. A pitfall of the MIPEX database is that it does not vary enough in order to be able to run regressions in a cross country comparison. Thus, to have insights on the effect of the legislation corpus, sudden and unpredictable changes in legislation must be studied. The databases help to identify the period in which the legislation changed, and helped to identify the case study Germany which is the topic of the present paper.

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[16]http://www.mipex.eu/

[17] Labour Market Mobility, Family Reunion, Education, Health, Political Participation, Permanent Residence, Access to Nationality, Anti-Discrimination

2 The German Puzzle: Tuition Fees, Recognition of Qualifications Acquired Abroad and Number of Foreign Students

The German recent experience regarding tuition fees and the access to the labor market for people having studied abroad provides an ideal natural experiment to study the effect of present and future costs regarding education. Since 1976, a federal law on the universities banned the use of tuition fees in the German Higher education system. However, in 2005, a decision of the Federal Constitutional Court declared that the law was not conform to the constitution and *de facto* authorized the German *Länder* to have their own policy regarding tuition fees. As a consequence, height *Länder* introduced moderate fees at different moments between 2006 and 2007, while the other continued to provide free education. From 2008 to 2014, often as a consequence of switching coalitions, tuition fees were abolished in the *Länder* that introduced them, which might have created an increase in the number of enrollments. Table 1 presents the date of introduction and the date of abolition of tuition fees.

Together with the tuition fees abolition movement, a law passed in April 2012 in Germany to facilitate the recognition of the qualifications acquired abroad, which should decrease the incentives for the foreign students to study in Germany as they can more easily work in Germany even if they have studied abroad. This law indeed permit the access to regulated professions to people with equivalent competencies obtained abroad. Although not necessary to access unregulated professions, the recognition of a migrant professional qualifications might also facilitate his access to the German labor market, as employers can more easily assess his qualifications. Thus, there are two movements going in opposite directions at the same time.

Table 1: History of the Introduction of Tuition Fees in Germany

Länder	Introduction of Tuition Fees	Abolition of Tuition Fees
North Rhine-Westphalia	Winter Semester 2006-2007	Winter Semester 2012-2013
Lower Saxony	Winter Semester 2006-2007	Winter Semester 2014-2015
Bavaria	Summer Semester 2007	Winter Semester 2013-2014
Baden- Württemberg	Summer Semester 2007	Summer Sumester 2012
Hamburg	Summer Semester 2007	Winter Semester 2012-2013
Hesse	Winter Semester 2007-2008	Winter Semester 2008-2009
Saarland	Winter Semester 2007-2008	Summer Sumester 2010

Source: Orr et al. (2014)

The originality of the German case is that the tuition fee reform was not national as it is usually the case[18]. Indeed, both the Swedish and the English reforms concerned the whole country. In Germany, the implementation of tuition fees was the result of political debates whose issue was uncertain and can be considered almost-random. In addition, the tuition fees that were implemented were almost uniform across (in a 300-500€ range) the states which facilitates the identification of the effect of the policy on the enrollment behavior of students (Hübner, 2012). In addition, the abolition of tuition fees can also be considered as random as this was the result of shifting political coalition, which is also difficult to anticipate. Finally, the insignificant proportion of the private sector in the German Higher education system, lowers the alternatives for Germans and non-German students to acquire education in Germany. Thus, the German case is an ideal natural experiment to study the impact of tuition fees on the enrollment behavior of foreign students in

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[18]See for instance the Swedish reform of tuition fees for international students or the tuition fees reform in England which all were implemented at the same time in the whole country.

response of an increase of tuition fees.

The legislation on the recognition of qualifications obtained abroad also provides good grounds for a natural experiment. Indeed, the European students are mostly not concerned by this reforms, since the European Union already favors the recognition of the qualifications obtained inside the EU. Moreover, foreigners might have difficulties to anticipate the evolution of the German legislation for different reasons (languages, media, ...), which make the legislative difficult to anticipate.

One of the limitations of the natural experiment is that in some states tuition fees already existed prior 2005 for long term students. Indeed, in 1998, for the first time the state of Baden-Württemberg introduced fees for long term students and was followed in the following years by 9 other *Länder*[19]. The objective of the policy was to decrease the average study length which was at that the time relatively high in Germany compared to European standards. These tuition fees have increased the probability to obtain a degree, to transfer to a state with no tuition fees for long term students, the probability to drop out and the probability of failing. In addition, the behavior of changing field of study tends to decrease (Heineck et al., 2006). Note however that this policy might have a lower effect on international students, as there are other constraints that are limiting their time of study. For instance, in France, the visa for a foreign student is first given for a period of one year and is renewed conditional on academic results for a length not exceeding the length required to complete the degree, which limits the capacity of foreign students to extent the length of their study in the country.

2.1   What does the Data says ?

Increasing the tuition fees, even slightly should decrease the number of enrollments for all categories of population. The theory is not clear whether it should have a greater effect on foreign or local students. As shown on figure 2, from 1998 to 2014 the number of German students studying in Germany increased from 1.6 million to a little over 2.3 million. In the meantime, the number of foreign students in Germany almost doubled to reach 340 000 in the Winter Term 2014/2015. From the Winter Term 2006/2007, some *Länder* started to introduce tuition fees and by the Winter Term 2007/2008 seven *Länder*[20] had introduced fees. In Germany, this corresponds to a drop by 1.4% in the number of enrollments of German students and a decrease by 5.2% of the number of foreign students. This figure suggests that the tuition fees had a greater impact on the foreign students than the national students. Several channels might explain this conclusion. The German students might relocate more easily in a *Land* where universities do not charge fees, while for foreigner deciding to study outside Germany might be less costly than for a German citizen.

The comparison of a German state that introduced the fees and a German state that did not tend to confirm the hypothesis. The state of Rheinland-Pflatz has choosen not to introduce fees after the federal court authorized it, while Baden-Württemberg introduced fees in the summer semester 2007 and abolished them in for the summer semester 2012. In addition, from 2009, a student with two siblings already paying fees was exempt from tuition fees. The amount of the fees was 500€. Figure 3 shows the evolution of the number of students in these two states. It appears that while the number of German students in Rheinland-Pflatz increased steadily throughout the period, the number of German students in Baden-Württemberg initially dropped in 2007 before experiencing a greater growth in the following years. This, unprecedented growth might be signal of an improvement of the study conditions in the state that raised the fees. Concerning the

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[19]Bavaria, Hamburg, Hesse, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Saarland, Saxony-Anhalt and Thuringia

[20]North Rhine-Westphalia, Lower Saxony, Bavaria, Baden-Württemberg, Hamburg, the Saarland, and Hesse (Orr et al., 2014)

Figure 2: Student enrollments in Germany, Winter Term 1998/1999 - Winter Term 2014/2015

Source: German Federal Statistical Office
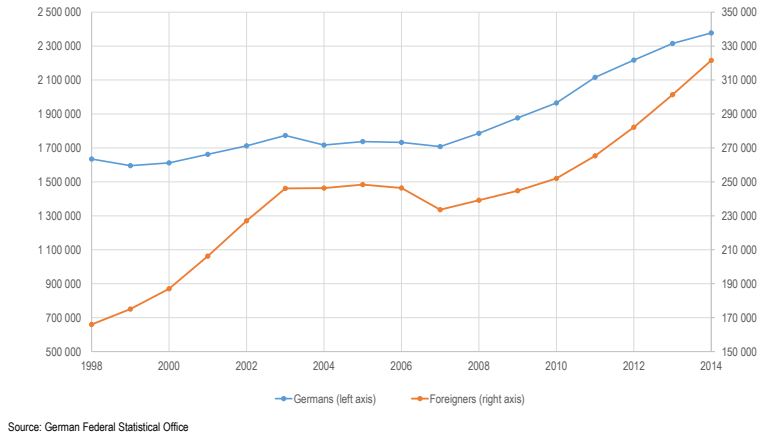
Figure 3: Students enrollments in two German states, Winter Term 1998/1999 - Winter Term 2014/2015

Source: German Federal Statistical Office
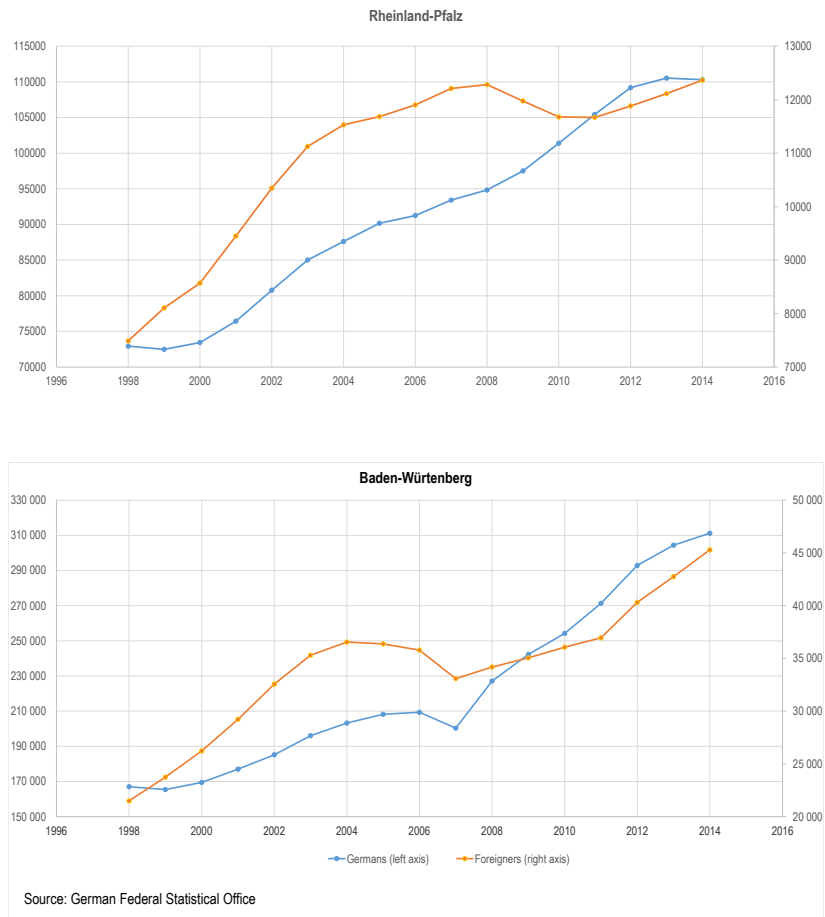
foreign students, they followed the same pattern as the German students in Baden-Württemberg. However, the growth in the number of foreign students seems to have been moderate throughout the implementation of the tuition fees policy, and accelerated after the abolition of tuition fees. In Rheinland-Pflatz, the behavior of foreign students is more surprising. The state does not seem to have received more foreign students due to

the implementation of the tuition fee policy in the other states. An hypothesis here, is that the introduction of tuition fees in the other state would have signal Germany as a more expensive country to study as a whole.

