Geographical Distribution of Interns in General Practice: A Tool for Regulating Place of Settlement?

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Abstract – Since 2004, interns in general practice have been distributed among universities following the internship competition based on their wishes, the ranking in the competition, and the number of available positions at each university. The significant reallocation of intern posts which took place between 2004 and 2007 is used as a natural experiment to assess the effect of distribution of interns on geographical distribution of settlement. We estimate that an increase of one percentage point in the proportion of interns placed at a university is associated, on average, with an increase of 0.4 percentage points in the proportion of general practitioners in private practice resulting from these cohorts having settled in the university zone twelve years later. The study shows that place of birth is also a significant decisive factor in relation to place of settlement. Recruiting medicine students in "medical deserts" could therefore be a tool for regulating place of settlement.

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Since the turn of the millennium, the issue of accessibility to care has increasingly been the subject of public debate. Effectively, there are large, expanding zones in which there are known to be fewer doctors with regard to the population than in the rest of the country (Vergier & Chaput, 2017). The ageing of the population, the decrease in the ratio of doctors to inhabitants and, above all, the sharp decrease in the average labour supply of doctors are likely to have increased these imbalances (Bachelet & Anguis, 2017).

This article focuses on general practitioners in private practice, who perform 95% of general practice procedures.[1] In addition to the care they provide themselves (first-line care, chronic disease monitoring, prevention, etc.), they refer patients to all other areas of the health care system. As such, they are an essential factor in the efficiency of medical and paramedical provision (Ferrer *et al.*, 2005).

General practitioners in private practice are at liberty to choose where they practise. The public decision-maker therefore has little leverage in regulating the distribution of settlement. However, it acts upstream, by distributing intern positions among universities. Many medical students are therefore forced to move geographically when they become interns. This distribution has a significant short-term effect: as junior doctors, interns contribute to the functioning of hospitals and practices in the region in which they are placed. More interns directed towards a university therefore translates into increased care provision in the surrounding hospitals and practices.

But this distribution could also have a long-term effect. The placement system leads interns to work in regions to which they initially did not want to move. By completing their studies there, some of them may ultimately decide to settle there. Exposure to the region where they are placed is lengthy and intense, and takes place at a key moment in the doctor's life. Generally aged between 25 and 30, interns undertake various placements there for at least three years at a working pace that does not allow them to return to their home region every weekend. They receive their first wages, form their first professional network and are likely to form personal relationships. The internship experience is therefore likely to modify the perception they had of the region before being placed there. Accordingly, the distribution of intern positions appears to be a potential tool for geographical regulation of future settlement.

This article considers the effectiveness of this tool. With this aim, the geographical trajectories of the 2004 to 2007 cohorts of interns in general practice will be followed. During this period, a significant reallocation of intern positions took place. Compared to 2004, in 2007 they were less frequently attributed to universities in the largest urban areas (Paris, Lyon, Marseille, Toulouse, etc.), in favour of those located in smaller urban areas (Angers, Clermont-Ferrand, Saint-Étienne, Dijon, etc.). This reallocation can be seen as a quasi-natural experiment in so far as, upstream, the distribution of places for entry to the second year of medical studies for students in these cohorts had remained unchanged. It enables the effect of distribution of interns on distribution of place of practice to be identified.

The data used contains doctors' municipalities of birth. We use these as a proxy for where the doctor grew up, which is known to be a significant decisive factor in place of settlement. Once the places of birth are taken into account, we find that by increasing by one percentage point the proportion of interns of a cohort placed at a university, the proportion of general practitioners in private practice from this cohort who settle in the university zone increases by about 0.4 percentage points. We also find that distribution of births has an effect of similar magnitude on distribution of settlement.

This article does not specifically address the decisive factors for settlement in "medical deserts". Indeed, although a "medical desert" does not correspond to an official statistical category (Vergier & Chaput, 2017), the term refers to the idea of an area in which access to care is difficult in every respect. However, we observe a division of the country into 28 zones, each municipality being associated with the nearest university hosting interns (Figure I). These zones are very large (more than three departments on average) and therefore contain areas with different levels of accessibility to doctors. Nevertheless, the average ratio of general practitioners to population also varies greatly from one zone to another: in 2020, there were 10.7 general practitioners in private practice per 10,000 inhabitants in the zones of the universities of Marseille and Nice, but less than 7.8 in those of the universities of Reims, Rouen and Tours. A better distribution of settlement among these zones would therefore contribute to a better geographical balance in care provision. Moreover, the effect of place of

1. *Sources: National Health Data System (*Système National des Données de Santé, *SNDS) via the application https://cartosante.atlasante.fr, which contributes to the network of regional health agencies (Agences Régionales de Santé, ARS).*

birth on place of settlement, highlighted in this article can certainly be extrapolated in part to smaller geographical units.

The article is structured as follows: Section 1 provides a review of the literature on decisive factors relating to doctors' place of settlement. Background information is provided in Section 2. The data is presented in Section 3. In Section 4, we consider variations in the distribution of interns in general practice between 2004 and 2007 to identify the effect of place of internship on place of settlement. Finally, in Section 5, we adapt a competition model to put forward counterfactual simulations: we consider how settlement would have been distributed *(i)* if the distribution of interns in 2004 had been maintained in subsequent years or *(ii)* if a policy of recruitment of medicine students specifically in certain zones had been adopted.

1. Review of the Literature

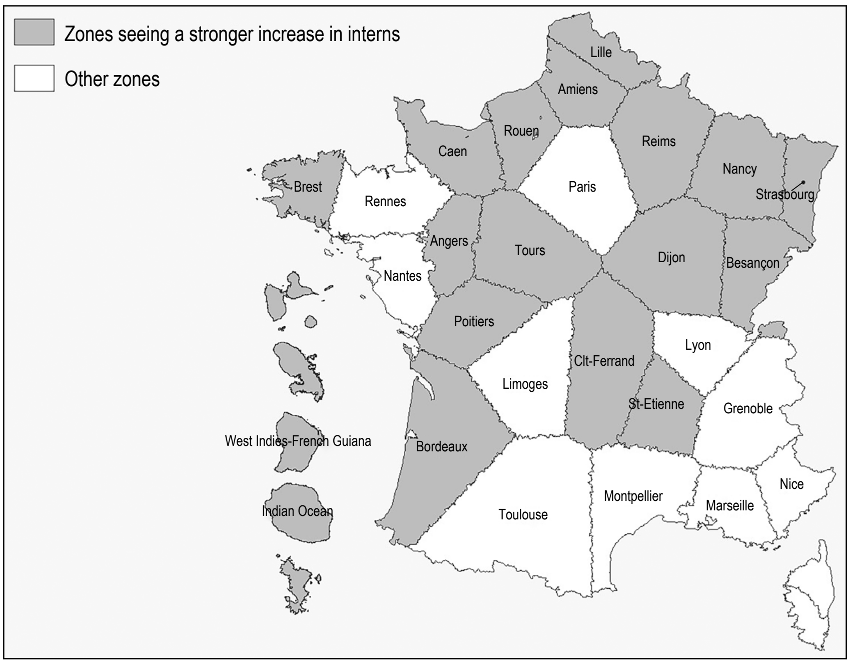
Regional inequalities in access to care are not unique to France. In many countries, rural areas and disadvantaged urban zones, in particular, may have fewer doctors. Accordingly, there is significant literature focusing on identifying the decisive factors for settlement in these types of areas. A better understanding of these decisive factors aids in developing public policies for the geographical regulation of more efficient settlement. This literature can be divided into two categories of studies.[2] The first focuses on the geographical trajectories of doctors. The second on the effects of financial incentives.

