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**The Geographies of Segregation in
French Universities from 2006 to 2016**

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The Geographies of Segregation in French Universities from 2006 to 2016

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Abstract

Since the French university system is non-selective, the question of segregation has long remained unaddressed. However, the recent increase in enrolment, as well as the implementation of cluster-building policies, have brought the issue of university segregation and its geography to the forefront. This article proposes the first exhaustive geographical decomposition of segregation in French universities. Using a mutual information index, we identify the different local components and layers of social segregation and measure their contribution to the national level of segregation between 2006 and 2016. Our results show that in the French university system, segregation is quite low and tended to decrease over the period. However, we also show that only about 18% of the total segregation is due to macro-scale factors: i.e., social differences across regional areas: social segregation is mainly a local phenomenon that could be reduced with reforms of higher education enrolment policy, implemented at the regional level.

Keywords:

Segregation, Higher Education, Diversity, France.

JEL Codes:

I23, R10

Introduction

The identification of segregation patterns is generally considered as important regarding the geographies of education. Indeed, the variation of exposure of individuals to disfavored groups (ethnic minorities, modest socioeconomic backgrounds) and their impact on education performance remains an issue for education, urban and housing policy in many countries. Recently, many studies have proposed to identify the geography of social segregation in education patterns (Andersson et al., 2010; Courtioux and Maury, 2020). But only a few studies assess the question of higher education.

Indeed, regarding tertiary education, the geography literature has mainly focused on how students' residential location may lead to a particular form of urban gentrification, sometimes called "studentification" (Smith, 2008; Garmendia et al. 2012; Munro and Livingston 2012; He, 2015; Moos et al., 2019; Prada, 2019; Holton and Mouat, 2021). But cases of reverse dynamics (i.e. when non-student residents are integrated into student dominated neighborhoods) are also described and analyzed (Revington, 2022).

Moreover, some studies have stressed the necessity to apprehend more generally the role of higher education, higher education policy and their geographical consequences at various levels. For instance, the interactions between higher education and labor market are analyzed by Faggian et al. (2007) with the case of Welsh and Scottish students' migrations before and after higher education. Kleibert et al (2020) argue that state-led knowledge economy policies that put the stress on education cities, lead to give an important role to university in the shaping of transnational education zone within the city. But these consequences may occur within the geography of higher education policy. For instance, in the Case of Malaysia, Koh (2022) shows that the implementation of offshore universities and the student migrations induced lead to reverse the very composition of higher education and the ethnic majority/minority.

In this article, we adopt a different perspective and explicitly focus on the geographies of students in French universities, according to their social background. We aim to identify the different components and geographic layers of social segregation for French universities. We have two key aims. First, we want to determine if social segregation at university is more a national phenomenon or a local one. Second, we measure the contribution of two key factors – the choice of academic discipline by students and education level – to segregation and determine whether this contribution is geographically homogenous or, on the contrary, whether it follows specific local patterns. To produce a consistent measure of segregation, we compute and break down a series of the so-called mutual information index. We base this methodological choice on recent literature on the mathematical properties of segregation indexes: Frankel and Volij (2011) demonstrate that only the mutual information index allows strong disaggregation to be carried out. Our study is thus the first to demonstrate the local character of social segregation in the French University system. We provide evidence that most of the segregation occurs between neighboring universities (i.e., located in the same region), rather than across regions. Moreover, we explore the factors responsible for this local dimension of segregation and highlight the role of the academic discipline and the number of years of study. We show that the choice of academic discipline is an important and rising factor of local segregation: some disciplines concentrate most of the advantaged students, but they are not the same all over the country. This calls for higher education enrolment policies to be implemented at the local/regional level.

Finally, we break down our analysis according to the size of the metropolitan area. As expected, segregation is stronger in Greater Paris than in the rest of the country, but we also highlight strong social divisions in medium-sized cities. In particular, the role of the choice of courses of study is more

pronounced than in larger cities. This is in line with recent literature on the emergence of segregation dynamics in medium-sized cities.

The paper is structured as follows. We start by focusing on segregation in the French higher education system. In what follows, we present our datasets and define our key variables (students' social background, different geographical scales), the French university system and its geography. In the next section, we describe our segregation index and the segregation decomposition method used. Next, we present our national-level results and assess the impact of local factors. We then discuss segregation patterns according to the size of the metropolitan area. The last section concludes.

Social segregation and the geography of higher education in France

When dealing with the question of segregation in France, many studies focus on the higher education system of *grandes écoles* (e.g. Croulé et al., 2020), whose enrolment is restricted to students with excellent academic records and which lead to top careers. There has been a long-running debate about the social diversity of these *grandes écoles*. This segment of France's higher education system is generally opposed to two others: first, the so-called BTS sector (*Brevet de Technicien Supérieur*) based on a two-year track that is also selective but dedicated to vocational training; and second, France's universities that are non-selective tertiary general education institutions (access is usually open to anyone holding a *baccalauréat*, France's high-school diploma).