Another effect to investigate is the extent to which the tuition fees policy and the policy of recognition of foreign qualification affected more certain categories of foreign students. The tuition fees remained limited to a maximum of 500€ per academic year which is low compared to international standards. Moreover, all the foreign students do not have the same ressources while going in Germany to study. An African student who do not benefit from any kind of financial aid will probably be more price elastic than a student from the US for whom 500€ per academic year remains cheap compared to the American standards. On the contrary the law on the recognition of qualifications obtained abroad would probably more matter to explain a decrease in the number of student from the US than African students. Indeed, the law specify that the recognition of the foreign qualification is facilitated, conditionally on the quality of the qualification. Data on visas collected from the German Federal Statistical Office (figure 4) seems to confirm the hypothesis on tuition fees, while remaining inconclusive on the effect of the legislation on the recognition of qualifications obtained abroad. Indeed, while the number of visas delivered for study purposes to North-American students raised smoothly throughout the period, the number of visas delivered to African students decreased from 2007 to 2011 before rising up again after 2012 which coincide with the abolition of tuition fees in many German *Länder*. An acceleration in the growth of the number of visas delivered to Asian and South-American students tend to confirm the hypothesis of a greater sensibility to tuition fees of students originating for developing countries[21]. However, the relative stability of the visas delivered to North American students in 2014 compared to 2013 is difficult to interpret as a consequence of the recognition of qualifications obtained abroad even though it might be a delayed consequence of the policy.

Figure 4: Visas delivered for study or training reasons by region of origin in Germany (2006-2014)
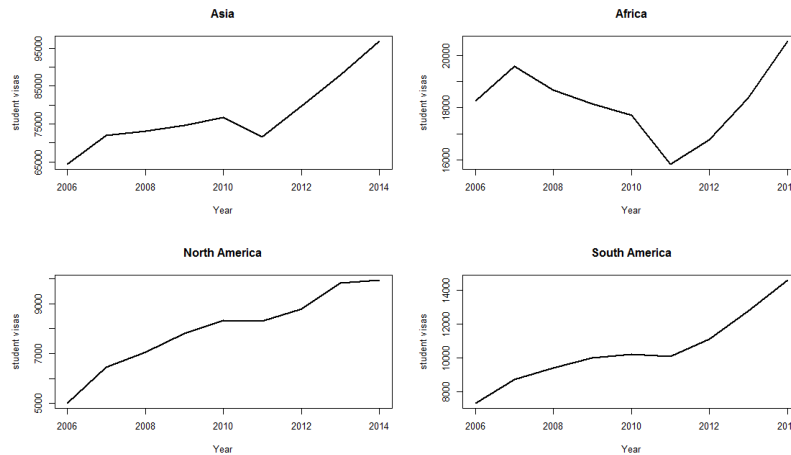
Note: *Students from the Shengen space do not need a visa to study in Germany*

Source: *German Federal Statistical Office*

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[21]Note that the number of visas delivered to Asian students encompasses visas delivered to students from developed countries such as Japan.

2.2   In the Economic Literature

The economic theory is not clear on whether the change of tuition fees in Germany should have a negative effect on overall enrollments. Indeed, on the one hand, if the student who cannot afford the fees can just move to a fees-free state then the change of policy will have no effect on the enrollment. On the contrary, if there is some rigidity in the student's capacity to move to another state, then the overall enrollments might decrease because of the policy. Finally, the introduction of tuition fees acts as a positive signal on the quality of the state's HEI, the policy might have a surprising positive effect on the number of enrollments. Thus, a key question while using this natural experiment to study an effect of tuition fees on enrollments, is the question of students who change the state in which they study because of the reform. In other words, the contamination of the control group needs to be addressed (Hübner, 2012).

Studying the effect of the reform on the enrollment of German students, Hübner (2012) controls for the spillover effect. Using a model of the student's enrollment decision, he finds a negative effect of the tuition fee reform on the enrollment behavior of prospective German students. However, the literature remains inconclusive regarding the size of the induced mobility between states with tuition fees and states without. For instance, Dwenger et al. (2012) find that in tuition fees states, high-school graduates are 2% less likely to apply in their home state compared to student from states without tuition fees. In addition, the effects seems more important for students with better grades in high-school. This, suggest that the impact of the tuition fee policy also depends on the inherent ability of the applicants.

3   Literature Review

The German experience regarding tuition fees and the legislation on the qualification obtained abroad, appeal to a literature studying the determinants of the location of the studies. When students choose where to study, several factors are taken into account. They consider first the cost of education which consists in a direct cost, the tuition fees and the cost of living, and an opportunity cost which are the salaries they would have earned if they had decided to work instead of studying after high school. The main benefit of education is the wage premium associated to a university diploma. This wage premium depends mainly on the graduate's labor market conditions. This cost-benefit analysis links directly the labor market conditions and the education market.
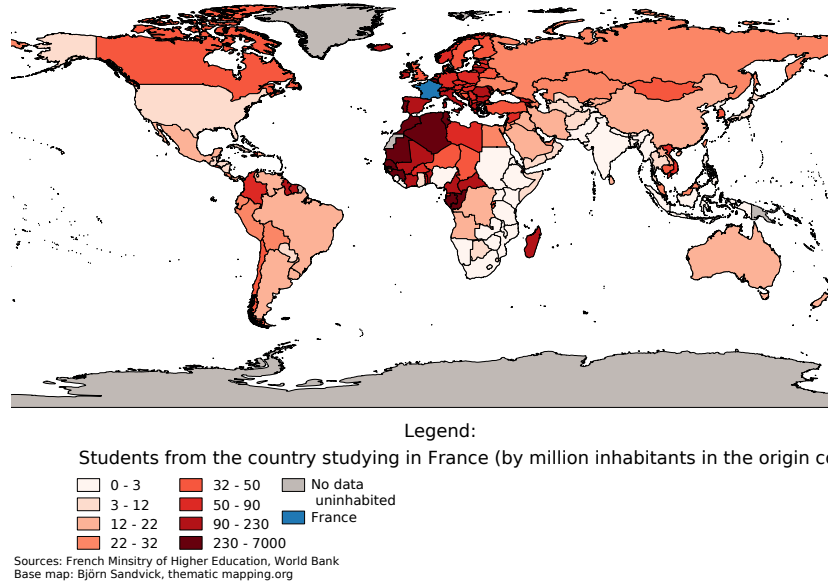
3.1   How Students Choose where to Study ?

In an international context other elements must be added to this cost-benefit analysis. There is indeed a fixed cost of migration. Migrants face monetary costs such as the visa, and other implicit costs like the acculturation. Traditional models of migration indeed assume a fixed cost of migration. More complex models (Mountford, 1997; Beine et al., 2001) also assume that the migration is not certain. In these models, education, which can be only acquired at home, increases the probability that migration is successful. Thus, education acquired at home might be a way for certain prospective migrants to achieve better standard of living. Concretely, obtaining a degree in the country, where the individual aims to work in might considerably increase the chances of a successful labor migration. Studying the behavior of Asian students studying in the US, Rosenzweig (2008) confirm the hypothesis that foreign students come to the US in the prospect to get a job. The skill price in both the destination and the host country is key to characterize the flow of students between two countries.

However, countries have often different policies for the migration in the context of the studies and labor migration. The first is often perceived as a way to enhance multiculturalism, while the second is often caricatured as a threat to the local workers. As the ultimate goal of the students is to be employed. Thus, while choosing where to study, they consider the immigration rules for the studies as well as the rules for the labor market. For instance, in the US it is relatively easy to obtain a student visa. The only conditions are to have been admitted into a US higher education institution, which is not that difficult for people with appropriate means and to pass some light background checks (criminal or terrorist records). Thus, migrating to the US as a student is relatively easy (Rosenzweig et al., 2006).

Finally, other factors are taken into account by the students who are migrating. The languages, the cultural proximity and the historical ties influence the choice of the students. As a consequence, Great Britain will tend to attract relatively more students from the Commonwealth countries, while France will attract more students from its former colonies as illustrated in figure 5. Beine et al. (2014) study a set 13 OECD countries, for which the determinants of the mobility of foreign students are examined. In addition to identifying the importance of colonial and cultural ties, they also show the importance of the national network in the foreign country. The cost of immigration such has housing price is also proven to be significant. Policies in the home and the destination country are also key determinants.

Figure 5: Foreign students in France in 2014-2015. Relative to the population of the origin country.

Legend:
Students from the country studying in France (by million inhabitants in the origin c

☐ 0 - 3	🟧 32 - 50	☐ No data
☐ 3 - 12	🟥 50 - 90	uninhabited
☐ 12 - 22	🟥 90 - 230	🟦 France
🟧 22 - 32	🟥 230 - 7000	

Sources: French Minsitry of Higher Education, World Bank
Base map: Björn Sandvick, thematic mapping.org

3.2 Tuition Fees, Scholarships and Educational choices

Tuition fees have an impact on the student behavior regarding education. In the Bocconi University, students are assigned to one of the twelve tuition fees level depending on their family income. Exploiting the discontinuities in tuition fees paid by the student shows that an increase of tuition fees tends to decrease the probability to extend the study beyond the required minimal time. In addition, in this context tuition fees have no impact on the quality of the study as the students below and above the threshold tend to have the same final grades (Garibaldi et al., 2012). Beine et al. (2014) find indeed an important effect of the cost factors like housing price, but do not concur the hypothesis of an effect of registration fees.

Financial aid is a way to compete for the best students. As Van der Klaauw (2002) shows using discontinuities in financial aid proposals of the East Coast college, scholarships increase the enrollment rate of prospective students. Financial aid is thus a tool to compete against other colleges. However, in their survey of the literature, Leslie and Brinkman (1987) shows that the size of the impact of the education cost varies a lot across studies.

Thus, an increase on the fees can not only have an effect on enrollment but also on what the student decide to study.

3.3 Higher Education and the Brain Drain in the Literature

The brain drain literature has focused mainly on the consequences for departure countries in the context of a south-north migration. In his seminal contribution Mountford (1997) shows that when the migration is uncertain, the brain drain might increase the productivity level of departure country. The prospective migrants choose to acquire education which is a *sine qua non* condition to be allowed to migrate. Once they have acquired education, only a fraction of the educated population is allowed to migrate. Finally, the educated migrants who stayed at home contribute to the increase in productivity. Beine et al. (2001) extend the model to show that two effects are at play. The "brain effect" increases the average education of the

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population because prospective migrants acquire education. The "drain effect" is the effect of educated people actually leaving the country because they are attracted by higher marginal product abroad. The condition stated for a "beneficial brain drain" is that the brain effect exceed the drain effect. Finally, Dos Santos and Postel-Vinay (2003) consider in addition the phenomena of return migration. They show that after a period abroad, some migrants can have incentives to come back home. The accumulation of knowledge while being is here key to explain the return migration. In their model, in the long run, the brain drain migration decreases and the return migration increases. Thus, the legislation of the receiving country has an impact on the well being of the sending country.

Nonetheless, these models might also apply to a north-north migration. Studying the brain drain of European PhDs, Docquier and Rapoport (2012) find that the European brain drain affects more strongly the most qualified of the skilled workers. They argue that this is a consequence of the difference in R&D spending in Europe and in the US. Thus, workers tend to immigrate in countries where the return on skill is higher. In this context, brain drain can also yield negative externalities, especially in the context of a federation of national states. In the European Union, there is a consensus that the education policy should remain a competency of the member states. In such setting, member states tend to over-invest in country specific skills, while under-investing in internationally applicable skills. This result in an under-optimal equilibrium, where there are for instance too many lawyers and not enough engineers. In terms of public policy, graduate taxes such as income contingent loans can be a way to address this externality (Poutvaara, 2008). This illustrates the challenges posed by the internationalization of higher education.