Geographical Trajectories

A first category of studies focuses on doctors' geographical origins. The principal decisive factor identified for settlement in a zone with a low density of doctors is having grown up there and, to a lesser extent, having studied there. Asghari *et al.* (2020) undertake a meta-analysis of this issue. To rectify the shortage of doctors in rural areas, the authors advocate continuity between places of recruitment of medical students, places of study, and places benefiting from settlement incentives. The expression "*rural pipeline*" has therefore emerged to characterise this geographical continuity, which appears to be a constant. This term may also describe programs to recruit medical students in rural areas and/or promote placements there, in order to increase settlement in areas of this type (Witter *et al.*, 2020). However, rural areas do not entirely overlap with the areas that have a low density of doctors. In the United States and Canada, studies also focus on identifying the decisive factors for settlement in disadvantaged urban areas where certain ethnic communities

2. *Some studies highlight other local or individual decisive factors in relation to place of settlement. For example, Chevillard & Mousquès (2020) show that multidisciplinary nursing homes are attractive to doctors. We do not address studies of this type here because the places of settlement observed in this study are extensive (cf. Figure I) and, therefore, contain areas in which the presence of these decisive factors is very uneven. In addition, the dataset used contains very few individual characteristics.*

Figure I – **University zones**



Notes: Each municipality is attached to the nearest university hosting interns in general medicine.

(particularly Black, Hispanic, or Native American communities) are concentrated. In line with the concept of a rural pipeline, these studies show that coming from each of these types of areas significantly increases the likelihood of settling there (Goodfellow *et al.*, 2016).

The links between places of study and places of settlement are discussed further. Using French data, Vilain & Niel (1999) and Delattre & Samson (2012) find that three quarters of doctors are based in the region where they submitted their thesis. But this high proportion could actually be linked to a rural pipeline effect, since most doctors study in the region where they grew up. There is less research aiming to disentangle the effect of the place where a doctor grew up from the place where they trained, as decisive factors in relation to their place of settlement. Xu *et al.* (1997), based on a sample of just over 2,000 doctors whose place of settlement was observed ten years after completion of their studies, show that practising in a rural zone is associated with having grown up there, but not with having completed part of their training there. A similar result is found in Easterbrook (1999). However, the effect of place of study on place of settlement, net of the place where the doctor grew up, remains the subject of discussion: it is strongly suspected to depend on the "duration of exposure" to the region concerned (Denz-Penhey *et al.*, 2005) and on when this "acculturation period" occurs (Wilkinson *et al.,* 2003). These issues are considered in this article.

Financial Incentives

The second category of studies assesses the effects of financial incentives intended to regulate place of settlement. This traditional public policy instrument consists of bonuses or tariff increases for doctors practising in low-density zones, or takes the form of funding for years of study in return for which the beneficiary students commit to practising in certain regions for a fixed period of time after graduation. Both types of financial incentives exist in France (Box).

There are few assessments of the effects of bonuses and tariff increases on settlement in certain regions, but these are consistent: the effects are generally assessed as fairly minimal. Moreover, it has been observed that the imbalances are still present in countries that used these early on (in the 1970s and 1980s in Canada and the United States). They were therefore not sufficient to attract enough doctors. Experimental economics studies carried out to document doctors' choices provide some clarification in relation to doctors' limited response to this type of mechanism. Polton *et al.* (2021) contains a review of nine studies analysing preferences expressed by doctors: income level is not seen as a significant decisive factor when doctors have to choose between various scenarios. Using French data, Delattre & Samson (2012) also show that, in order to influence doctors' preferences to the extent of changing their inter-regional distribution, bonus amounts need to be very high. In fact, a report by the Cour des comptes (Cour des comptes, 2014) states that the conventional option – a mechanism which increased the price of consultations for doctors practising in certain regions by 20%, or on average around €25,000 per doctor – only led to the arrival of 60 new general practitioners in private practice during the 2007-2010 period, some of whom might have chosen these regions without this intervention. The targeted zones were, however, quite extensive (4,500 municipalities/2.6 million inhabitants). It should also be noted that these financial incentives could have counter-productive effects. Indeed, many doctors seem to adjust their working time to the income they seek (Rizzo & Blumenthal, 1996; Chanel *et al.*, 2017). Financial incentives could lead to a reduction in the number of consultations offered, as beneficiary doctors receive part of their income from the incentive itself.

There are more studies dealing with the effects of financial assistance to students in exchange for a period of practice in a zone with a low density of doctors. The summary of 43 articles produced by Bärnighausen & Bloom (2009) shows firstly that only seven tenths of students included in these programmes meet their obligation to practise in a low-density zone after graduation – this proportion is 67% on average when the programme offers a buy-out option and 84% when this option is not available. It also appears that the periods doctors who have benefited from these programmes and meet their obligation spend practising in low density zones are variable, but are generally shorter than in the case of doctors who choose to settle there. Financial incentives alone cannot, therefore, balance out the geographical distribution of doctors.

2. Background

2.1. Placement of Interns at Different Universities

Internat (internship) is the name given to post-graduate medicine studies. Originally, Box – **Policies for Regulating the Settlement of Doctors in France**

Freedom of settlement, i.e. the option to freely choose one's place of practice, is included in the 1927 charter written by the doctors' trade unions to establish the principles of private medical practice. This freedom has never been questioned, neither when the social security system was set up in 1945, nor in the successive medical agreements defining the relationship between health insurance bodies and doctors' representatives.

Until the mid-2000s, the policy for regulating settlement was based on a single factor: the setting of the total number of students admitted to continue medicine studies beyond the first year. This number, the *numerus clausus*, is provided each year in a ministerial order which also sets out how is it broken down for each university. However, the distribution of second-year admissions between universities is more or less stable over time (see Appendix 1) and therefore does not constitute a tool for geographical regulation of future settlement.

The evolution of the *numerus clausus* follows a U-curve. Set at 8,588 in 1972, the *numerus clausus* initially saw a downward trend until 1993 (3,500) and then increased until 2020 (9,361 students). The *numerus clausus* was abolished in 2021.

In 2004, general medicine became a medical speciality. In the past, students wishing to enter this field could complete all their studies at the same university. As of 2004, all fifth-year students sit the national ranking tests (*Épreuves Classantes Nationales*, ECN). At the end of these tests they are placed at a university to carry out their postgraduate study, the internship. The placement is made based on of their wishes, their ranking in the ECN and the number of available intern positions. By making intern positions available at universities and withdrawing them, the public decision-maker drives this distribution. The objective of this study is to measure the effect of this distribution of interns among universities on the geographical distribution of settlement.

The Act of 13 August 2004 (*loi du 13 août 2004*) amends the Social Security Code, notably by broadening the scope of negotiations in relation to medical agreements. In particular, it opens up the possibility of introducing financial incentives to settlement in zones where there are considered to be too few doctors.

The 2005 medical agreement, signed in 2007, therefore provides for an increase of up to 20% in the fees of doctors practising in zones of this type, defined by the regional health departments (*Missions Régionales de Santé*). But this tool created a windfall effect given that doctors already settled in these zones benefited from these increases. At a cost of around €20 million per year, only 60 or so new general practitioners in private practice settled in one of the 4,600 target municipalities having a total of 2.6 million inhabitants, between 2007 and 2010 (Cour des comptes, 2014).