Traditionally, segregation within France's non-selective system of universities has simply not been examined. But recently, the increase in tertiary education enrolment and the introduction of cluster-building policies by successive French governments seeking to respond to the pressure of international ranking have challenged open enrolment.¹ The public policy issue here is to decide whether it is better to concentrate public funds on a few world-class universities (to stimulate world-class research) or to maintain and/or develop the proximity of higher education throughout the French territory (to promote enrolment of students from remote and more rural area). This has led to the development of some recent studies looking at segregation dynamics in universities.

Frouillou (2016) examined social segregation in French universities through an analysis of student interviews, which provided the possibility of understanding the motivations of individual students to choose a given university and/or a given field of study. But this study only focused on the Greater Paris region and was mainly qualitative.

The few available quantitative studies indicate that the level of social segregation in universities has remained stable or has slightly decreased in recent years (Avouac and Harari-Kermadec, 2021; Bechichi et al. 2021; Courtioux et al. 2022). Avouac and Harari-Kermadec (2021) found that the decrease in the level of segregation has been combined with an increase in the polarization of French higher education institutions. However, their appraisal of the phenomenon focuses on the national level.

The other available quantitative studies give some geographical appraisal of segregation across universities. Bechichi et al. (2021) analyze all segments of higher education (selective and non-selective). They show that the level of social segregation for the Greater Paris Region (*Ile-de-France*) is higher than for the whole of France, but they provide no further geographical analysis. Courtioux et al. (2022) propose a more comprehensive view of the geography of social segregation. Focusing on France's Regional Education Authorities (REAs) as the unit of analysis, they show that the level of segregation in certain REAs may be higher than in the Greater Paris Region, suggesting that there is great heterogeneity in the level of social segregation across the country. They also show that there is a decrease in the level of social segregation with the level of education. This pattern could be explained

by a higher drop-out rate of socially-disadvantaged students, and the fact that consequently these young people disappear from the education tracks in which they were numerous. This phenomenon leads to a more homogeneous social background across universities in students actually obtaining a higher diploma in the higher education segment. From a geographical perspective, Courtioux et al. (2020) simply compare regional patterns in their analysis, but do not break down geographically the pattern observed at the national level.

In this article, we aim at complementing this literature by identifying the different local components and layers of national segregation. In a disaggregation process, we identify the share of national segregation that is general (i.e., due to differences across regions). Then, by moving to a finer geographic scale (within each region), we identify what share of segregation is due to students' choice of discipline, and what is due to the education level. Indeed, identifying segregation differences between education levels is crucial to analyzing some local factors differentiated by students' social profile, like the drop-out rate or enrolment, which may influence the social segregation process. Such an integrated approach has not yet been proposed in the literature and makes it possible to identify whether segregation is a local phenomenon (e.g., observed within REAs) or whether certain trends are general (e.g., national disparities between different fields of study or levels of study) and which hence require the implementation of national policies.

Understanding French university enrolment and students' social background

To analyze the non-selective segment of France's higher education system, we use a dataset stemming from SISE (*Système d'Information Sur le Suivi de l'Etudiant*) of the French Ministry of Higher Education, Research and Innovation (MESRI) and provided by the French network of data centers for social sciences (PROGEDO). The period available is from the academic years 2006-2007 to 2016-2017. This is a comprehensive administrative database that contains information relating to enrolment at French universities. For each student, the database includes information on the university of enrolment, the field of study and the social background. The number of students included in the 113 public universities covered here was 1,407,820 in 2006 and 1,629,853 in 2016.

Students' social background

We use a variable based on the occupation of the parent legally responsible for the student during high school years. We use a standard definition of social backgrounds split into four categories: highly advantaged, advantaged, intermediate and disadvantaged. . This definition is usual in the academic literature and is also used by the French Ministry of Education for policy evaluation purposes. The 'disadvantaged' category concerns families where the head of household is an unskilled blue-collar worker, jobseeker or inactive. The 'intermediate' category is for farmers, craftsmen, tradesmen, and unskilled white-collar workers (administrative or public sector employees without any managerial responsibilities). The 'advantaged' category is for clergymen, foremen, technicians and associated professionals, as well as clerical and service workers; in the usual French occupation classification they are called 'intermediate professions' meaning that they have some managerial responsibilities. The 'highly advantaged' category is for managers, professionals, and high-skilled, self-employed persons.

The academic units for segregation

To determine the academic unit, we use two types of variables.

First, we consider geographical variables at two different levels: the Regional Education Authorities (REAs – the broader level) and the universities (narrower level). Education in France is supervised by 30 REAs. The assignment of students and the allocation of funds to universities are conducted by each REA in its region. The REAs are therefore an appropriate level for a geographical analysis of education policies. The narrower level corresponds to the universities themselves. In 2006, there were 113 universities in France: i.e., between 3 and 4 per REA on average, which is still a relatively aggregated level for studying segregation.