These theories provide a precise grasp of the conditions under which the brain drain is beneficial to the origin countries. Nonetheless, in these models the education is acquired in the home country. Two main factors could explain why people from origin countries might prefer to acquire education abroad. First, migration legislation is often more flexible for students than for workers and acquiring education in a foreign country might increase the individual chance to have a permanent migration in that country. Moreover, the literature has documented the fact that the same diploma obtained in two different countries does not provide the same level of skills, which in turn affects the individual's productivity (Hanushek and Kimko, 2000). Thus, the brain drain can enhance the origin country productivity, at the expense of the destination country, if the return rate of foreign students is sufficiently high.

4 Model:

This model is derived from the set up of Beine et al. (2001) with two educational choices. Their notations are also borrowed. Other sources of inspiration are Mountford (1997) and Dos Santos and Postel-Vinay (2003). Nevertheless, the objective of this model is different from these authors. We aim to study the effect of the immigration legislation on the number of students migrating from the source economy. Compared to this class of model, we get rid of the OLG dimensions as growth consequences are not the focus of the paper. The model presents a small open economy populated with agents living two periods $t \in \{1, 2\}$. In the first period of their life, agents make a choice of education. In the second period, agents choose where to work. Agent's objective is to maximize income

4.1 Production Sector

There are two factors of production, capital (K_t) and labor (L_t). The output is produce according to a standard production function $Y_t = F(K_t, L_t)$. Output per head is also standard: $y_t = f(k_t)$ where $k_t = K_t/L_t$. Capital is assumed to be perfectly mobile, and the retrun on capital r assumed to be constant accross time. The return on one unit of labor is assumed to be unity.

4.2 Agent Behavior

In period 1, each agent i is endowed with an identical level of human capital $h_1^i = 1$ which is inherited from previous generations. In the first period of their life have three choices regarding education. They spend either P_h and stay at home to acquire $e^i = e_h$ units of education or P_f and go in a foreign country to acquire $e^i = e_f$ units of education. The last option is to remain uneducated ($e^i = e_0 = 0$), to pay nothing $P_0 = 0$, and to work to earn a salary normalized to unity. When agent study they don't work and have to borrow at rate $1 + r$ to pay back their education. For different reasons (transportation cost, tuition fees, ...) going to study abroad is more expensive than at home and thus $P_f > P_h > 0$ and education is of better quality abroad and thus $e_f > e_h > e_0$. In addition, each individual has an inate ability that make the education more or less successful. The ability is distributed between two positive, finite thresholds. Formally, $a^i \in [\underline{a}, \overline{a}]$ h_2^i is a function of the educational choices. Formally:

$$h_2^i = 1 + a^i e^{i\beta} \text{ where } 0 < \beta < 1$$

Migration flows are assumed to be small enough such that the wages are not impacted by the migration. In addition, the relative return on education is higher abroad than in the source economy. Formally, this return on education abroad is denoted by $w > 1$. Thus, the productivity of a migrant in the second period is:

$$h_2^i = 1 + wa^i e^{i\beta} \text{ where } 0 < \beta < 1$$

In the first period, agents are free to move in order to acquire education. This assumption is relatively consistent with the empirical fact that student visa are relatively easy to obtain. In the second period of their life they are subject to migration constraints. Being educated is a prerequisite to emigrate. In addition, due to legal constraint, both educated agent face uncertainty. Agents who acquired education abroad have a probability λp to transform their student visa into a work visa. Agents who stayed in the source economy are less likely to be allowed to migrate. Formally, the probability of these agents to be allowed to migrate is

γp where $\gamma < \lambda$.

The agents maximize their expected income over their entire life. r is used as the discount rate. Lets define the expected income for each of three educational choices. The expected income of the migrant student nomalized with respect to the first period is :

$$\frac{\lambda p[1 + wa^i e_f^\beta]}{1 + r} + \frac{(1 - \lambda p)[1 + a^i e_f^\beta]}{1 + r} - P_f \tag{1}$$

The expected income of the prospective migrant acquiring education in the source economy is:

$$\frac{\gamma p[1 + wa^i e_h^\beta]h_t}{1 + r} + \frac{(1 - \gamma p)[1 + a^i e_h^\beta]h_t}{1 + r} - P_h \tag{2}$$

The income of the uneducated agent is:

$$1 + \frac{1}{1 + r} \tag{3}$$

Thus, if $1 > 2$ and $1 > 3$ the agent migrate as a student and tries to stay in the country after he has completed his education. If $2 > 1$ and $2 > 3$ then the agent acquires education in the source economy, in the prospect of migration for period 2. Finally, if $3 > 1$ and $3 > 2$ the agent chooses to remain uneducated. From the three relations above, the cutoff level of ability between any two choices of education can be determine. For each level of ability $a^i \geq a^\star(e_k, e_l)$, the agent will choose education choice k rather than l. It can be shown that for $(k, l) \in f, h, 0$:

$$a^\star(e_k, e_l) = \frac{(1 + r)(P_k - P_l)}{\phi[p(e_k), p(e_l), w, e_k, e_l]} \tag{4}$$

where:

$$\phi[p(e_k), p(e_l), w, e_k, e_l] = (p(e_k)(w - 1) + 1)e_k^\beta - (p(e_l)(w - 1) + 1)e_l^\beta$$

and $p(e_k)$ is the probability of migration for educational choice k in period 2.

Lemma 1: The condition to have both education at home and abroad is $\frac{\lambda p(w-1)+1}{\gamma p(w-1)+1} \leq \frac{P_f}{P_h}\left(\frac{e_h}{e_f}\right)^\beta$. Otherwise student do not acquire education at home.

Proof: Assuming that education preferences are transitive allows to define two condition to have an equilibrium

$$a^\star(e_f, e_h) \geq a^\star(e_f, e_0) \geq a^\star(e_h, e_0) \tag{5}$$

$$a^\star(e_f, e_h) \leq a^\star(e_f, e_0) \leq a^\star(e_h, e_0) \tag{6}$$

5 is the case of mixed migration choices, while 6 is the case where the choice is in reality between getting education abroad and no education. All other cases violates transitivity assumption at some point. Proof of this fact needs to consider the six possible orderings of $a^\star(e_f, e_h)$, $a^\star(e_f, e_0)$ and $a(e_h, e_0)$. From, there is is possible to deduce a set of assumptions. To satisfy 5, a key condition condition is $\frac{a^\star(e_h, e_0)}{a^\star(e_f, e_h)} \leq 1$. Which

rewrites as:

$$\frac{P_h}{P_f - P_h} \left[\frac{(\lambda p(w-1)+1)e_f^\beta}{(\gamma p(w-1)+1)e_h^\beta} - 1 \right] \leq 1$$

$$\frac{(\lambda p(w-1)+1)e_f^\beta}{(\gamma p(w-1)+1)e_h^\beta} \leq \frac{P_f}{P_h}$$

$$\frac{\lambda p(w-1)+1}{\gamma p(w-1)+1} \leq \frac{P_f}{P_h} \left(\frac{e_h}{e_f} \right)^\beta \tag{7}$$

Similarly, $\frac{a^\star(e_h, e_0)}{a^\star(e_f, e_0)} \leq 1$ rewrites as:

$$\frac{\lambda p(w-1)+1}{\gamma p(w-1)+1} \leq \frac{P_f}{P_h} \left(\frac{e_h}{e_f} \right)^\beta \tag{8}$$

and finally, $\frac{a^\star(e_f, e_0)}{a^\star(e_f, e_h)} \leq 1$ rewrites as:

$$\frac{\gamma p(w-1)+1}{\lambda p(w-1)+1} \geq \frac{P_h}{P_f} \left(\frac{e_f}{e_h} \right)^\beta \tag{9}$$

Conditions 5 and 6 combined with relations 7, 8 and 9 yield the result. $\square$

Lemma 1 provides a good insight on the forces at play and especially on the effect of legislation. *Ceteris paribus*, an increase in the discrimination between the two types of students (an increase of λ, a decrease of γ) might decrease the incentive to study in the source country. Similarly an increase in p or an increase in w would have a negative impact on the level of education at home if the increase is too important.

Beine et al. (2001) examine the growth effect of their model and determine conditions for a beneficial brain drain. The purpose is different here as there is no accumulation of human capital and no OLG dimension in the model. One want to examine the effect of the immigration legislation on the flows of students. The setup allows us to examine the effect of three different policies. First, a change in λ is a change in the policy aiming to better integrate (or not) foreign student in the foreign labor market. Then, a change in γ is a policy targeting to attract (or to discourage) foreign workers who have studied in their origin country. Finally, a change in p is a policy aiming to change the level of immigrants in the foreign economy, irrespective of their study track. In the following, the changes are small enough, such that the conditions of Lemma 1 are still respected.

In the framework of condition, 5 (education in both countries), the student whose ability is between $a^\star(e_f, e_h)$ and $\bar{a}$ are migrating. Equation 4 allows to examine the effect of the legislation in that context. Obviously, the derivative of $a^\star(e_f, e_h)$ with respect to λ is negative, while the derivative with respect to γ is positive. This identifies a key dilemma for the receiving country (here the rest of the world). Starting from a situation when there is no differences in terms of migration opportunities between a migrant who has decided to study in the country and a migrant who has not, deciding to favor the student who have studied abroad, will result in an increase of the number of foreign students in the country. The derivative of $a^\star(e_f, e_h)$ with respect to p is negative. This result corresponds to the intuition that a more permissive migration legislation would result in a bigger number of foreign students as $a^\star(e_f, e_h)$ decreases.

Equation 4 and lemma 1 gives also a good outlook of the fact that tuition fees have an impact on migration flows. An increase in the gap between education prices would result in a decrease of student migration, unless

the quality of the education provided abroad, measured by e_f also increases with tuition fees. In any case, augmenting the tuition fees from the point of view of the receiving country is a way to make sure to select the "best and the brightest". Interestingly, the gap between quality of the education and price of education have an effect on opposite directions. This, indeed suggest that an increase in prices has to result in an increase in quality in order to maintain the attractiveness of the foreign countries.

4.3   Limitations

A strong assumption of the model, regarding recent migration event is that immigrants do not have impact on the receiving country. In the model migrant do not endogenize their impact on the foreign labor market. This suppose that the sending country is relatively small compared to the receiving country. This corresponds to the reality of the migrant who probably does not anticipate the impact he might have on a foreign labor market. However, this limits the full comparability with our empirical part, where we have a small receiving country country (Germany) compared to a large sending country (the rest in the world in some cases). Nevertheless, we believe that the conclusion of the model would remain unchanged including this specification.

A multi-receiving country model, would fit better the reality of international students arbitrating between different receiving countries. However, the small country assumption and the fact that the migrant would have an impact on the different labor market, would be delicate to integrate. Also, having reasonable assumption on the migration probabilities would be difficult. Nevertheless, I would intend to have a sorting of student in the choice of the study locations. The most able would go to the place where education requires the most effort, the second most able would go to the place where education requires a bit less effort, and so on until the less able do not acquire education and stay in the source country.

5 Data

5.1 On Migration Flows

International migration is a phenomenon, hard to grasp in official statistics. Moving from one country to another implies a change of statistical system. The flow from country A to B is then impossible to measure with precision. Often, the country's statistical system is not efficient enough to measure people who are leaving. For instance, in France the registration on consular register is not mandatory and around a quarter to a third of French living abroad is not registered. On the contrary, statistical system performs relatively well to account for the migrant arriving or present in a country. The stocks of migrants are indeed generally rather simpler to measure, as traditional statistical instruments such as censuses or population register tend to have information on the origin of people.