The 2011 agreement abolished this arrangement and created the *demography option* (aimed at encouraging new doctors to settle in zones having a shortage) and the *health-solidarity option* (the purpose of which was to encourage doctors practising in other zones to come and work in zones with a shortage on a short-term basis). New zoning was implemented by the regional health agencies (*Agences Régionales de Santé*, ARS). In addition to support with settlement, *the demography option* led to a 10% increase in fees, with a cap of €20,000 per year, conditional on practising in a group practice. It only applied to newly-settled doctors.

Following the medical agreement of 2016, new zoning was carried out, based on a geostatistical indicator (the Localised Potential Accessibility indicator – *l'indicateur d'Accessibilité Potentielle Localisé*) and the local expertise of the ARS. From January 1, 2019, general practitioners in private practice who settle for at least five years in a multidisciplinary nursing home based in a Priority Intervention Zone (*Zone d'Intervention Prioritaire*, ZIP) receive a bonus based on the number of days worked during the week, which can be up to €60,000 if it is increased by the ARS.

In addition, the Act on Hospitals, Health, Patients and Regions (*loi Hôpital Santé Patient Territoire*) of 2009 offers medical students the option of receiving a monthly allowance of €1,200 if they commit to working in a shortage zone after their studies, for a period at least equal to the number of years for which this allowance was received. This public service commitment contract (*Contrat d'Engagement du Service Public*, CES) therefore constitutes a tool for regulating place of practice. Doctors covered by this study were not able to benefit from this new regulation because they completed their internship between 2004 and 2007 and the first CES were signed in 2011.

students who had completed their degree in medicine were housed in hospitals: this is from whence the terms *internat* (*internship)* and *interne (intern)* come from. Interns are placed at a university, where they attend classes. But most of their time is spent on placements that they undertake in hospital settings or practices located close to the university. They are then considered junior doctors: they enjoy a degree of autonomy (they see patients alone and are able to prescribe treatment) while being supervised and trained by senior doctors.

General practice has ranked as a medical speciality as of the 2004 cohort of interns. Previously, students could stay at the university where they had completed their first five years of study. The post-graduate period of study was then called a *residanat* rather than an *internat*. When general practice became a medical speciality, all medicine students were required to join the intern placement process.

This process is centralised. Each year, intern positions are allocated by medical speciality and university. Students in their fifth-year of medicine take a competitive exam, officially known as the *Épreuves Classantes Nationales* (National ranking tests, ECN), better known as the *concours de l'internat* (internship competition), following which they choose an intern position in order of ranking (Billaut, 2005). Students choose, in turn, a combination of Speciality×University. When a student chooses the last intern position in medical speciality Sk available at university Uj, students with a lower ranking can no longer choose the combination Sk×Uj. Such a system causes the lowest ranked students to have only a limited choice of specialties and universities for their internships.

The university options for the internship placement available to the students ranked lowest in the ECN gradually narrowed between 2004 and 2007. According to Vanderschelden (2007), all intern places in general practice at 19 out of 28 universities were filled in 2007, meaning that they were not accessible to the lowest ranked students. This was the case for 15 universities in 2006 and only 11 in 2005. On the contrary, in 2004, the year in which this placement system was implemented, there was a degree of flexibility: universities were able to accommodate more interns than the number of positions they had available. The public decision-maker therefore controls much of the process of distributing interns. However, it does not have complete control. Indeed, the number of available positions is greater than the number of interns placed because at the end of the placement process some students retake their fifth year.[3]

2.2. Major Changes in the Distribution of Interns in General Practice Between 2004 and 2007

The number of interns in general practice doubled (+96%) between 2004 and 2007. This doubling was due to an upstream increase in the *numerus clausus* (see Appendix 1), as well as a change in the distribution of students between specialties in favour of general practice.

This doubling was not homogeneous across universities, which led to a change in the distribution of interns between universities (Table 1). Therefore, the number of interns in general practice placed at the university of Montpellier even decreased by 17% during this period, while it increased for all other universities, but in proportions ranging from +10% (Grenoble) to +400% (Saint-Étienne).

From one year to the next, the variations can be modest, or go in opposite directions, as was the case for the university of Angers where the number of interns placed initially doubled between 2004 and 2005, then dropped by 30%, then doubled again. However, a general trend emerges: by reducing the proportion of available positions in universities in the largest agglomerations (Paris, Lyon, Marseille, Nice, etc.) which are the most attractive (Vanderschelden, 2007), in favour of universities in smaller cities (Amiens, Caen, Reims, etc.), public decision-makers are causing more and more students to do their internships outside the major metropolitan areas (cf. Figure I). There are exceptions, however. The number of interns in general practice placed at universities in the agglomerations of Bordeaux, Lille, and Strasbourg is seeing slightly above average growth. One explanation could be their position, far away from other universities in the case of Bordeaux, or in regions with a low density of doctors (in the Haut-Rhin, Moselle and Vosges departments, the density of general practitioners was less than 9 general practitioners in private practice per 10,000 inhabitants in 2006, while the average density in mainland France slightly exceeded 10). Conversely, the lower than average growth in the number of interns placed at the university of Limoges (+84%) could stem from a difficulty in attracting students, even among the lowest ranked.

This reallocation of intern positions is significant: a third of the placements were reallocated among universities between 2004 and 2007. It seems to reflect the public decision-maker's desire to direct interns to the regions with the greatest shortages in general practitioners. Excluding the Paris and overseas departments and regions (DROM) zones,[4] there were 9.8 general practitioners in private practice per 10,000 inhabitants in 2006 in the university zones[5] where the number of interns more than doubled between 2004 and 2007, while this figure was 11.0 in the other zones.

2.3. Stability of the Distribution of Students Upstream of the Internship

We will use these changes in internship placements, which vary greatly from one university to the next, to identify the effect of the distribution between universities of a cohort of interns on the distribution of settlement locations of the doctors who come from that cohort. It is

3. Because they are not happy with their placement and wish to resit the ECN or because they have not fully completed their fifth year.
4. The Paris zone has a fairly low density of general practitioners (8.5 in 2006), but it has very specific features: its population is younger and the density of specialists much higher. Densities of general practitioners in the overseas departments and regions (DROM) in 2006 are not available.
5. The university zones are defined in Section 3.1.