Therefore, we consider a second set of variables, namely the academic discipline and the education level. For 2006, we have 16 disciplines in our dataset: the main ones being law and political science, economics and management, humanities and arts, languages, social sciences, life sciences, fundamental sciences, and medicine; the others are hybrid or more specific disciplines. Within the same university, students from different disciplines are sometimes spread over different academic units. This complements the geographical dimension of our analysis. We also consider five different education levels: the first year of a bachelor's degree, called a *Licence* in French (L1), the second (L2), and the third year (L3), the first year of a master's degree (M1), and the second year one (M2): we excluded PhD students from our analysis as their number is very low. Through various processes (failing exams, dropping out, selection for entry into a master's degree), the social composition may vary from one level to another, which may contribute to overall segregation.

Globally, we measure segregation at the *diploma level*, which corresponds to the combination of the three variables previously defined: a given university, a given discipline and a given education level. For example, all law students at the Université Lumière Lyon 2 enrolled in the first year of a master's degree (M1) are grouped together in the same diploma. In 2006, the number of diplomas was 3,758, so the average number of students per basic unit was 375; which is small compared to most of the literature on residential or school segregation. This creates a small-unit bias issue that we need to address (see the next section). All along the whole period, the number of diplomas available in France may have evolved because of changes in the supply of education: for instance, the opening of a master's track in a new discipline for a given university or the official creation of a new discipline could lead to an increase in the number of diplomas. By contrast with Bechechi et al. (2021), in our study we consider that the opening/closing of diplomas in a given university, in as far as they legally need the authorization of the local education authority (REA) to be an element of the national policy. This impacts the geography of higher education, and so needs to be considered.

Measuring segregation with a decomposable index

There are many ways to measure segregation (Massey and Denton, 1988; Reardon and Firebaugh, 2002; Frankel and Volij, 2011). A major issue here is that our index should be decomposable in several dimensions: geographical (across or within REAs), by discipline, and by education level. According to Frankel and Volij (2011), only the mutual information index (*M*) allows this. It is "strongly decomposable", that is, the share of a group in the total segregation is a measure of how much overall segregation would be reduced if any segregation within that subgroup were to disappear. For example, if we find that segregation in a given REA represents 5% of the total segregation in France, this means

that if this segregation were to disappear in this region, then the overall segregation in France would fall by 5%. Most other indices of segregation do not exhibit this property. M is given by

$$M = h(P) - \sum_{k=1}^K p^k h(P^k) \quad (1)$$

where $h(P)$ is the entropy of the distribution P (i.e., the distribution of the four social groups in the population, $P = (p_1, p_2, p_3, p_4)$); K is the number of units that divide the population of students (i.e., the diploma mentioned in the previous section); p^k is the share of unit k in terms of the whole student population; and P^k is the distribution of the different groups in unit k , $P^k = (p_1^k, p_2^k, p_3^k, p_4^k)$. The entropy of the distribution P is given by:

$$h(P) = \sum_{g=1}^4 p_g \ln \left(\frac{1}{p_g} \right) \quad (2)$$

where g is a social group, and p_g is the share of group g in the population of students.

Using its mathematical properties, it is possible to compute the share of M that is due to differences between geographical areas (the REAs that make up the national territory) or between fields of study. For instance, the *between-REA* component of segregation is the segregation level obtained if the unit is the REA. The *within-REA* component is the average amount of segregation at the basic unit level (i.e. the diploma level) within each REA. Thanks to the decomposability property of the M-index, the *between-REA* and *within-REA* sum up to total segregation M . The same can be done for between- (or within-) fields of study or education level.

This means that we may also proceed to a *nested* decomposition of segregation and for instance consider the within-REAs/between-discipline component of segregation. This represents the average amount of segregation across fields of study of the same REA. This component may be added to the between-REA component, in order to assess the cumulative contribution of segregation across REAs, and across fields of study of the same REA to total segregation. The remaining part of total segregation corresponds to segregation across basic units in the same fields of study and the same REAs.

An important concern is that the segregation index may be strictly positive, even when students are allocated randomly across units. This problem is all the more acute, the smaller the size of the spatial units. The random allocation of students to (small) units will typically generate some deviation from evenness. Some small units will be allocated students from only one group, instead of being allocated the national distribution of all the groups as expected. Stated differently, evenness ($M = 0$) is not randomness ($M > 0$). Thus, in line with Carrington and Troske (1997), we measure segregation as the distance from randomness, rather than its distance from evenness. We, therefore, calculate the measure of segregation in the population and compare it to the (random) measure obtained by reallocating students in units by simulation techniques. The gap corresponds to the bias-corrected measure of segregation.