While using the census files to study migrations, some assumptions had to be made. Two definitions can be retained: the place of birth or the country of citizenship. Typically, with the former a person born abroad from national parents would count as a migrant, while with the latter a person born in the country from foreign parents would not count as a migrant. From there, it is possible to proxy the flows of migrants by aggregating the censuses from different countries. Brücker et al. (2013) have gathered data from censuses of 20 OECD countries. Using the place of birth to define a migrant, they compute the immigrant stocks in all the considered countries. They also provide information on the level of education in three modalities (low, medium, high), but a limitation is that the place where this education was obtained is not available. Nonetheless, this data set could be useful for some falsification test.

Measuring international mobility of the graduates is relatively easier. Foreign students often need to apply for a visa and are asked to supply their nationality when they register at a university. This data are then gathered and distributed by different international institutions such as the UNESCO or the OECD. Two definitions of an international student coexist. Some countries, such as France, only use criteria of nationality to define an international student. Here, a Moroccan student born in France and studying in a French University would thus be considered as an international student even though he does not have an international experience *per se*. However, most countries also take into account the criteria of residence in defining an international student. The UNESCO and OECD data therefore does not allow for a perfect cross country comparison, and it is also often hard to know which definition of foreigners is retained.

The German Federal Statistical Office (DESTATIS) provides data that allows to estimate the flows of migration towards Germany. First, information on students allows to distinguish between German and foreign students. The criteria which is retained to define a foreigner is a criteria of nationality, which is a limitation considering the immigration wave of *Gastarbeiter* in the 1960s and the 1970s[22]. Data are then provided on the all the students or only on first year students which is an important information when trying to assess the effects of a legislative change on this population. There is indeed a path dependence in the choice of the location of student. Once the study have begun, it might be not optimal to stop in the middle of curriculum only because the fees have raised. All the investment made previously in terms of effort and opportunity cost would be lost. Finally, disaggregation by *Länder* is also provided which enable to evaluate the effect of the legislative changes in tuition fees.

However, the foreign student category has no subcategories, which poses issues regarding the identification of the impact of tuition fees on enrollments of foreign workers. Indeed, as presented in section 2, a modest

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[22]In the 1950s Germany experience a period of fast growth. The government developed a formal program to recruit workers from foreign countries known as Gastarbeiterprogramm. The main country of origin of the Gastarbeiter was Turkey.

raise in tuition fees is likely to have more effect on the enrollments of African students than on the North-American citizens regarding educational behavior. Luckily, DESTATIS provides data on visa by region of origin[23] and by *Länder*. These data are not perfect as foreign students from countries outside the Shengen space must apply for a visa even if they are exchange students and thus not concerned by the fee policy. Another limitation is the time scope. the data are available from 2006 onward, which is not ideal since the two first Länder two introduce fees already introduced them in 2006, Lower-Saxony and North Rhine-Westphalia. These two states have thus been removed from the disagreggation of the analysis by Region of origin.

5.2 Controls

A first driver of the attractiveness of a *Länder* to capture is income. Even if most students can finance their education through loans some entry cost are at play and might penalize the students from developing countries. Moreover, the GDP per capita also capture the opportunity cost of going to study in Germany in terms of living costs. The data on GDP per capita by *Länder* are gathered from the OECD website. They are expressed in constant 2010 prices over the period 1998-2013. As with all the following control variable, the GDP per capita value for year x is matched with the observation corresponding to Winter Term $x/x+1$.

Figure 6: Share of GDP spend in R&D, by *Land*, 1997-2013.
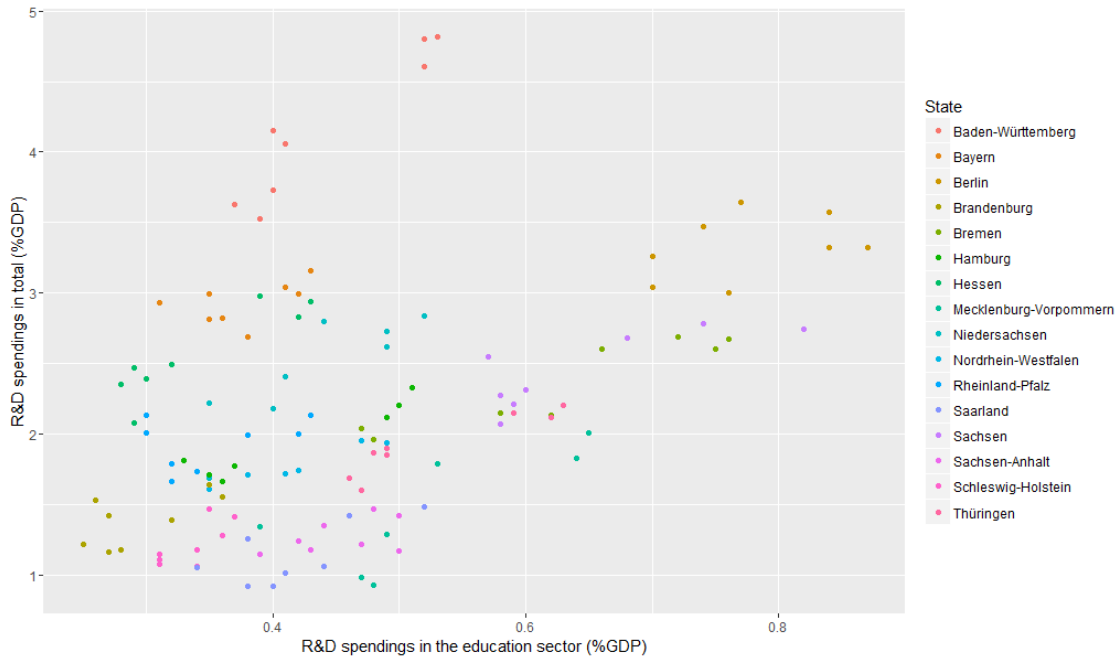
Note: Each dot represent one observation for one year for one Land.
Source: OECD

Länder with higher spendings in Research and Development (R&D) are also more likely to attract students, as this is a sector employing graduates heavily. In addition, they are also a proxy for the importance of education in a given *Land* . Data from the OECD are available on the share of GDP spend in R&D by activity by *Land*. Unfortunately, there are missing years[24] in the data. To get data for every year, a weighted

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[23]These are the data used in section 2.1

[24]1998,2000,2001,2002,2004,2006,2008,2010,2012

average of the previous and future available is performed[25]. In addition to control for missing data we also add the data for R&D spendings by the heigher education sector, for which there are much less missing data[26]. As shown in figure 6, the R&D spendings by the higher education spending account poorly for the differences in the total R&D spendings. For instance, the same level of 0.4% of GDP spends by the heigher education sector in R&D can correspond to less than 1% (Saarland) to more than 4% (Baden-Württemberg) overall spendings in R&D. Indeed the OLS regression[27] of the total spendings on the spendings by the heigher education sector only yield an R^2 of 0.16, while adding an interaction for the state yield an R^2 of 0.96. This result would prevent to use spendings by the higher education sector as a proxy for the overall R&D spendings but validate the approach to consider that previous and future observations in a state are a good proxy for the present value.

Population data by *Länder* are gathered from the OECD. The log of the total population will be used. We also compute the percentage of 15-24 by *Länder* using the same data source. In addition, we compute the share of foreigners, in order to control for the number of the foreign students who are present in the *Land* prior to the beginning of the studies. Data on foreigners are provided by Destatis.

The quality of the university in Germany will be capture using QS university ranking for German universities. The QS university is constructed as follows. 40% of the final score comes from the academic excellence of the university. This score is based on a survey among thousands of scholar in which they are asked to give universities which are the best in their field of expertise. Then, an employer survey ranks universities by their propensity to produce the best graduates (10% of final score). Then the student per faculty ration accounts for 20% of the final score. The citations per faculty is another measure of academic excellence (20%). Finally, international openness is taken into account and international faculty and international student ratios are weighted 5% each (QS, 2015). The universities are then localized at the *Länder* level in order to construct an index of the quality of universities. Many such rankings exists and a pooling of several ranking or another ranking might as well provide information of the quality of HEI in Germany. Rankings seems to be an appropriate measure of HEI quality in the context of this master thesis, since obtaining a diploma from a sufficiently well ranked HEI, might facilitate immigration in some countries. These rankings are also used in some countries such as Russia to determine the process of the recognition of the qualifications obtained abroad (Rauhvargers, 2011). The choice of QS rest on several criteria. First, it is one of the rankings with the Times of Higher Education (THE) and the Shanghai ranking [28], which is the most widely known. Compared to the Shanghai ranking, the QS ranking is more perception based and include insights from the academic and the professional world. Between 2004 and 2009, QS and THE worked together and published a common ranking. In 2010 and in the following years each of them published its own ranking. The QS ranking methodology is the closest to the former methodology and thus for stability reasons it has been chosen.

Finally, due to data availability we collect the 200 first universities in the overall ranking[29]. 2004-2009 rankings are gathered from the corresponding Wikipedia webpage. The 2012-2016 rankings can be retrieved from QS website in Excel format. Finally, the 2010 and 2011 rankings have been gathered from a PDF document. The indicator for the quality of universities in a given *Land*, is simply the number of universities located in the *Land* in the top 200. Note that between 2004 and 2014 only 9 out of 16*Länder* have university

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[25]Suppose that the data for $t = X$ and $t = X + 3$ are available, while data for years $t = X + 1$ and $t = X + 2$ are not available. Then, $RD_{x+1} = \frac{2}{3}RD_x + \frac{1}{3}RD_{x+3}$ (formally, a barycenter is computed).

[26]2001 and 2002

[27]One observation is one year, one state

[28]Also known as SRC ARWU

[29]In the beginning, only the 200 first universities in the ranking were published. Now about a thousand are present in the ranking.

in the top 200 at least one year.

The descriptive statistics presented in table 2 illustrates a limit of the empirical part. The treatment and control group seems to be quite different along several dimensions. Indeed, the mean GDP per capita is much different in the mean between control and treated group. Treated states are states in which more is spent in R&D even though levels of R&D spent by the education sector is relatively similar between the *Länder*. Fee payings states tend to have a larger population, the percentage of 15-24 years old being similar, while there are more foreigners in the treated states. Finally, the best ranked universities tend to be more in the treated states than in the non-treated states, even though Berlin, which is not treated had three universities[30] is the top 200 of the 2005 QS-THE world university ranking.