Table 1 – **Distribution of interns in general practice among universities during the period 2004-2007**

University	2004		2005		2006		2007		Change in number (%) (between 2004 and 2007)
	Number	%	Number	%	Number	%	Number	%	
Amiens	22	1.8	17	1.2	74	3.6	77	3.2	+250
Angers	23	1.9	50	3.5	35	1.7	74	3.1	+222
West Indies-French Guiana	13	1.1	21	1.5	38	1.9	41	1.7	+215
Besançon	18	1.5	25	1.8	50	2.5	50	2.1	+178
Bordeaux	50	4.1	49	3.5	64	3.1	117	4.8	+134
Brest	26	2.1	31	2.2	44	2.2	71	2.9	+173
Caen	26	2.1	37	2.6	51	2.5	71	2.9	+173
Clermont-Ferrand	23	1.9	31	2.2	50	2.5	70	2.9	+204
Dijon	13	1.1	15	1.1	61	3.0	49	2.0	+277
Grenoble	67	5.4	69	4.9	65	3.2	74	3.1	+10
Lille	82	6.7	89	6.3	150	7.4	170	7.0	+107
Limoges	19	1.5	24	1.7	26	1.3	35	1.4	+84
Lyon	85	6.9	95	6.7	111	5.5	125	5.2	+47
Marseille	66	5.4	70	4.9	83	4.1	90	3.7	+36
Montpellier	79	6.4	39	2.8	45	2.2	65	2.7	-18
Nancy	47	3.8	53	3.7	83	4.1	121	5.0	+157
Nantes	50	4.1	60	4.2	65	3.2	75	3.1	+50
Nice	27	2.2	27	1.9	31	1.5	35	1.4	+30
Indian Ocean	9	0.7	15	1.1	17	0.8	25	1.0	+178
Paris	209	17.0	292	20.6	380	18.7	372	15.4	+78
Poitiers	21	1.7	46	3.2	63	3.1	101	4.2	+381
Reims	16	1.3	18	1.3	51	2.5	54	2.2	+238
Rennes	65	5.3	52	3.7	60	3.0	73	3.0	+12
Rouen	30	2.4	29	2.0	65	3.2	77	3.2	+157
Saint-Étienne	11	0.9	22	1.6	50	2.5	55	2.3	+400
Strasbourg	50	4.1	70	4.9	84	4.1	108	4.5	+116
Toulouse	60	4.9	48	3.4	63	3.1	80	3.3	+33
Tours	26	2.1	24	1.7	73	3.6	59	2.4	+127
Total	1,233	*100*	1,418	*100*	2,032	*100*	2,414	100	+96

Reading note: 22 interns in general practice were placed at the university of Amiens in 2004, which represented 1.8% of interns in general practice. 77 were placed there in 2007 (3.2%): the change is +250%.
Source: Intern placement orders.

important to note that while the distribution of interns varied greatly between 2004 and 2007, this was not the case, upstream, for their distribution as undergraduate students. Changes in the distribution of these students could have been a confounding factor. Students placed on internships between 2004 and 2007 began their second year of medicine between September 1999 and September 2002. The distribution of students admitted to the second year, fixed by ministerial orders, remained stable during those four years (see Appendix 1).

3. Data

3.1. Zones of Birth, Internship, Settlement

In order to establish the links between the places of birth, internship, and practice of doctors, we divide up the area by attaching each municipality to the nearest university. For this we use the criterion of the shortest distance (as the crow flies) between the centroid of the municipality in question and the centroids of the municipalities where the universities hosting the interns are located (cf. Figure I). We assume that interns placed at a university carry out most of their placements in the zone thus obtained.[6] The geographical unit of observation is therefore identical for these three points in the doctor's life. Therefore, a doctor born in Mulhouse, who settled in Colmar after having been an intern at the university of Strasbourg, is counted among doctors who were born, did their internship and settle in the Strasbourg zone.

6. With a few exceptions. For example, for historical reasons, interns placed at Lyon can do a placement in the René Sabran hospital in the municipality of Giens, which is attached to the Hospices Civils de Lyon.

3.2. Cross-Referencing Three Sources

The database used in this study has been produced by matching the self-employed databases (produced by INSEE[7]), the *Sirene directory,* and the internship placement ministerial orders.

We extract the general practitioners in private practice, the municipalities where they practise, their sex and their *SIREN* number from each annual self-employed database from 2016 to 2019. The business register identification system (*Système national d'identification et du répertoire des entreprises et de leurs établissements*, Sirene) assigns a SIREN number to companies, organisations and associations. Registration is compulsory. This Sirene directory makes possible *(i)* to lift anonymity of the doctors present in the self-employed databases,[8] which enables them to be matched with the internship placement ministerial orders, *(ii)* to access the municipality of birth of the doctors, information that appears in the Sirene directory.

Finally, placement ministerial orders contain the list of interns, the speciality in which they practise and the university where they are placed. We only include students placed in internships in general practice. These orders also indicate the ECN ranking. Some names appear in several orders from different years. They correspond to students who resat the ECN. As a result, we do not match the raw placement orders, but first remove from the order for year *t* all the names that reappear in the orders for years *t+1* or *t+2*. Matching is done by surname, first names, sex and year of birth, except for the order for 2006 which does not contain the year of birth.

We only include general practitioners in private practice born in France and having done their internship between 2004 and 2007. Using this period allows us to observe the place of settlement twelve years after the beginning of the internship, or around eight years after the thesis. The place of practice twelve years after the beginning of the internship is more permanent than the place of practice just after thesis acceptance.[9]

This data is not exhaustive: registration in the Sirene directory does not necessarily mean that the information contained therein will be made available. In addition, we exclude doctors for whom the municipality of birth or the municipality of practice is not provided.

Of the 5,048 general practitioners in private practice who sat the internship competition between 2004 and 2007 that we identify at least once in the self-employed databases, we only include those observed as working on a private basis twelve years after the beginning of their internship in our analyses. The municipality of practice of the general practitioner twelve years after the beginning of their internship is considered as their municipality of settlement in this article. For the 2004 cohort (respectively 2005, 2006, 2007), the municipality considered is, therefore, the one where the general practitioner practises in 2016 (respectively 2017, 2018, 2019). General practitioners who have only been in private practice for a short time (a few locum posts at the start of their careers for example) and have then been employed are therefore not included in our analyses. The final number is 3,798 general practitioners in private practice. We consider the resulting database to be representative (see Appendix 2). We observe:

- the zone of birth (the municipalities of birth are aggregated at the university zone level, see Section 3.1),

- the university where the student was placed on internship,

- the settlement zone (cf. Section 3.1) twelve years after the beginning of the internship,

- the sex of the doctor and their ECN ranking: as the cohorts are of different sizes, this ranking is standardised.

It is important to bear in mind that the data only concerns general practitioners working on a private basis. The data is indeed constructed using the SIREN numbers of general practitioners in private practice. This article therefore provides information on the link between the distribution of interns in general practice and the distribution of general practitioners in private practice.

3.3. Descriptive Statistics

Twelve years after the start of their internship, more than two thirds (68%) of general practitioners in private practice are practising in the zone where they did their internship. We therefore find an important link, already documented, between place of internship and place of settlement (Vilain & Niel, 2007; Delattre & Samson, 2012). More interestingly, we observe a correlation between the increase in the number

7. The French National Institute of Statistics and Economic Studies.
8. The Sirene directory enable access to the surname and first names of doctors in private practice using their SIREN number.
9. We are also limited by the year 2004 (before 2004, general practice was not recognised as a medical speciality and was not included in the internship placement orders). In 2008, the placement of interns did not give rise to a named order. We therefore do not know the distribution of this cohort among universities.

of interns at a university between 2004 and 2007 and the increase in the settlement of doctors from these cohorts in the university zone (Figure II).

Place of birth is also a significant decisive factor in relation to place of settlement. About half (46%) of the doctors practise in the zone (see Figure I) in which they were born and one third (32.6%) in their department of birth. We also observe that half of the doctors practise less than 85 km (as the crow flies) from their municipality of birth.

4. Effects of Place of Birth and Place of Internship on Place of Settlement

Place of birth and place of internship are both decisive factors in relation to place of settlement. However, these effects are intertwined, since a significant proportion of doctors undertake an internship in the zone in which they were born. We intend to separate these two effects here.