In the existing literature on French higher education, Courtioux et al. (2022) and Bechichi et al. (2021) have used the Normalized Exposure Index (NEI). This index satisfies an additional decomposability property, but only when there are two groups. For instance, Bechichi et al. (2021) use the decomposability property to analyze which share of segregation is due to the selective segment of higher education, and which share is due to the non-selective segment. However, they had to group, on the one hand, the highly advantaged and the advantaged background, and on the other hand the

intermediate and disadvantaged. In our analysis of segregation, the aim is to maintain a distinction between the four usual social background categories (and then to choose to use the M-index), if the patterns of access to university differ across these categories.

Enrolment at university: the variety of patterns across social backgrounds

Overall, in 2006, Table 1 shows that 31.58% of French students came from a highly-advantaged social background which is much higher than the proportions observed in middle-school (19.42%, Courtioux and Maury, 2020). At the same time, the proportion of disadvantaged students was 31.25%, compared to 39.21% in middle school. These gaps reflect the comparatively important attrition of disadvantaged students in pursuing a general, rather than a vocational education, in the secondary and tertiary education levels. Interestingly, while the proportion of highly-advantaged (respectively disadvantaged) students is increasing (respectively decreasing) in schools (reflecting general population trends, see Courtioux and Maury, 2020; Ly and Riegert, 2015). The opposite patterns may be observed at university. This reflects the increasing openness of universities (i.e., the non-selective segment of French higher education) to students with disadvantaged profiles.

If we refine our analysis according to education level, we find that in 2006 the share of highly advantaged students was higher in M2 than at the beginning (in L1). This is also true for the disadvantaged students, but not for advantaged or intermediate students. This means that it is sound not to aggregate highly-advantaged with advantaged students or intermediate with disadvantaged students, as they have different patterns of access to higher education. Clearly, these results support our choice of a four-category target variable, instead of a more usual binary variable (e.g., advantaged vs. disadvantaged) which would erase some interesting segregative patterns.

The growing share of highly advantaged students may reflect a higher failure or drop-out rate of students with other social backgrounds throughout the program. It may also be linked to a selection procedure at the entrance to some masters' programs, which may possibly benefit highly-advantaged students. However, this was no longer observed in 2016. Moreover, in 2016, the proportion of disadvantaged students was actually higher in M1 or M2 than in L1. This counterintuitive situation may result from a cyclical effect, namely a possible tightening of university entry conditions in 2016. Before 2016, there was no selection at the entry of a master's degree (M1), but generally, a selection process was at work for the enrolment in M2. Since 2016, a government decree has allowed selection for the enrolment in M1, but it is no longer legal for the enrolment in M2. The objective was to reduce the number of students who enroll in a master's tracks without completing a master's degree. One should notice that following Table 1, for the whole population of students the ratio of students in M2 compared to students in M1 rose from 83% to 98%. This change may have particularly penalized disadvantaged students, who exhibited a ratio over 100% for 2016, meaning that they are fewer in M1 – in this first year of selection – whereas they were more numerous to enter in the previous years (thus they were more numerous in M2 in 2016).

Table 1. Enrolment at University across social background in 2006 and 2016

Education level	2006					2016				
	Social Background				Total	Social Background				Total
Highly advantaged	Advantaged	Intermediate	Disadvantaged	Highly advantaged		Advantaged	Intermediate	Disadvantaged		
First-year <i>Licence</i> degree (L1)	127,697 29.65%	35,678 8.29%	128,001 29.72%	139,247 32.34%	430,623 100.00%	145,351 28.84%	36,179 7.18%	151,904 30.14%	170,511 33.84%	503,945 100.00%
Second-year <i>Licence</i> degree (L2)	78,926 33.29%	20,687 8.73%	73,584 31.04%	63,901 26.95%	237,098 100.00%	93,489 33.81%	20,339 7.36%	84,805 30.67%	77,850 28.16%	276,483 100.00%
Third-year <i>Licence</i> degree (L3)	79,896 30.47%	21,892 8.35%	78,065 29.77%	82,354 31.41%	262,207 100.00%	81,519 29.82%	17,777 6.50%	79,910 29.23%	94,190 34.45%	273,396 100.00%
First-year Master's degree (M1)	63,036 33.67%	14,642 7.82%	51,757 27.65%	57,779 30.86%	187,214 100.00%	68,099 30.94%	14,045 6.38%	60,806 27.63%	77,161 35.06%	220,111 100.00%
Second-year Master's degree (M2)	52,800 33.68%	10,776 6.87%	38,387 24.48%	54,823 34.97%	156,786 100.00%	64,452 29.82%	12,323 5.70%	54,612 25.27%	84,766 39.22%	216,153 100.00%
Total	402,355 31.58%	103,675 8.14%	369,794 29.03%	398,104 31.25%	1,273,928 100.00%	452,910 30.39%	100,663 6.76%	432,037 28.99%	504,478 33.86%	1,490,088 100.00%

Source: SISE (MESRI) –authors' calculation.

At the national level: a slight decrease in segregation levels over 10 years

In 2006 at the national level, segregation was equal to 0.0661; 10 years later, segregation had fallen slightly to 0.0574: a decrease of about 13% (Table 2, first line).