Table 2: Descriptive Statistics (year 2005 - before any treatment)

Variable	Treat.	n	Min	q_1	$\widetilde{x}$	$\bar{x}$	q_3	Max	s	IQR
# Foreign Students	0	9	2 138	3 859	5 388	7 375	9 518	20 422	5 782	5 659
	1	7	3 317	13 061	23 980	25 998	32 657	63 252	19 954	19 596
	all	16	2 138	4 327	9 306	15 522	21 311	63 252	16 375	16 985
GDP per capita	0	9	24 309	24 755	26 622	30 425	32 742	50 160	8 325	7 987
	1	7	32 517	36 414	41 576	43 100	44 127	66 528	11 283	7 712
	all	16	24 309	26 290	33 327	35 970	41 695	66 528	11 404	15 405
Spendings in R&D (Total - % GDP)	0	9	1.150	1.180	1.660	1.814	2.130	3.470	0.753	0.950
	1	7	1.010	1.745	2.180	2.294	2.660	4.060	0.983	0.915
	all	16	1.010	1.360	1.810	2.024	2.330	4.060	0.866	0.970
Spendings in R&D (Educ. Sector - % GDP)	0	9	0.270	0.320	0.490	0.476	0.600	0.740	0.159	0.280
	1	7	0.300	0.340	0.400	0.373	0.410	0.410	0.049	0.070
	all	16	0.270	0.318	0.410	0.431	0.492	0.740	0.131	0.175
Population (in million)	0	9	0.660	2.360	2.570	2.709	3.390	4.300	1.129	1.030
	1	7	1.060	3.915	8.000	8.304	11.580	18.080	6.044	7.665
	all	16	0.660	2.203	3.110	5.157	6.575	18.080	4.849	4.372
Share aged 15-24	0	9	0.107	0.115	0.130	0.126	0.136	0.145	0.013	0.021
	1	7	0.109	0.111	0.113	0.113	0.114	0.118	0.003	0.003
	all	16	0.107	0.112	0.115	0.120	0.131	0.145	0.012	0.018
Share foreigners	0	9	0.014	0.019	0.020	0.051	0.072	0.124	0.045	0.053
	1	7	0.058	0.080	0.100	0.097	0.116	0.131	0.026	0.037
	all	16	0.014	0.020	0.073	0.071	0.113	0.131	0.044	0.094
# Univ. in world top 200	0	9	0	0	0	0.333	0	3	1	0
	1	7	0	0.500	1	0.857	1	2	0.690	0.500
	all	16	0	0	0	0.562	1	3	0.892	1

Note: For the column "Treat" a 0 denotes the states that did not implemented tuition fees while a 1 denote the states that did.

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[30]Berlin University (112th), Berlin Technical University (154th) and Berlin Free University (172th)

6 Empirical Estimation

The empirical estimation has been structured as follows. We first try to assess the effect of tuition fees alone, while in a second subsection we propose a more general estimation strategy allowing to estimate the effect of tuition fees and the effect of the legislation on foreign qualifications. We then explore the disaggregation by region of origin. We then tried to solve sample selection issue by running a synthetic control method. Finally, we explore some channels to explain the results and run a falsification test.

6.1 The Treatments Impact on Foreign Students

We are interested effect of the introduction of tuition fees in several *Länder* from 2007 onwards and its comparative intensity on German and foreign Students. The tuition fees were all abolished between 2008 to 2012. We would like to apply a Difference-in-Difference setup to this natural experiment. Several issues are faced in this natural experiment. First, the treatment does not occurs in the same time in all regions. Then, as shown in the previous section the control group has a limited comparability with the treatment group. Finally, the contamination of the control group is also an issue (Germans and foreign students who choose to relocate because of the fees). We will first propose a first set of regression, ignoring these pitfalls, but allowing to have a glance of the effect of the policy. Several solutions to the issue will be then proposed. Note also that exchange students do not have to pay fees. We assume this effect to be negligible.

The first estimated model is the following

$$Y_{it} = \alpha + \delta_1 Fees_{it} + \lambda t + \gamma_i + \beta X_{it} + \epsilon_{it} \tag{10}$$

Y_{it} denotes the log of the number of students in the *Land* i at time t. $Fees_{it}$ is a dummy that takes value 1 if students in i at time t had to pay fees to attend the university. We allow for a trend (λt) as there is 15 time periods to estimate it. State fixed effects, γ_i are also in the model. Finally X_{it} denotes the control variables presented in the data section and ϵ_{it} is the error. The quantity of interest is thus δ_1 which is the effect of the tuition fees on overall enrollments. The use of the specification is justified by the fact that the tuition fees ranged between 300 and 500€ per term in the different states which is the same order of magnitude (Hübner, 2012; Orr et al., 2014). Thus controlling for the level of tuition fees is not necessary.

The regression is performed separately for Germans and foreign students (regression (1) and (2)). A within estimator is used in order to average out the state fixed effect. Standard errors are then clustered by state following Arellano (1987) in order to control for serial auto-correlation. A second set of regression (regression (3) and (4)) is made adding the control for the quality of the universities. These regression posed several methodological issues. Due to the shorter time period (2004-2014), the time trend cannot be efficiently estimated[31] as in 10 , as there are only three time periods before the implementation of the policy. The time trend is thus replaced by time fixed effects. Standard errors are again clustered by state.

Results of these first four regressions are presented in table 3. As expected, tuition have a negative effect on enrollment, even though this effect is statistically significant only at 10% confidence level in the regressions with a shorter time period. The regression (1) and (2) seem to suggest that the introduction of tuition fees tend to have a greater impact on the foreign students that the German student. This tend to support the hypothesis of a wider education market for the foreign students, while the German students are less impacted by the tuition fees because they have less higher education opportunity than internationally mobile students.

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[31] The variance covariance matrix is computationnally singular..

Table 3: Eect of Tuition Fees: Regression Output

	Dependent variable:			
	Number of Students (logarithm)			
	Foreigner	Germans	Foreigners	Germans
	(1)	(2)	(3)	(4)
Tuition Fees	−0.152***	−0.097***	−0.041*	−0.047**
	(0.037)	(0.031)	(0.024)	(0.019)
Trend	0.037***	0.024***		
	(0.009)	(0.004)		
Univ. in top 200			0.015	0.014
			(0.009)	(0.010)
GDP (log - p. cap.)	0.632	0.004	−0.712	−0.389
	(0.533)	(0.215)	(0.468)	(0.331)
Spendings in R&D (Total)	−0.062	0.169**	−0.076	0.185***
	(0.081)	(0.072)	(0.075)	(0.058)
Spendings in R&D (by educ. sector)	−0.173	−0.366**	−0.125	−0.313
	(0.505)	(0.143)	(0.298)	(0.192)
Population (log)	−3.738***	−0.054	−0.701	−0.407
	(1.088)	(0.451)	(0.723)	(0.957)
Population 15-24 (%)	3.061	0.855	−4.362***	2.475*
	(2.621)	(1.275)	(1.248)	(1.415)
Foreigners (%)	−0.631	1.393	12.068***	9.842***
	(0.888)	(0.893)	(2.991)	(3.543)
Year Fixed Effects	No	No	Yes	Yes
Observations	256	256	160	160
R^2	0.777	0.744	0.687	0.839
Adjusted R^2	0.704	0.674	0.546	0.666
F Statistic	100.942***	84.346***	16.425***	38.936***
	(df = 8; 232)	(df = 8; 232)	(df = 17; 127)	(df = 17; 127)

*p<0.1; **p<0.05; ***p<0.01

As expected, the trend for the two first regressions is statistically significant and positive. The fact that the trend is more important for the foreign students (+3.8% a year on average) compared to German students (2.4% a year) is consistent with the observation that Germany has a constantly aging population and a low natality, while many developing countries have a young population who is more and more studying abroad.

On the control side, total R&D spending have a positive impact on the number of students enrolled but only on Germans students. More surprisingly, the R&D spending by the education sector tend to decrease the enrollments which might be interpreted as a consequence of an arbitrage from the universities point of view between research and teaching.

This regressions have however three limits. First, the relocation of students is not measured and not measurable. Technically, there is indeed a contamination of the control group. Hübner (2012) proposes to correct the error due to the relocation of German students thanks to a calibrated structural model. However, the basic assumption underlying his model are not sustained in the context of the present study. Indeed, as the focus is on international migration, it is hard to assume that the treatment group would only contaminate the control group. While choosing where to study, international students tend to arbitrate between countries. Thus, the implementation of tuition fees might encourage foreign students to study in the Länder without tuition fees or towards other countries. Thus the level of the contamination of the control group is thus hard to evaluate with precision.

Another, confounding factor is the presence of non-fee paying students. The students receiving a scholarship usually do not pay fees to attend universities. Also, we have no data on this the phenomenon must be marginal compared to the overall student population. Another group of non-fee paying students is the exchange student group. Exchange students do not pay fees as they study within the framework of an university agreement. DESTATIS website is not clear on whether these students are accounted for in the data. In any case, such students are not impacted by the change of tuition fees, unless they plan to study in Germany afterwards.

Finally, the comparability of the control group is limited as the table 2 suggest. Moreover there might be a selection bias in the state which introduced fees as the political coalitions which took the decisions were all led by the center-right party *Christlich Demokratische Union Deutschlands* (CDU). As the social composition of the Land might influence both the number of students and the political composition of the ruling coalition. However, as Germany has a federal system, the Länder are relatively independent from each other in terms of higher education policy, which might temper the selection issue.

6.2 Estimating the Impact of the Legislation on the Recognition of Qualifications Obtained Abroad

We then attempt to estimate the impact of the legislation on the recoginition of the qualification obtained abroad on the educational choices made abroad. The model suggests that facilitating the recognition of the qualification obtained abroad should decrease the number of foreign students as they have a better access to the labour market with their foreign diploma. At the same time for in Germany the tuition fees policy also ended in some Länder in 2012 just before the law on the recognition of professional qualification enter in action. Finally, as the law on the recognition of qualifications obtained abroad is a federal law, the Länder cannot be a good counter factual for this. Thus, we use Germans students as a counterfactual for the foreign students. Formally, the estimated model is the following:

$$Y_{itn} = \alpha_n + \delta_{1n}Fees_{it} + \delta_2 Qualif_t * 1\{n = Foreigners\} + \lambda_n t + \gamma_{in} + \beta_n X_{it} + \epsilon_{itn} \qquad (11)$$

Here, we denote by subscript n the nationality of the considered quantity. This index can take two values either Germans or Foreigners. The parameter of interest is δ_2 which measures the effect of the recognition of

qualification legislation. We allow for a nationality specific time trend in the regression (5) (which corresponds to equation 11) but only for general time fixed effect[32] in regression (6). We believe the setup allow to control for the difference in the evolution of the number of Germans and foreign students. The treatment begins in 2012 as the enrollment data are for the Winter Semester and the law passed in April 2012. Finally standard errors are clustered by couple nationality-state to control for autocorrelation. Differentiated means are averaged out thanks to a within estimator. Regression results are presented in table 4.

Table 4: Tuition Fees and Legislation on Qualification Obtained Abroad

	Dependent variable:	
	Number of students (logarithm)	
	1998-2014	2004-2014 (w. Univ. quality)
	(5)	(6)
Tuition fees (Foreigners)	−0.177*** (0.037)	−0.043* (0.022)
Tuition fees (Germans	−0.097*** (0.031)	−0.044** (0.018)
Qualification legislation	−0.101*** (0.036)	0.012 (0.020)
Trend (Foreigners)	0.043*** (0.008)	
Trend (Germans)	0.024*** (0.004)	
Univ. in top 200 (Foreigners)		0.013 (0.009)
Univ. in top 200 (Germans)		0.015 (0.011)
Time Fixed Effect	No	Yes
Controls	Yes	Yes
Observations	512	320
R^2	0.777	0.761
Adjusted R^2	0.702	0.623
F Statistic	94.663*** (df = 17; 463)	32.024*** (df = 26; 262)

*p<0.1; **p<0.05; ***p<0.01

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[32]Specification with nationality specific time fixed effect cannot be estimated consistently

The Germans are used as a control group as it seems to satisfy the exclusivity condition. Our model is not equipped to deal with such questions, as the legislation of the home cpountry is not a parameter of interest. We believe that, the German students are much less impacted by the law on the recognition of the qualifications obtained abroad as only a fraction of them actually study abroad. However, the common trend assumption cannot be assumed here as table 3 suggests that the trend is 50% greater for foreign students than German students. We thus allowed for a differentiated trend in the set up when there were enough observations to estimate it. Note that the estimates are substantially close to the one estimated in regression (1) and (2).