The data allows for calculation of the proportions of general practitioners in private practice, from these cohorts, settled in each zone. We calculate these proportions using the places of practice observed twelve years after the beginning of the internship. For example, 1.4% of general practitioners in private practice who started their internship in 2004 work in the Amiens zone in 2016. This proportion increased for interns in the 2005, 2006 and 2007 cohorts (respectively of 2.7%, 2.6% and 2.5%) whose places of settlement were observed in 2017, 2018 and 2019 respectively.

Finally, the data allows for calculation of the proportions of general practitioners in private practice born in each zone.

It is therefore possible to compare the proportions of births, internships and settlement: we consider the panel model (1), in which *t* indexes the cohorts and *j* indexes universities or university zones.

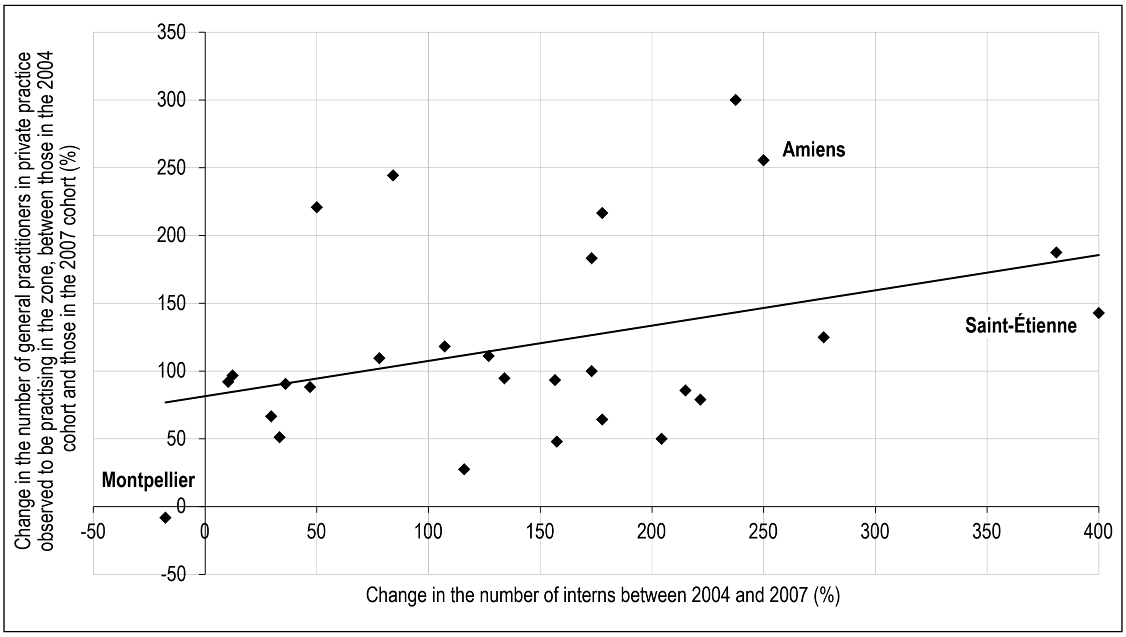
$$S_{jt}^{Installations} = \alpha_1 S_{jt}^{Internes} + \alpha_2 S_{jt}^{Naissances} + \beta_j + \gamma_t + \varepsilon_{jt} \quad (1)$$

with $j \in \{1;2;\ldots;28\}$ and $t \in \{2004;\ldots;2007\}$

where:

- $S_{jt}^{Installations}$ is the proportion of general practitioners in private practice from the cohort *t* practising in zone *j* in *t+12*,
- $S_{jt}^{Internes}$ is the proportion of interns from cohort *t* placed at university *j*,
- $S_{jt}^{Naissances}$ is the proportion of general practitioners in private practice from cohort *t* who were born in zone *j*,
- β_j and γ_t are fixed effects of zone and date respectively.

Figure II – **Correlation between the change in the number of interns at a university and the change in the number of doctors settling in its zone**



Notes: The place of settlement is observed 12 years after the beginning of the internship. The slope of the least squares line shown in the figure is 0.26.
Reading note: Between 2004 and 2007, the number of interns placed at the university of Amiens increased by 250%. The number of general practitioners in private practice from the 2007 cohort settled in the Amiens zone is 256% higher than the number of general practitioners in private practice from the 2004 cohort settled in this zone.
Source and coverage: Internship placement orders and self-employed database (INSEE). General practitioners in private practice who started their internship in 2004 or 2007.

Intuitively, it can be expected that the proportion of doctors practising in zone *j* will depend heavily on its attractiveness. For example, the average number of days of sunshine per year is identified in Delattre & Samson (2012) as having an influence on doctors' choice of settlement place. This type of attractiveness factor and all such factors that are invariant over time are controlled by the fixed effect β_j.

The proportion of students admitted to the second year at each university four years earlier is not introduced as a control variable in this model since it is constant over time (see Appendix 1).

We also test the addition of two control variables:

- The proportion of women among the interns of cohort *t* placed at university *j*,
- The proportion of students with low ranking in the internship competition. More precisely, within each group of interns placed at university *j* in year *t*, we use the proportion of those whose ranking in the internship competition (ECN) is in the lowest 20%.

The estimated coefficients are shown in Table 2.[10] Appendix 3 provides robustness checks for these estimates.

Without taking place of birth into account, we find that, on average, a one percentage point (pp) increase in the proportion of general practice interns placed at a university is associated with a 0.44 pp increase in the proportion of general practitioners in private practice who settle in this zone. The estimated effect is lower (0.35 pp), but the difference is not statistically significant at the usual thresholds. We find that the distribution of place of birth has an effect of the same order of magnitude (0.37 pp). The place where the doctor grew up is known to be a decisive factor in settlement place decision. In this article, doctor place of birth is used, in the absence of any more reliable information, to represent the place where he grew up. If, for example, we knew the distribution of places where the baccalaureate was awarded, we would undoubtedly find that this distribution has an even greater effect on place of settlement, perhaps to the detriment of that associated with the distribution of interns. Adding the control variables does not significantly change these results.

Paris is an atypical zone where a fifth of all intern positions are based. The link between place of internship and place of settlement is more significant, regardless of the specification, when we repeat the estimates excluding the interns placed at universities in this zone (see the three right-hand columns of Table 2), with no significant disparities. These slightly higher estimates could reflect the increased opportunities for salaried employment in the Paris region or a residential trajectory of young doctors similar to that of many young professionals, from the Paris region to the rest of France.

Our estimates therefore show that the distribution of place of internship has a significant effect on that of place of settlement, and the distribution of place of birth has an effect of the same magnitude.

The estimated effect of distribution of place of birth clearly reduces the effect of the distribution

10. We find a variance inflation index equal to 8.5, which reflects a situation in which correlations between the proportions of births, internships and settlement are moderate. Standard practice is to take problems related to multicollinearity into account when this index exceeds 10.