Several points are worth highlighting. Firstly, segregation is significantly above zero. Indeed, as explained in the methodology section, we assess the amount of segregation resulting from the small size of our basic spatial unit. By randomly reallocating students across universities/disciplines/levels, we end up with very low levels of segregation (only 0.0041 in 2006 and 0.0035 in 2016). Hence, most of the observed values of M are really due to unevenness (e.g., $0.0661 - 0.0041 = 0.0620$ in 2006) instead of randomness (0.0041, so only 6.20% of the value of M). Moreover, the decrease in segregation is also about 13% when one takes into account this small-sample bias. Students are not randomly distributed across the various universities throughout the country, regardless of their social background. Some universities have more advantaged students than the national average, and others have relatively more disadvantaged students. Segregation is therefore undoubtedly present in the university system.

Secondly, segregation appears to be lower than in secondary education. Using exactly the same breakdown into four social categories, Courtioux and Maury (2020) obtained relatively constant segregation levels of around 0.13 between 2004 and 2016 for French middle schools. This was more than twice the level found here.² In France, the end of secondary education, marked by the *baccalauréat*, leads to different patterns of access to higher education among students of different social backgrounds. Not surprisingly, as shown by Bechichi et al. (2021), most of social segregation stems from the differences between the selective segments of France's higher education system and its non-selective universities.³ This helps to reduce segregation within the latter, but does not remove it completely.

Finally, the observed decline in segregation between 2006 and 2016 is in line with Avouac and Harari-Kermadec (2021) or Courtioux et al. (2022), who report quantitatively comparable results, though with different indices and spatial units. Generally, this trend in universities seems to be at odds with the one observed for school segregation (+4.23% between 2004 and 2016, according to Courtioux and Maury, 2020), or residential segregation (+3.05% between 1999 and 2015, according to Beaubrun-Diant and Maury, 2022).

Table 2. Decomposition of national segregation (Mutual Information Index M). 2006-2016

Level of decomposition of M	2006	2016
Aggregate level (M)*	0.0661 (0.0041)	0.0574 (0.0035)
Between REAs**	0.0117 17.70%	0.0102 17.77%
Between-disciplines**	0.0131 19.82%	0.0131 22.82%
Within-REAs, between-disciplines**	0.0203 30.71%	0.0202 35.19%
Between-levels**	0.0065 9.83%	0.0056 9.76%
Within-REAs, between-levels**	0.0101 15.28%	0.0082 14.29%
Within-REAs, within-disciplines, between-levels**	0.0191 28.90%	0.015 26.13%

Lecture: (*) The first row gives the value of the index at the national level, while figures in parentheses give the estimate of the small-unit bias. (**) The second and subsequent rows give the value of the sub-division of the index and, below, the percentage of segregation that correspond to this sub-division. In 2006, segregation in France was 0.0661, the level of between-REAs segregation was 0.0117 (17.70% of total segregation).

Source: SISE (MESRI), authors' calculations.

Segregation at university is mainly a local phenomenon

Our basic spatial unit for measuring segregation is the *diploma*, measured by the intersection of the university, the discipline and the level of study. Each REA comprises several universities with, in most cases, a comprehensive range of academic fields of study and the whole set of levels (three levels/years for a *Licence* and two for a Master's).

As a first step, it is possible to break down segregation according to geographical criteria (between-REA). In a second step, we refine our analysis and gauge the local components of segregation (i.e., within-REA). Then, we measure the amount of total segregation which is due to differences between academic fields of study or between levels, *within the same REA*.

Segregation and the geography of social background distribution

We start with the geographical decomposition by breaking down in two components, the levels of segregation presented in the first row of Table 2. We distinguish the level of segregation *between REAs* and the level of segregation *within REAs*. The first component reflects the level of segregation obtained if the basic spatial unit were the REA. The second component measures the weighted average of the segregation levels obtained within each REA considered separately. As shown in the methodology

section, the M-index has the property of being highly decomposable. Therefore, the sum of the two components results in the national segregation M .

We find that the segregation between REAs (first component) was equal to 0.0117 in 2006: i.e., almost 18% of the total segregation observed. This figure was very stable over the period studied. This means that about one fifth of the total segregation is general: i.e., due to inter-REA differences in students' social profiles. Mechanically this means that more than 80% of segregation is due to a non-homogeneous distribution of student profiles *within* each REA (second component, not reproduced in the Table). Segregation is therefore a local phenomenon in the French university system. There are more differences between the social compositions of two randomly- selected diplomas in the same REA than between the average social composition of two randomly- selected REAs. This result is echoed in the literature on regional differences in France. Numerous academic references emphasize the importance of interregional redistribution in France, which considerably limits disparities (particularly income disparities) between regions. In a study on residential segregation (measured by income), Beaubrun-Diant and Maury (2022) show that segregation is mainly local (intra-municipal) and that inter-regional differences only marginally contribute to overall segregation. There may be more differences between neighborhoods in the same municipality than between municipalities in different regions. Similarly, Courtioux and Maury (2020) measured middle school segregation and showed that in 2016 only 17.63% of the total segregation observed was due to its inter-REA component. The study here is thus in line with these results, but is the first to demonstrate the local character of segregation in the French university system.