Results for tuition fees are consistent with the findings of regressions 1-4. All coefficients for the tuition fees are negative and statitically significative. In regression (5), the fact that the effect of tuition fees is more important for foreigners in found back, while in regression (6) the effect is of the same order of magnitude for both categories of students. For both regressions the effects are coherent with what was found in regressions 1-4. The effect of the legislation yield a negative, statistically significant, estimate in regression (5), which goes in the sense of our theory while the point estimate in regression (6) is positive but not statistically different from zero. This result for regression (6) is probably due to the time fixed effect not specific to the nationality variable. This results seems to confirm that the legislation on the recognition of the qualifications obtained abroad has had a negative impact on the enrollment of foreign students. However, the size of the effect is rather uncertain and the figure of a decrease by 10% in the number of foreign students might seems a bit high.

The limit of this approach is mainly that the effect of the qualification legislation is estimated over two periods only (2012-2013), which make the measure relatively noisy. The precautions that applied for regressions 1-4 also apply here as the specification is a generalization of equation 10.

6.3   Region of Origin and Impact of Tuition Fees

The tuition fees are likely to have a differentiated impact on students depending on their origin. Indeed, 500€ represent more for an African student than for a student from the U.S.A. whose education would cost thousands of dollars. Thus, there the heterogeneity in the foreign student category is high as we do not measure the propensity to pay of each student. To address this end we disaggregate the analysis to the region of origin level to see whether some region drive the result. This part uses visas data. We selected the number of visas for "educational or training purpose" delivered in each *Länder* between 2006 and 2013. Summary statistics of the visas are provided in table 5. The main region of origin for training and education visas holders in Germany is Asia with a strong dominance of East and Central Asia. Unfortunately, DESTATIS does not provide any information on the composition of this region, but we believe this corresponds to the region of Kazakhstan. For all the region of origin, the number of visas seems to have increase throughout the considered period.

We then replicate the analysis made in section 6.1, but by we run the analysis for each region of origins. Standard errors are also clustered at the state level. The states of Lower-Saxony and North Rhine-Westphalia have been removed from the sample as there is no pre-treatment observations for them. Results are provided in table 6 (regressions 7 to 18). Coefficients are negative and significant for North Africa, South West Asia and East and Central Asia which are three of the main providers of foreign students visas. The magnitude seems to be more important for students from North Africa than students from West and Central Asia. This tend to support our hypothesis that African are more impacted by the level of tuition fees than other students. However, the coefficients are not statistically significant for other regions. For some of them, the

Table 5: Visas for Education and Training by Region of Origin of the Demander

	2006	2007	2008	2009	2010	2011	2012	2013	2014
North America	4 995	6 443	7 055	7 796	8 313	8 285	8 793	9 833	9 950
Cent. Am. & Carib.	2 501	2 981	3250	3 407	3 573	3 589	3 926	4 424	4 706
South America	7 289	8 695	9 400	9 998	10 186	10 054	11 080	12 758	14 606
North Africa	8 999	9 403	8 835	8 405	7 971	6 887	7 263	8 077	9 387
West Africa	2 195	2 294	2 307	2 217	2 185	1 997	2 093	2 382	2 575
Central Africa	5 255	5 807	5 429	5 338	5 203	4 553	4 748	5 109	5 668
Southern Africa	479	544	549	555	546	612	645	635	662
East Africa	1 319	1 516	1 540	1 635	1 800	1 789	2 035	2 172	2 252
South West Asia	11 179	12 530	12 916	13 636	14 403	13 882	15 213	15 981	17 260
E. & Central Asia	40 262	44 763	45 127	45 163	45 047	40 894	44 325	47 792	51 431
S. & SE. Asia	12 830	14 614	15 022	15 841	17 192	16 841	20 219	24 199	28 211
Australia & Oceania	619	782	822	914	952	995	1 080	1 150	1 264

Source: DESTATIS

low number of visas awarded makes the measure relatively noisy, while for others the effect is non significant.

This analysis tend to precise the conclusion that increasing tuition fees decrease the enrollments of foreign students. The student who are the most impacted seems to come from less develop regions of the world. This approach has however some limits. First, the European students are not accounted for as they do not need a visa to study in Germany. As they account for an important proportion of foreign student in Germany, they might drive the result in the previous sections. The second issue is that the visas measure is more noisy than the measure of foreign students as they encompass not only visas for students, but also visas for training purposes. Thus people needing a visas for short training missions are also accounted for in these numbers.

6.4   Synthetic Control Approach

An issue of the previous regressions is the limited comparability between the seven treated states and the nine states that were not treated. To address this issue we implemented a synhtetic control method approach. We use the 9 states as control group units to which weights are assigned. We implement the method with the GDP per capita, the R&D spendings (both overall and by the education sector), the number of 15-24 in the population, the number of foreigners and the overall population. We implement the method one treated state at the time. Due to the limited pool of controls (nine *Länder*), the method works more or less well depending on the picked treated states.

Figure 8 in annex represents the result of the synthetic control method for Hamburg. Hamburg was treated in the summer 2007. The weights are provided in table 7. Unsurprisingly, most of the wieght falls on the neighbouring state of Schleswig-Holstein, while Berlin and Bremen two city-*Länder* like Hamburg have also a positive weight. From the graphs it seems apparent that the tuition fees did cause a drop in the number of foreign students in Hamburg. The gaps plot provided in annex let appear a drop of about 1 300-1 400 at this date between the actual and the synthetic Hamburg. This corresponds to about 15% of the foreign students studying in Hamburg, which is in line with our estimates. The result for the German students is surprising. It seems that the number of student has increase after the introduction of the fees which stayed in place until 2012.

The regressions for the other treated states are not conclusive most of times since that for most of the

Table 6: Effect of Tuition Fees Legislation by Region of Origin

	Dependent variable:											
	Visas for education and training purposes (in log)											
	N. America	Central Am. & Carib.	S. America	N. Africa	W. Africa	Central Africa	Southern Africa	E. Africa	SW. Asia	East-Central Asia	S. & SE. Asia	Australia and Oceania
	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Tuition_Fees	−0.096 (0.094)	−0.001 (0.089)	−0.020 (0.042)	−0.135** (0.052)	0.001 (0.076)	−0.108 (0.074)	0.118 (0.161)	0.054 (0.124)	−0.125*** (0.037)	−0.086** (0.041)	−0.035 (0.033)	−0.105 (0.142)
GDP p. cap. (Land)	0.055 (0.972)	−1.087 (0.995)	−0.557 (0.888)	1.270 (1.171)	1.213 (1.403)	−0.455 (1.182)	2.766 (1.992)	1.804 (1.233)	−0.376 (0.712)	−1.513 (0.945)	−1.062 (0.672)	0.523 (3.037)
R&D (Total)	−0.536 (0.372)	−0.547 (0.397)	−0.439* (0.258)	−0.251 (0.320)	−0.335 (0.400)	−0.034 (0.225)	−0.144 (0.486)	−0.306 (0.311)	−0.629*** (0.186)	−0.711*** (0.263)	−0.597*** (0.188)	−0.904* (0.487)
R&D (Educ.)	0.191 (0.573)	−1.392* (0.776)	0.047 (0.642)	1.025* (0.522)	−0.213 (0.996)	−1.053 (0.740)	2.450* (1.300)	0.998 (1.130)	−0.221 (0.397)	0.040 (0.703)	−0.070 (0.392)	−1.168 (1.562)
Population (log)	10.927*** (1.835)	8.632*** (2.789)	8.488*** (2.244)	−0.136 (3.219)	5.293** (2.592)	−7.180** (3.501)	13.980*** (5.123)	0.500 (2.934)	3.497** (1.691)	5.195** (2.505)	3.733** (1.772)	14.758 (9.599)
Population (15-24 - %)	−5.107 (3.391)	−4.507 (3.297)	−13.780*** (3.711)	0.543 (4.612)	−14.731*** (4.537)	9.463* (5.654)	−14.563* (7.543)	3.039 (5.151)	−10.499*** (3.968)	−8.897** (3.897)	−5.545** (2.600)	−9.922 (7.546)
Foreigners (%)	6.536 (11.858)	10.065 (11.397)	7.326 (13.263)	12.884 (9.173)	6.921 (12.551)	20.412* (10.812)	−15.223 (15.884)	17.131* (8.712)	7.387 (9.066)	11.263 (12.295)	9.123 (8.039)	−11.716 (24.695)
Univ. in top 200	0.012 (0.031)	0.008 (0.046)	−0.028 (0.025)	0.022 (0.030)	−0.025 (0.027)	0.012 (0.027)	−0.011 (0.080)	0.006 (0.059)	0.015 (0.037)	0.014 (0.021)	0.008 (0.024)	−0.061 (0.072)
Observations	112	112	112	112	112	112	110	112	112	112	112	112
R^2	0.666	0.602	0.762	0.303	0.336	0.367	0.332	0.506	0.709	0.444	0.852	0.243
Adjusted R^2	0.493	0.446	0.564	0.225	0.249	0.272	0.245	0.375	0.525	0.329	0.631	0.180
F Statistic	11.017***	8.359***	17.668***	2.411***	2.795***	3.202***	2.690***	5.669***	13.452***	4.413***	31.812***	1.774*

df = 15; 83 for all regressions

*p<0.1; **p<0.05; ***p<0.01

Table 7: Weights for the synthetic control method for Hamburg

Control States	Weights for the Foreign Students	Weight for the German students
Berlin	0.257	0.25
Brandenburg	0.000	0.000
Bremen	0.150	0.019
Mecklenburg-Vorpommern	0.000	0.000
Rheinland-Pfalz	0.000	0.000
Sachsen	0.000	0.000
Sachsen-Anhalt	0.000	0.000
Schleswig-Holstein	0.594	0.73
Thüringen	0.000	0.000

controls, the pre-treatment behavior was not replicated. This is due to the small size of the pool of potential controls, which does not allow to build a decent synthetic *Land* each time. A summary, of these experiments is provided in annex. A solution to the issue would be to add more regions to the sample by getting data for Austria and Switzerland, since they are also German Speaking countries.

6.5 Channels

First-year Students The choice of the place of education implies a dependency path. Because credits are not perfectly transferable, students do not perfectly arbitrate between the different universities. Thus the tuition fees impact should be more visible on the students who choose to enter the university for the first time, or on students who start a master. DESTATIS provides data on the number of foreign students by academic year over the period 1998-2014. We use these data to replicate the regressions 1-6 which tried to asses the impact of the introduction of tuition fees. The result are provided in table 8, standard errors are clustered as before.

The impact of tuition fees is negative as before. It is statistically significant for foreign students and of the same order of magnitude as before. The effect is indeed much bigger if the period 1998-2013 is considered than with the period 2004-2013 and the introduction of university quality index. However, for German students, the point estimates are negative but not statistically significant. Together with the result of sections 6.1 and 6.2 seems to suggest that tuition fees had a negative impact on the enrollment of foreign students. This, impact, if it exists, is however less important for German students but remains negative. This seems to confirm the hypothesis that foreign student demand for higher education is more price sensitive than the education demand of local people.

On the impact of the legislation on the recognition of qualifications obtained abroad, this new set of regressions does not concur with the result of regression (5). The effect is either non statistically significant (regression 23) or positive and statistically significant (regression 24) which goes in the other directions as the previous estimation and the result of our model. Note that the set up is probably not perfect to reach a definitive conclusion.