Table 2 – **Effect of intern distribution on settlement distribution**

	All zones			All zones except Paris		
	(1)	(2)	(3)	(1)	(2)	(3)
Proportion of interns	0.44*** (0.07)	0.35*** (0.07)	0.40*** (0.10)	0.52*** (0.08)	0.42*** (0.08)	0.45*** (0.10)
Proportion of births	-	0.37*** (0.09)	0.35*** (0.10)	-	0.38*** (0.10)	0.38*** (0.10)
Controls (ECN ranking and proportion of wom-en)	No	No	Yes	No	No	Yes
R²	0.96	0.97	0.97	0.88	0.89	0.93
Observations	28 x 4	28 x 4	28 x 4	27 x 4	27 x 4	27 x 4

Notes: The settlement of each cohort of interns is observed twelve years after the beginning of the internship. *** corresponds to the significance threshold at 1%, ** at 5%, and * at 10%.
Reading note: On average, a one percentage point increase in the proportion of interns placed at a university is associated with a 0.44 percentage point increase in the proportion of private doctors settling in the university zone when place of birth is not taken into account.
Source and coverage: internship placement orders, self-employed database (INSEE) and Sirene directory (INSEE). General practitioners in private practice who started their internship between 2004 and 2007.

of places where doctors grew up. Therefore, in line with the rural pipeline programmes (cf. Section 1), our estimates show that to increase the number of doctors in a region, a policy consisting of encouraging secondary school students in this region to engage in medical studies, and providing them with support, could contribute to a better geographical distribution of settlement.

5. Modification of the Distribution of Settlement Following a Reallocation of Intern Positions or Places for Entry to the Second Year

To what extent did the distribution of interns in 2007 lead to a distribution of settlement very different to that which would have occurred if the distribution of interns in 2004 had been maintained?

What distribution of settlement could be expected if a policy was put in place aiming to recruit medical students in zones with a shortage of doctors?

In this section, we suggest the simulation of counterfactual situations in order to address these questions.

5.1. Econometric Specifications

In order to simulate counterfactual situations, we adapt a competition model introduced by Berry (1994), basing our approach on Silhol & Wilner (2023). In this model, potential consumers face a number of differentiated products and purchase the one that maximizes their utility; they may also decide not to purchase at all. When the consumer opts for one of the products, he "reveals" a level of utility of that product (its hedonic price). This model can be transposed to young doctors who have to choose one of the 28 zones in which to settle as a general practitioner in private practice, therefore revealing their level of utility for the zone. To complete the transposition, interns who do not settle as private practitioners (because they are employed, not working or practising abroad) play the role of consumers who decide not to buy.

The adaptation of the model leads to the estimation of equation (2) in which δ_{jt} represents the level of attractiveness exerted by zone j on the general practitioners from cohort t ($t \in \{2004;\ldots;2007\}$ and $j \in \{1;2;\ldots;28\}$). The attractiveness of each zone depends on its specific features, considered constant over time and captured by the fixed effect β_j. It also depends on the proportion $S_{jt}^{Internes}$ of interns who have been placed there: the greater the number of interns creating links with this zone during their internship, the more attractive the zone is to the cohort. Finally, it depends on the proportion of births, $S_{jt}^{Naissances}$, doctors having a strong propensity to settle where they grew up.

$$\delta_{jt} = \alpha_1 S_{jt}^{Internes} + \alpha_2 S_{jt}^{Naissances} + \beta_j + \gamma_t + \varepsilon_{jt} \qquad (2)$$

Berry (1994) used a measure of attractiveness δ_{jt} ($j \in \{1;2;\ldots;28\}$) in the form $\delta_{jt} = \log s_{jt} - \log s_{0t}$, where s_{jt} is the proportion of interns settled in private practice in zone j of all interns in cohort t, and s_{0t} is the proportion of interns who are not observed as practising on a private basis twelve years after the beginning of the internship. δ_{0t} denotes the attractiveness associated with the decision not to practise on a private basis in France. This measure enables an expression of s_{jt} which depends only on δ_{jt} given that the nullity of δ_{0t} ensures the equivalence of equalities (3) and (4):

$$\delta_{jt} = \log s_{jt} - \log s_{0t} \qquad (3)$$

$$s_{jt} = \frac{e^{\delta_{jt}}}{\sum_{k=0}^{28} e^{\delta_{jt}}} \qquad (4)$$

The coefficients of model (2) are estimated by ordinary least squares, based on the data used in the previous section. These then enable the levels of attractiveness $\hat{\delta}_{jt}$ of each of the zones to be estimated, corresponding to given distributions of interns in universities ($S_{jt}^{Internes}$) and of births in the zones ($S_{jt}^{Naissances}$). The equality (4) then enables an estimate to be made of the corresponding distribution of place of settlement (s_{jt}).

Models (1) (Section 4) and (2) (Section 5) are, therefore, complementary. The coefficients estimated in model (1) are interpreted directly as an effect on the proportion of settlement in a zone, which model (2) does not allow, due to the form of the variable explained. Conversely, model (2) enables a direct estimate to be obtained (via equality (4)) of the distribution of place of settlement for given distributions of place of birth and place of internship, which model (1) does not allow.[11]

Table 3 provides estimates of coefficients α_1 and α_2 of model (2).[12]

11. Model (1) does not allow counterfactual situations to be simulated. If distributions of interns in universities and of places of birth were chosen, model 1 would give proportions of settlement that do not amount to 100 and could in some cases be negative.

12. As models (1) and (2) are not the same, since the variables explained are different, it is unsurprising that the estimates in Table 3 are different from those in Table 2.

Table 3 – **Estimates of model for choice of place of settlement (model 2)**

	All zones			All zones except Paris		
	(1)	(2)	(3)	(1)	(2)	(3)
Proportion of interns	0.12*** (0.03)	0.09*** (0.03)	0.09*** (0.03)	0.15*** (0.03)	0.12*** (0.03)	0.13*** (0.04)
Proportion of births	-	0.11*** (0.04)	0.11*** (0.04)	-	0.13*** (0.04)	0.13*** (0.04)
Controls (ECN ranking and proportion of women)	No	No	Yes	No	No	Yes
R²	0.92	0.92	0.93	0.90	0.91	0.92
Observations	28 x 4	28 x 4	28 x 4	27 x 4	27 x 4	27 x 4

Notes: Settlement of each cohort of interns is observed twelve years after the beginning of the internship. *** corresponds to the significance threshold at 1%, ** at 5% and * at 10%.
Source and coverage: Internship placement orders, self-employed database (INSEE) and Sirene directory (INSEE). General practitioners in private practice who started their internship between 2004 and 2007.

5.2. Aggregation Into Two Types of Zones

Estimates are made at the level jt (with $j \geq 1$) as described above. But the results are presented after the zones are aggregated into two groups, according to whether they saw a particular increase in interns (i.e. the number of interns more than doubled between 2004 and 2007) or not (cf. Figure I). This aggregation allows for a clearer representation of public policy, which has involved an increase in the number of interns in general practice at 18 universities in particular, to the detriment of the other 10. It also enables more robust results to be presented.

The proportions of births, internships and settlement in these two types of zones are presented in Figure III. By construction, the curves are symmetrical (the sum of the two parts is 100%[13]). The doctors from the 2004 and 2005 cohorts, whose places of settlement are observed respectively in 2016 and 2017, mostly settled in zones that did not see a particular increase in interns. For the 2006 and 2007 cohorts, the distribution of settlement is more balanced between the two types of zones. This change must be compared to the distribution of these doctors in internships, twelve years earlier, and perhaps also to the distribution of their places of birth. The proportions of doctors from the 2006 and 2007 cohorts born in zones seeing a particular increase in interns are slightly higher than those from the 2004 and 2005 cohorts.