From a policy perspective, this also means that segregation in universities is not due to an over-concentration of highly-advantaged students in specific REAs (e.g., those in Greater Paris). Neither is segregation massively due to the flight of students from certain disadvantaged universities, where the authorities should focus their resources. Instead, it is a local and diffuse phenomenon, present throughout France. Following this first one-step decomposition of segregation, we may conclude that the geographical (REA) dispersion of social backgrounds across the country is not the main component of segregation of the non-selective segment of tertiary education. Thus, a major component of segregation exists at more granular levels, leading us to refine our decomposition of segregation.

Academic disciplines as a strong vector of segregation at the local level

We now refine our geographical analysis and proceed to an analysis of the factors contributing to *local* (within-REA) segregation. First, we measure the share of total segregation due to field of study differences *within each REA* (Table 2, fourth row). The results are especially striking. In 2006, more than 30% of segregation in France was linked to local (intra-REAs) differences in the social composition of the different disciplines. This figure should be compared to its overall counterpart: between-discipline spreads at the national level accounted for less than 20% of segregation in the same year. The between-discipline differences are therefore local rather than national. Selection across disciplines clearly operates at a local instead of the overall level. Concretely, this means that some disciplines have a majority of advantaged students, and others have a majority of disadvantaged students, so that academic disciplines are a factor of segregation. But the social profiles of disciplines vary considerably geographically. It is possible, for instance, that in some REAs the science tracks differ strongly from other disciplines, because of an overrepresentation of the most advantaged students, but not, or much less, in other REAs. In these other REAs, segregation may be just as high, but driven by other differences across disciplines (e.g., it would not be the science tracks that attract the most advantaged students). The most attractive/selective tracks are not the same throughout the country, but whatever their type,

the local choice of tracks generates a very strong segregation process at university. It should be noted that, in 2006, this figure of 30.71% could be added to the 17.70% (segregation between REAs) previously analyzed.⁴ In other words, nearly half of the segregation in France is linked to differences in geography (between REAs) or disciplines (between-tracks, but within-REAs). The remainder is therefore related to differences between universities (or between education levels within the same university) in the same REA, and in the same discipline.

It should be noted that the local decomposition (within-REA) of the contribution of education levels (L1, L2, L3, M1, and M2) to segregation confirms the results obtained regarding the contribution of disciplines. Differences across education levels contribute much more to segregation when measured *locally* (*within-REAs*, between-level segregation represented around 15% of total segregation in 2016) than generally (between-level segregation represented less than 10% of total segregation). The effects of selection and student drop-out throughout the bachelor's and master's programs are significant, but need to be analyzed at a fine geographical scale.

Another striking result shows that the differences between education levels at university (L1 to M2) are much more pronounced when we further refine the analysis and measure the levels of segregation, not only locally (within-REA) but also within-disciplines. Between-level segregation which accounted for less than 15% of segregation at broader scales,⁵ here represents more than 25% of total segregation (Table 2, last row). The gradual disappearance of disadvantaged students throughout the curriculum is a reality in France, but as it occurs at different rates from one discipline or REA to another. This effect is minimal when measured on an overall scale (mixing all REAs or streams), while being quantitatively significant locally.

To summarize our results: in 2006, 18% of segregation was explained by differences in students' social backgrounds between academic regions (REAs); 31% by differences between fields of study within these REA; and 29% by differences in education levels within these disciplines at the REA level; the remaining (23%) corresponded to differences in social background between the diplomas prepared. Ten years later, after a decrease of 13% in the overall segregation level, the share of segregation explained by differences in students' social backgrounds between regions remained the same (18%), whereas the share explained by discipline between these regions had increased by 4 percentage points, and the share explained within disciplines by social background differences among education levels had decreased by 3 percentage points. These results show that even if segregation in the French university system is quite low and tended to decrease over the period, the main driver of social segregation was the choice of the field of study at the local/regional level. This means that a policy aimed at decreasing social segregation at university would be more effective if it focuses on the student choices of discipline and at the same time is developed at the REA level. Some disciplines play a selective filtering role for advantaged social backgrounds, but as these disciplines differ across the country: a national policy would be ineffective. Policies to address enrolment conditions need to be designed at a local level. At this stage, it is important to verify that these results are true for all types of regions or if some specific patterns are observed depending on a region's characteristics.