Students Quality The model suggest that while increasing tuition fees the quality of the foreign students, their quality should increase. Exam achievement seems to be a good way to asses the quality of the foreign students. DESTATIS data provides data on the exam achievement of the students in Germany with a binary nationality (German/Foreigners) by Länder. These data concern only exams to get a diploma and does not include many intermediary exams. For instance in 2015, around 460 000 students have pass an exam

Table 8: Regressions of the Number of First-Year Students

	Dependent variable:					
	Number of first-year students (log)					
	Foreigner	Germans	Foreigners	Germans	Both	Both
	(19)	(20)	(21)	(22)	(23)	(24)
Tuition fees (Foreigners)	−0.153*** (0.049)		−0.027 (0.021)		−0.148*** (0.052)	−0.042** (0.021)
Tuition fees (Germans)		−0.014 (0.035)		−0.035 (0.027)	−0.014 (0.035)	−0.021 (0.028)
Qualification legislation					0.019 (0.031)	0.151*** (0.028)
Univ. Quality	No	No	Yes	Yes	No	Yes
Trend	Yes	Yes	No	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	256	256	160	160	512	320
Adj. R^2	0.680	0.725	0.654	0.692	0.694	0.686
F Statistic	86.927*** (df = 8; 232)	116.259*** (df = 8; 232)	35.113*** (df = 17; 127)	50.599*** (df = 17; 127)	90.059*** (df = 17; 463)	52.300*** (df = 26; 262)

*p<0.1; **p<0.05; ***p<0.01

in Germany. In the same year 2.6 million students were registered in the German universities. Thus, the success rate in the exam is very high (95%) and does not account for intermediary exams.

As figure 7 shows the data on examination do not tend to support the hypothesis of an increase in the quality of either the Germans or the foreign students. The evolution of the success rate seems to be uncorrelated with the introduction of tuition fees. This, is not highly surprising, since only the graduation exams are accounted for in this data. The issue is that the student do not have the obligation to pass exam. Thus, the students who choose not to go to the exam are probably those with the lowest chance of success which would bias the measure. In addition, some foreign students might simply use the student to get the visa but actually work while being in Germany.

6.6 Falsification Tests

We run some placebo test to check the robustness of our result. The first test consist in resampling the data to the years before 2006. Between 1998 and 2001, all the states remain untreated, while between 2002 and 2005, the *Länder* that recieve an actual treatment between 2006 and 2012, recieve a treatment. To be as close to the experiment, the states are first assigned a number of treatment periods between 1 and 4 and then

Figure 7: Exams Results by Nationality

(a) Germans
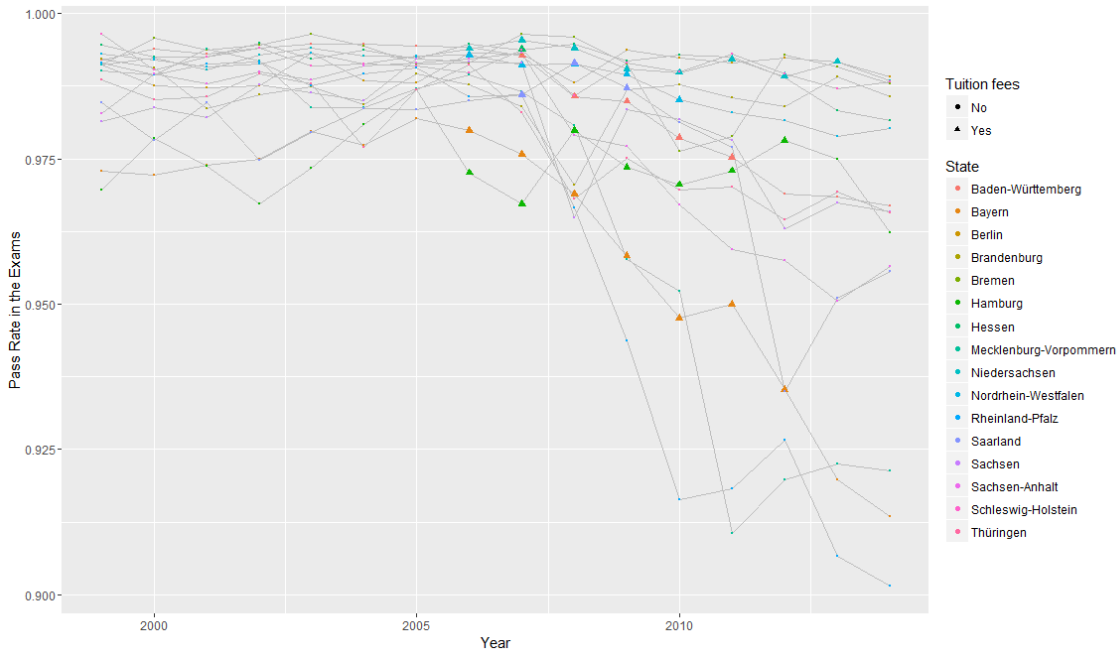
(b) Foreigners
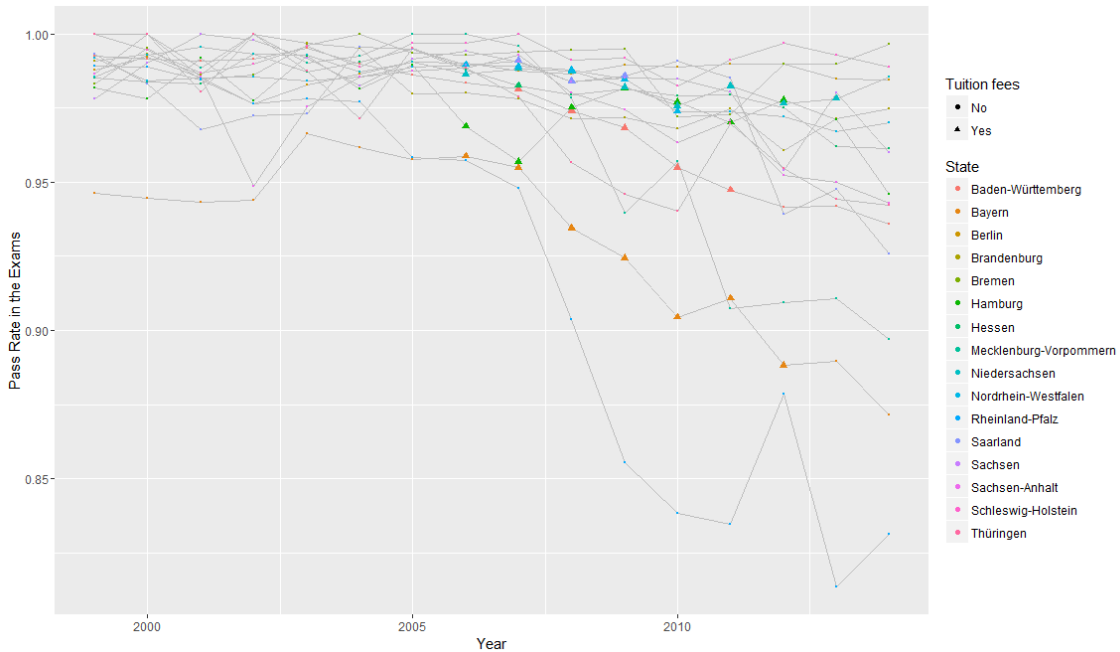
assigned at random a starting date compatible with the number of treatment period. For instance, a state having three periods of treatment, will have a starting date being randomly 2002 or 2003. The estimation seems to yield reasonable results as shown on table 9.

We then replicate the experiment 1 000 times and the results are less comforting. Around the 1000 replications of the placebo experiment, we rejected the null hypothesis at the 5% confidence level 129 times for the foreign students and 330 times for the Germans students. At the 1% confidence levels the results are

Table 9: Placebo regression

	Dependent variable:	
	Number of Students (log) 1998-2015	
	Foreigner	Germans
	(1)	(2)
Tuition Fees (placebo)	0.004	−0.033
	(0.040)	(0.032)
Year Fixed Effect	Yes	Yes
Controls	Yes	Yes
Univ. Quality	No	No
Observations	128	128
R^2	0.912	0.667
Adjusted R^2	0.698	0.511
F Statistic (df = 14; 98)	72.213***	14.031***

*p<0.1; **p<0.05; ***p<0.01

good for foreign student since the rejection rate was below 2%, but for german student this rate is of 13% which seems high. Finally, at the 10% confidence level about one experiment over two, for German students showed a significant effect of placebo tuition fees on the number of foreign students. Thus, the coefficients at the 10% level should be interpreted with caution.

7 Conclusion

From the empirical estimation, the introduction of tuition fees seems to have decrease the number of foreign and German students. the impact seems greater for the foreign students than for the German students, which tends to support the idea that the foreign students have a greater education market and are thus more price sensitive. The effect seems to be of the same order of magnitude on first-year students and on the overall student population. This tend to suggest that the introduction of tuition fees allowed to decrease the number of student who did not attend to any exam and who were registered at the university only to enjoy the privileges related to the student status. This seems to be confirmed by the data on exam achievement which are not impacted by the policy. The effect being greater for foreign students might also suggest that the policy might decrease the abuse of the student visas, such as migrant using the student status to be allowed to migrate, but choosing to work once in Germany. The analysis by country of origin gave little evidence that less developed countries might be more impacted by the policy. Finally, synthetic control method are rather inconclusive concerning the effect of the policy. Our results are in line with a literature suggesting that the introduction of small tuition fees tend to decrease consequently the attendance to the university due to the fact that some false students renounce to the student status because of its costs.

The evidence is more mixed concerning the implementation of the legislation facilitating the integration of workers whose qualifications have been obtained abroad. The first estimation suggested that the effect might be negative as predicted by our model, but the second set of regressions on first year students suggested otherwise. The econometric specification and the imperfect design of the natural experiment as well as the fact that German and Foreign students might not be comparable could explain the inconclusive results.

Annex:

Synthetic Control Method Full Results and Graphs

The synthetic control method has been ran for each of the seven treated *Länder*. The weights obtained for each state for both student category is provided in table 10. Most of the time all the weight was put on Berlin which does not help to have a good fit in the pre-treatment period. Figure 9 presents the type of output obtained that was not successful. In some extreme cases, the two curves were very distant from one another and never crossed each other. Finally, figure 10 presents the graph plot for the case of Hamburg, which shows that the implementation of tuition fees coincided with a drop by 15% in the number of Foreign students in Hamburg.