5.3. Simulation of the Absence of Change in the Distribution of Interns Among Universities

From equation (2), we obtain an estimate of the average levels of attractiveness of each zone in 2005, 2006 or 2007 assuming the 2004 distribution is maintained by:

$$\hat{\delta}_{jt}^{R_{2004}} = \hat{\delta}_{jt} - \hat{\alpha}_1 \left(s_{jt}^{Internes} - s_{j2004}^{Internes} \right)$$
$$\forall t \in \{2005; 2006; 2007\}$$

Simulated market shares are obtained through equality (4): $\hat{s}_{jt}^{R_{2004}} = \dfrac{e^{\hat{\delta}_{jt}^{R_{2004}}}}{\sum_{k=0}^{28} e^{\hat{\delta}_{jt}^{R_{2004}}}}$

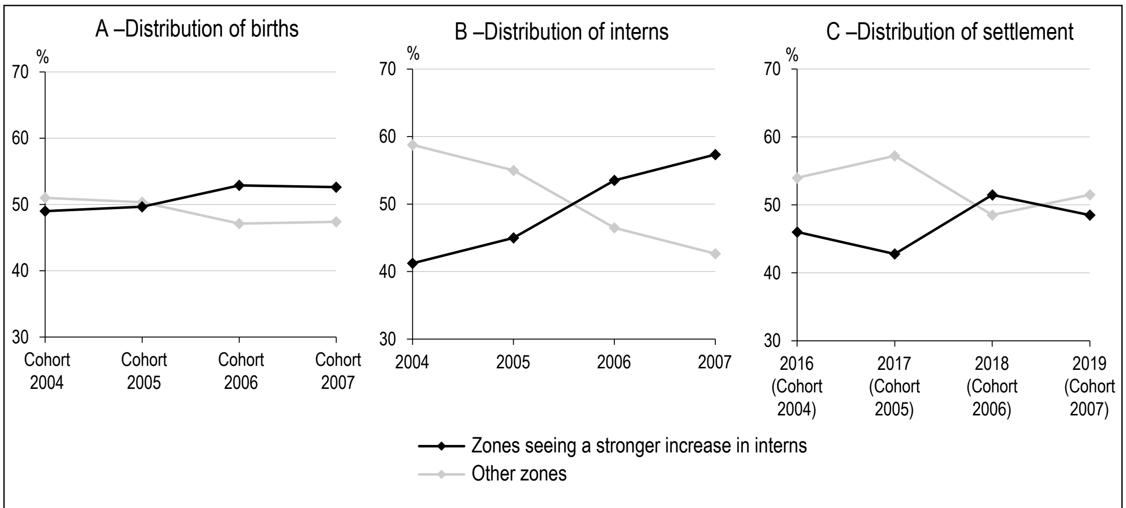
They are then added up by types of zone and represented in Figure IV.

According to this modelling, maintaining the 2004 distribution of interns would have led to settlement of a smaller proportion of doctors in zones seeing an increase in 2006 and 2007. In other words, the reallocation of interns carried out between 2004 and 2007 seems to have led to a reallocation of settlements. More specifically, the disparity between actual and simulated settlement in the two types of regions is 6.4 percentage points for the 2006 cohort and 2.7 percentage points for the 2007 cohort. Extrapolating these disparities to all general practitioners from these two cohorts of interns (those observed to be in private practice and others), we estimate that the change in the distribution of interns led around 200 general practitioners (in private practice or employed) to practise in zones seeing a particular increase in interns rather than in other zones.[14]

13. The model gives the proportion s_{0t} of interns who do not work on a private basis twelve years after the beginning of the internship and the proportions s_{jt} of doctors in private practice settled in each of the zones j, all these proportions being compared with all interns from cohort t. Figure III-C conversely represents the proportion of doctors in private practice settled in a type of zone compared solely with general practitioners in private practice.

14. In 2020, about 48,000 general practitioners (in private practice, employed, or mixed) practised in zones seeing a particular increase in interns and about 52,000 in other zones.

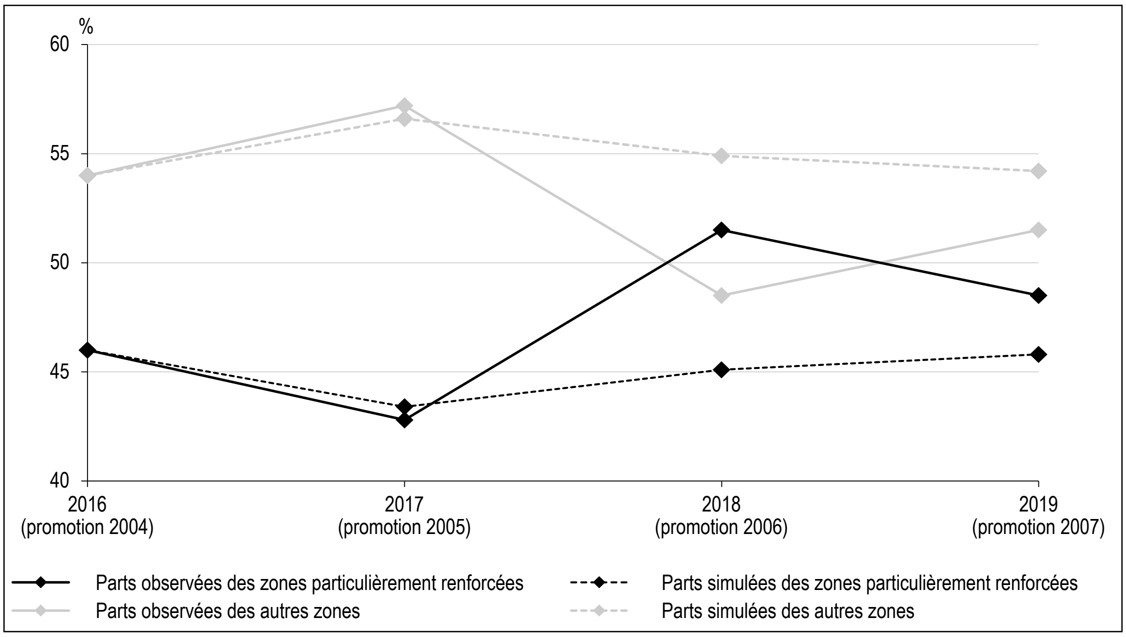
Figure III – **Changes in place of birth, of internship and of settlement according to the types of zones**



Increase in interns > 100% between 2004 and 2007	**Zones seeing a particular increase in interns:** Amiens, Angers, West Indies-French Guiana, Besançon, Bordeaux, Brest, Caen, Clermont-Ferrand, Dijon, Lille, Nancy, Indian Ocean, Poitiers, Reims, Rouen, Saint-Etienne, Strasbourg, Tours	**Other zones:** Grenoble, Limoges, Lyon, Marseille, Montpellier, Nantes, Nice, Paris, Rennes, Toulouse

Notes: The municipality of settlement observed is where the doctors are practising twelve years after the beginning of the internship.
Reading note: Of general practitioners in private practice who started their internship in 2004, 49% were born in a zone seeing a stronger increase in interns, 41% did their internship there and 46% settled there.
Source and coverage: Self-employed database (INSEE), Sirene directory (INSEE) and internship placement orders. General practitioners in private practice who started their internship between 2004 and 2007.

Figure IV – **Simulation of distribution of settlement if the 2004 distribution had been maintained**



Notes: The municipality of settlement observed is where the doctors are practising twelve years after the beginning of the internship.
Reading note: Of general practitioners in private practice who started their internship in 2007, 48.5% are observed to have settled in a zone seeing a particular increase in interns. The proportion of settlement of this type, if the distribution of interns of 2004 had been maintained, is estimated at 41.6%.
Source: Self-employed database (INSEE), Sirene directory (INSEE) and internship placement orders. General practitioners in private practice who started their internship between 2004 and 2007.