Contrasted segregation patterns according to the size of the metropolitan area

In the literature on segregation in France, the specific role of the Greater Paris is often highlighted (Oberti and Prêteceille, 2016). This area concentrates a large part of the country's wealth production, but it is also the place of large inequalities, notably income inequalities. Residential and school

segregation levels are consistently higher than in the rest of the country (Quillian and Lagrange, 2016; Ly and Riegert, 2017). It is therefore crucial to examine the segregation levels in Paris in this study, even though the situation is quite different at university, compared to middle or high school segregation. Indeed, inter-regional university students' mobility is an important phenomenon. Nearly 50% of students in France obtained their *baccalauréat* (thus finishing their secondary education) in a different REA from the one in which they pursue higher education. In the Greater Paris region, this proportion is as high as 80%.⁶ In Paris, the population of universities is quite different from the one of secondary schools. It is therefore interesting to see to what extent this high mobility may have contributed to moderating (or reinforcing) the segregation levels in Paris, compared to the rest of the country. Some interesting comparisons are available in Bechichi et al. (2021), but they limit their analysis to the first-year level and, as we have seen in the previous section, between 25% and 30% of segregation at university is due to differences among education levels.

Furthermore, we extend this analysis according to the size of the metropolitan area (MA). Thus, for secondary education, Courtioux and Maury (2020) showed that segregation was relatively high in large and medium-sized MAs (although less so than in Paris), and even that segregation had increased more strongly in medium-sized MAs than elsewhere, over the past 15 years. We therefore classify the REAs according to the size of their main metropolitan area and discuss the segregation dynamics in large MAs (more than 1 million inhabitants), medium MAs (between 400,000 and 1 million inhabitants) and small MAs (less than 400,000 inhabitants).

The results of Table 3 show that segregation levels in Paris are persistently above those observed in the rest of the country. Segregation in Paris was equal to 0.0736 in 2006, compared to less than 0.0680 in the rest of the country. However, it should be noted that the differences between Paris and the rest of the country are much smaller if we consider social segregation by university diploma, rather than other forms of segregation. For middle-schools, segregation in Paris was 51.22% higher than the national average in 2016 (Courtioux and Maury, 2020). For university, the difference was only 17.60%. Such a decrease in the Paris/Province gap between secondary education and university may be caused by several factors: 1) a segregation of the whole tertiary education sector that occurs mainly via the selective segment of tertiary education (the *grandes écoles* track and the vocational selective BTS track), which is outside the scope of our analysis here;⁷ 2) a massive post-high school geographical redistribution of students within the REAs of the Greater Paris region; and 3) the importance of student mobility flows to and from the Greater Paris region for university entrance. Although the data at our disposal do not allow us to identify and quantify these effects precisely (we do not know students' high school of origin and we do not have access to comparable data for the selective segment of higher education), the importance of the flows from the other regions to Paris (after high school) suggests that the new arrivals may have contributed to reducing segregation in Paris (or at least to levelling the gap with the rest of the country).

It should also be noted that, with the exception of Greater Paris, the highest levels of segregation are observed in medium-sized cities. It would therefore be incorrect to consider that the issue of segregation in the French university system is limited to Greater Paris and a few large cities. Our analysis here is in line with a literature on the emergence of segregation dynamics in medium-sized cities (Courtioux and Maury, 2020).

If we now interpret the segregation decompositions, we find sharp differences between Greater Paris or certain ranges of city sizes and national trends.

First, contrary to the national pattern presented in the previous section, the segregation due to differences in the regional social composition of students was not stable over the period. The share of

overall segregation due to between-REAs segregation rose in Greater Paris, while it tended to decrease in the rest of the country (small cities excepted). Despite its spatially limited territory, the three REAs of Greater Paris (Paris, Versailles and Créteil) are very socially heterogeneous. This phenomenon, which has already been identified in middle or high school education (Ly and Riegert, 2015, and for the first-year in tertiary education (Bechichi et al., 2021) is therefore still present at university, when all-levels of diplomas are considered.

Second, the contribution of between-discipline segregation within REAs is important on average (as a percentage of total segregation) for every MA size category. Surprisingly, however, this phenomenon is much more pronounced in small and medium-sized cities than in Paris (41.43% in 2006 in medium-sized MAs against 22.32% in Paris). One explanation for this result could be related to the geographical dispersion of academic disciplines across the different universities of French medium-sized cities (which cover a much larger geographical area than Greater Paris, which is more spatially concentrated). It is also important to note that the national pattern presented in the previous section is not observed for each MA size: indeed, in Greater Paris, as well as in large *and* small MAs, we observe an increase in the contribution of fields of study to social segregation. This was not the case for medium-sized MAs which already had a very high contribution in 2006.

Finally, if we focus on the contribution of within-REA and within-discipline effects between education levels on segregation, we find that, once again, these are greater in small and medium-sized cities (more than 30%, compared to only 22.69% in Greater Paris). The selection process and/or student failure rates lead to strong segregation dynamics in small cities.