Table 10: Weights for each treated state

Control States	Hamburg		Baden- Württemberg		Bavaria	
	Foreign Students	German Students	Foreign Students	German Students	Foreign Students	German Students
Berlin	0.257	0.25	1.000	1.000	1.000	1.000
Brandenburg	0.000	0.000	0.000	0.000	0.000	0.000
Bremen	0.150	0.019	0.000	0.000	0.000	0.000
Mecklenburg-Vor.	0.000	0.000	0.000	0.000	0.000	0.000
Rheinland-Pfalz	0.000	0.000	0.000	0.000	0.000	0.000
Sachsen	0.000	0.000	0.000	0.000	0.000	0.000
Sachsen-Anhalt	0.000	0.000	0.000	0.000	0.000	0.000
Schleswig-Holstein	0.594	0.73	0.000	0.000	0.000	0.000
Thüringen	0.000	0.000	0.000	0.000	0.000	0.000

Control States	Hessen		Lower Saxony		Saarland	
	Foreign Students	German Students	Foreign Students	German Students	Foreign Students	German Students
Berlin	1.000	1.000	0.498	1.000	0.000	0.000
Brandenburg	0.000	0.000	0.000	0.000	0.000	0.000
Bremen	0.000	0.000	0.000	0.000	0.000	0.735
Mecklenburg-Vor.	0.000	0.000	0.000	0.000	0.183	0.264
Rheinland-Pfalz	0.000	0.000	0.502	0.000	0.000	0.000
Sachsen	0.000	0.000	0.000	0.000	0.000	0.000
Sachsen-Anhalt	0.000	0.000	0.000	0.000	0.000	0.000
Schleswig-Holstein	0.000	0.000	0.000	0.000	0.817	0.000
Thüringen	0.000	0.000	0.000	0.000	0.000	0.000

Control States	North Rhine-Westphalia	
	Foreign Students	German Students
Berlin	1.000	1.000
Brandenburg	0.000	0.000
Bremen	0.000	0.000
Mecklenburg-Vor.	0.000	0.000
Rheinland-Pfalz	0.000	0.000
Sachsen	0.000	0.000
Sachsen-Anhalt	0.000	0.000
Schleswig-Holstein	0.000	0.000
Thüringen	0.000	0.000

Figure 8: Hamburg Results for foreign students

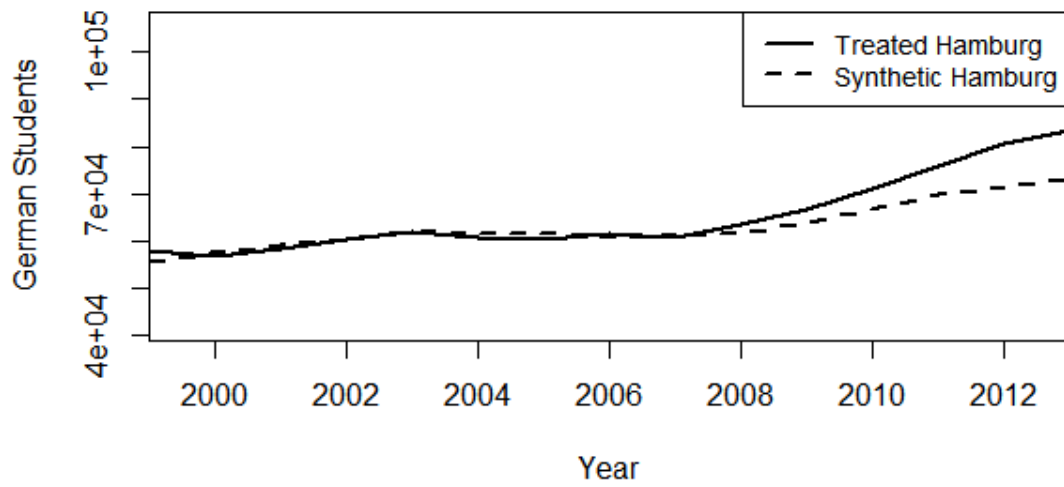(a) Foreign students
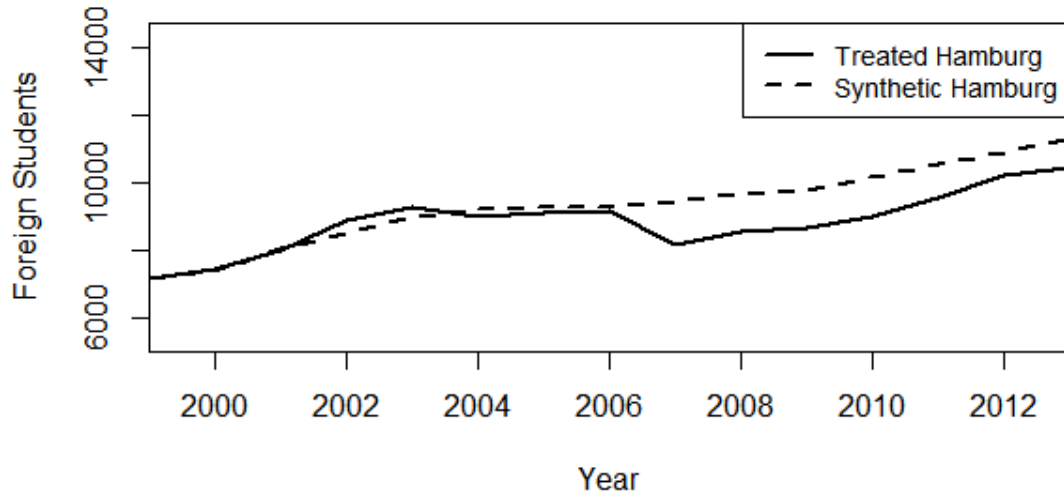
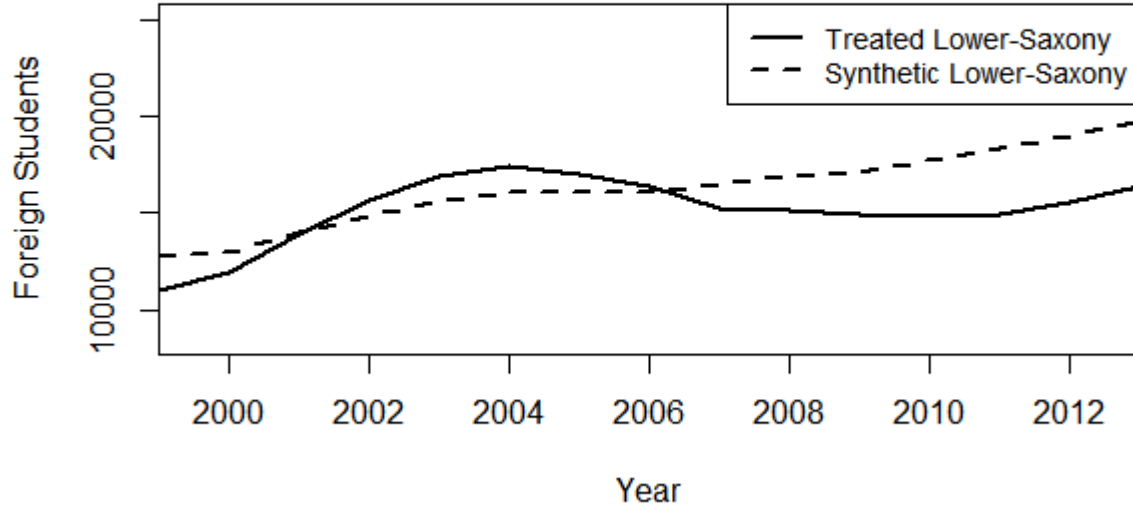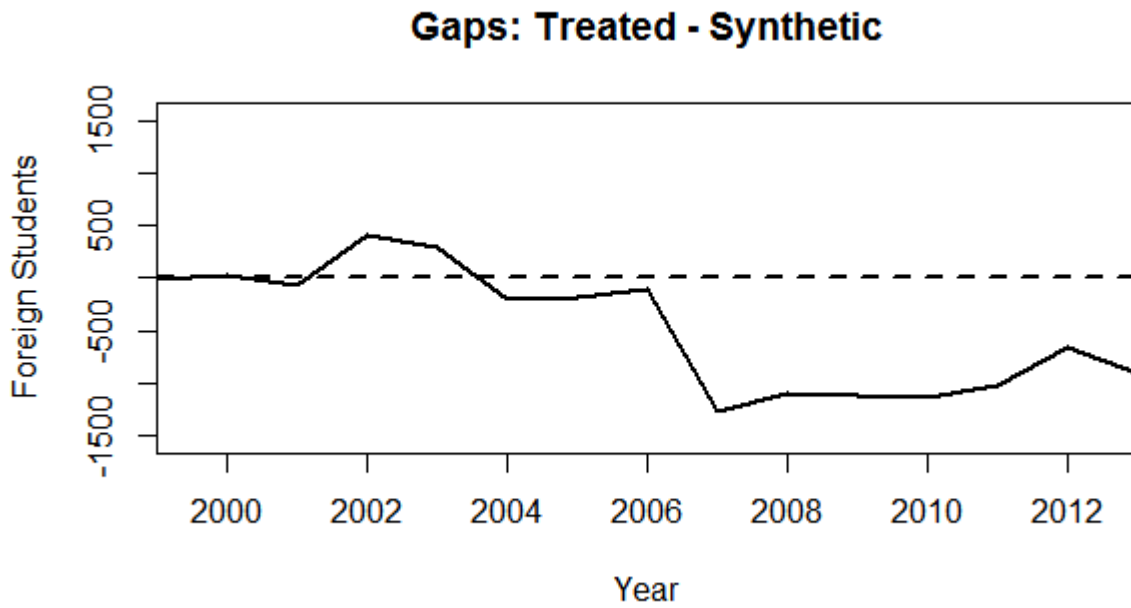(b) German students

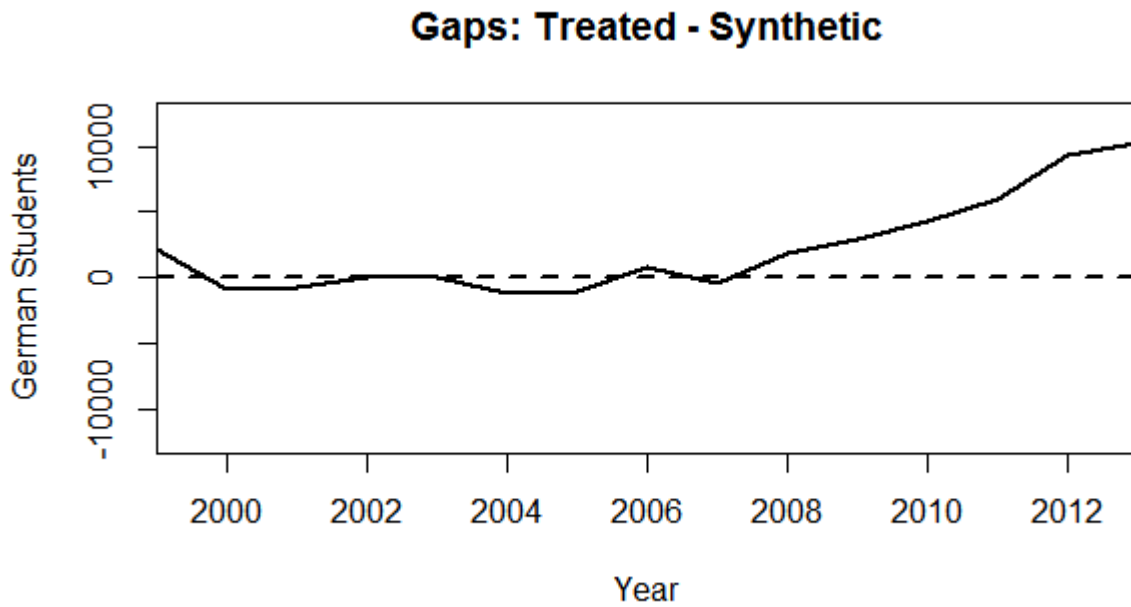Figure 9: Treated and Synthetic Lower-Saxony

Figure 10: Gaps Plot for Hamburg
(a) Foreign students

Gaps: Treated - Synthetic

(b) German students

Gaps: Treated - Synthetic

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