Table 3. Segregation according to the size of the MA (M-Index). 2006-2016

Level of decomposition of <i>M</i>	Paris		Large MA		Medium MA		Small MA	
	2006	2016	2006	2016	2006	2016	2006	2016
Aggregate level (<i>M</i>)*	0.0736	0.0675	0.0525	0.0469	0.068	0.0526	0.0538	0.05
Between REAs**	0.0077 10.42%	0.0091 13.48%	0.0043 8.14%	0.0027 5.70%	0.0064 9.42%	0.0039 7.44%	0.0107 19.94%	0.0102 20.30%
Within-REAs, between-disciplines**	0.0164 22.32%	0.0179 26.50%	0.0174 33.11%	0.019 40.40%	0.0282 41.43%	0.0215 40.76%	0.0207 38.47%	0.0232 46.29%
Within-REAs, within-disciplines, between-levels of education**	0.0221 30.01%	0.0153 22.69%	0.0174 33.20%	0.0131 27.85%	0.0194 28.55%	0.0167 31.79%	0.0177 32.93%	0.0155 31.08%

Reading: (*) The first row gives the value of the *M*-index; (**) the first row gives the value of the sub-division of the index, the second row gives the percentage of segregation that corresponds to this sub-division. In 2006, segregation in Paris was 0.0736, the level of between-REAs segregation was 0.0077 (10.42% of total segregation).

Source: SISE (MESRI), authors' calculations.

To summarize, even if small-MAs seem to meet the criteria of the national pattern presented in the previous section, we have also identified specific regional patterns that mitigate the national results. The average stability of the contribution share of REAs to student social segregation at the national level over the period hides strong heterogeneity and reverse trends for REAs in the Greater Paris Region on the one hand, and REAs in large and medium-sized MAs on the other hand. In this view, the Greater Paris region corresponds to the national pattern of segregation observed except that the differences in student social backgrounds have diverged across REAs; large MAs correspond to the national pattern except that student backgrounds are more homogeneous across REAs. The pattern for medium-sized MAs seems quite different: the share of students' social segregation due to differences in the field of study at the REA level is very high, but did not increase over the period; the share of social segregation due to education level within the REAs and academic disciplines tended to increase, and was highest at the end of the period. This means that given these differences in social background across fields of study, the social composition of students varied greatly across the curriculum.

These results confirm that a policy aimed at decreasing social segregation at university would be more effective if it were developed at the REA level. But the results also lead to recommending some regional differentiation in the implementation, for policy to be more effective. This suggests that in the Greater Paris region, policy should focus directly on diploma enrolment perhaps, with measures like quotas based on social background, notably on entry into tertiary education (L1) and for the selection at the enrolment gate for entering master's degrees (M1).⁸ In large MAs, the recommendations are consistent with the proposal derived from our results at the national level: it seems important to favor more social heterogeneity in the choice of field of study within in a given REA. In the medium MAs, the recommendation for more social heterogeneity per discipline in a given REA still stands; but it should be complemented with some efforts to decrease the segregation due to average differences in the social background of students of different education levels within the same discipline in a given REA: i.e., focusing efforts on reducing dropout rates of socially-disfavored students, and supporting their access to master's degrees.

Conclusion

Based on a comprehensive administrative dataset of French university students with information on their individual social background, we compute and decompose geographically a segregation index and analyze social segregation at university. We demonstrate that social segregation at university is rather a local phenomenon, and argue that a policy implemented at the Regional Education Authority (REA) level would be more efficient, as the main driver of social segregation is the choice of academic discipline at the local level. Moreover, in line with a literature on the emergence of segregation dynamics in medium-sized cities, we show that it is not relevant to contrast the Greater Paris region (or Greater Paris and some other regions with big cities) with the rest of the country. Notably, for the REAs in medium metropolitan areas (MAs), that are more homogeneous in terms of students' social profile than those of Greater Paris region, the contribution of the choice of academic discipline and the contribution of education level to segregation are particularly high. In order to affect the level of social segregation in these regions with medium MAs, it seems important to implement local higher education policies that are able to maintain students' from poor social backgrounds in all education levels.

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¹ For instance, see Avouac and Harari-Kermadec (2021).

² These results should be compared with caution because the sizes of the spatial units are not exactly the same. However, simple standardized calculations show that middle-school segregation is still almost twice as high as university segregation, once we correct for the size of the basic spatial unit. The are available upon request.

³ They estimate that it concerns 88% of total higher education segregation, and that the remainder stems from non-selective segment.

⁴ Again, this is due to the strong decomposability property of the M-index.

⁵ Table 2 shows that education level segregation represented less than 10% of national segregation when measured at the national level (fifth row), and that it increases when measured at a more local level (within-REAS, Table 2, sixth row).

⁶ The Greater Paris Region has only three REAs (Paris, Créteil and Versailles) with some inter-regional mobility, but most of the in- and out-flows come from REAs outside the Paris Region.

⁷ Following Bechichi et al. (2021), this is at least confirmed for the first year of tertiary education.

⁸ The highest share of the contribution to social segregation is the remainder that corresponds to average differences between diplomas of the same level and same field of study within the same REA: 37.33% in 2016 ($100\% - 13.48\% - 26.50\% - 22.69\% = 37.33\%$, see Table 3).