5.4. Simulation of the Recruitment of Local Students

At each university, students enrolled in the first year sit exams and are ranked in order of their results. During the period we are interested in, the number admitted to the second year was fixed centrally, by the *numerus clausus* and its breakdown by university. Those admitted to the second year then continued their studies at the same university.

Interns from the 2004 to 2007 cohorts were admitted to the second year of medicine between 1999 and 2002. During those years, the distribution of those admitted to the second year changed very little (see Appendix 1). Here, we simulate a reform of the distribution of admissions to the second year of medical studies for the years 1999 to 2002 which would have consisted of admitting more students to universities in zones seeing a particular increase in interns.[15] (as defined in Section 5.2). To simulate this reform with the data used in this article, we assume that it results in a change in the distribution of doctors' places of birth. The underlying assumption is that undergraduate students enrolled at a university were born in the zone of that university.

In this paragraph, we suggest the simulation of a reform of the distribution of students admitted to the second year which would have consisted of increasing by 10 percentage points the proportion of students admitted to the second year in universities in zones seeing the highest increases in interns. We assume that this reform results in a proportion of doctors born in zones seeing a particular increase in interns which is 10 percentage points higher in actuality.[16] This reallocation of places of birth is made to the detriment of other universities and pro rata to the births actually observed in each zone.

The attractiveness associated with settlement in each of the zones, for each of the cohorts, is estimated by:

$$\hat{\delta}_{jt}^{Simulation-naiss} = \hat{\delta}_{jt} - \hat{\alpha}_2 \left(s_{jt}^{Naissances} - s_{jt}^{Naissances-simulées} \right) \quad \forall t \in \{2004;...;2007\}$$

The proportions of settlement simulated in each of the zones and for each cohort are calculated using equality (4) and then aggregated according to the two types of zones (Figure V).

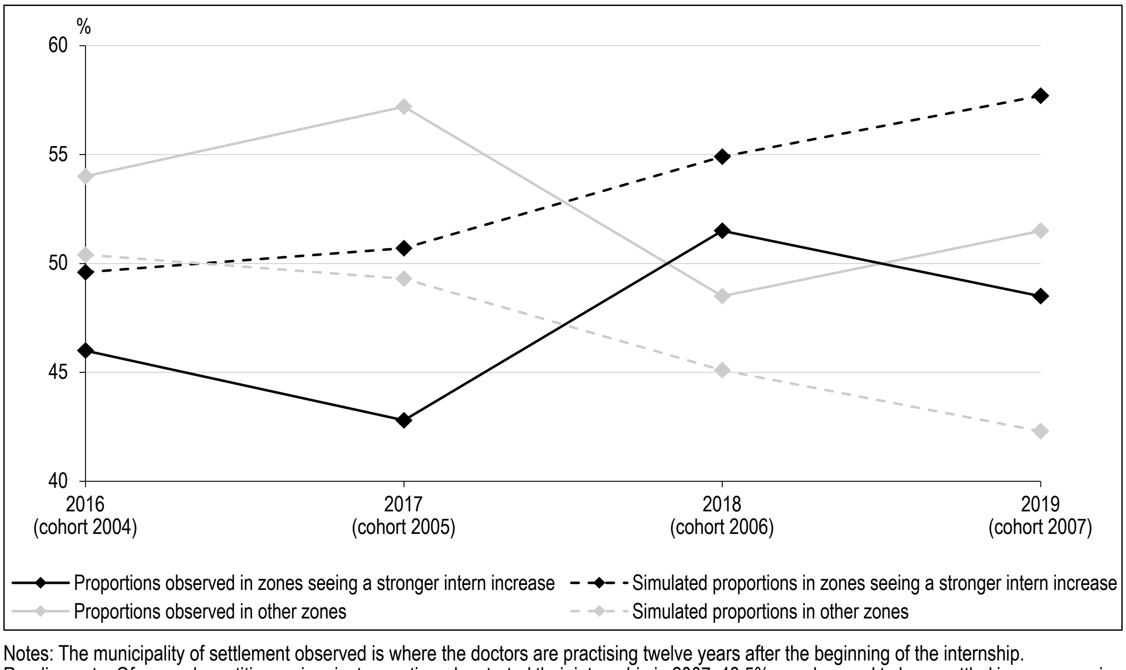
Using the same approach as in Section 5.3, we extrapolate the estimated disparities in settlement between the two types of zone to all general practitioners (in private practice, employed and mixed). The increase in settlement in favour of zones seeing a particular increase in doctors to the detriment of other zones, associated with the change to the distribution of students admitted to the second year, is around 450 general practitioners for the four cohorts considered, including around 300 for the 2006 and 2007 cohorts alone.

In Section 5.3, we estimated the increase in general practitioners practising in zones seeing

15. For example, the Angers zone is one of the zones seeing the highest increases in interns (Section 5.2). Each year between 1999 and 2002, it received 2.0% of those admitted to the second year (see Appendix 1). The reform simulated here would have involved an increase in this proportion.

16. This increase of 10% corresponds to a proportion of reallocation of places of birth similar to the proportion of intern positions reallocated between 2004 and 2007.

Figure V – **Simulation of distribution of settlement if the proportion of doctors born in zones seeing a particular increase in interns had been 10 percentage points higher**



Notes: The municipality of settlement observed is where the doctors are practising twelve years after the beginning of the internship.
Reading note: Of general practitioners in private practice who started their internship in 2007, 48.5% are observed to have settled in a zone seeing a stronger increase in interns. The proportion of this settlement, if an additional 10 percentage points of interns from the 2007 cohort were born in these zones, is estimated at 57.7%.
Source and coverage: Self-employed database (INSEE), Sirene directory (INSEE) and internship placement orders General practitioners in private practice who started their internship between 2004 and 2007.

a particular increase in interns associated with changes in the distribution of interns from these two cohorts at around 200. Compared to the distribution of interns in 2004, the 2006 distribution corresponds to a relocation of 12% of placements, and the 2007 distribution to a relocation of 16% (Figure V). It therefore appears that a more moderate rise (+10%) in students coming from zones seeing a particular increase in interns would produce a higher increase. However, the disparity between the increases in settlement obtained with the two simulations should be interpreted with caution. These increases are calculated using an estimate of the coefficients of model (2), and a method based on fairly strong assumptions.

* *
*

The analyses set out above are based on individual data relating to around 3,800 general practitioners in private practice who started their postgraduate medicine studies (internship) between 2004 and 2007. The combined presence, in the dataset, of places of birth, internship and settlement enables to shed light on some aspects of doctor settlement behaviours. In particular, we have been able disentangle the effects place of internship from place of birth on place of settlement.

We find that the geographical distribution of interns has a significant effect on the geographical distribution of their places of settlement. On average, we find that an increase of one percentage point in the proportion of interns placed at a university is associated with an increase of around 0.4 percentage points in the proportion of general practitioners in private practice, from these cohorts, who settle in the university zone. Therefore, the reallocation of intern positions carried out between 2004 and 2007 acted as a tool for regulating place of settlement. The distribution of place of birth has an effect of comparable magnitude.

Place of internship and place of birth are not the only factors that can influence the settlement choices of young doctors. In particular, future research could explore how these factors relate to other factors known to be decisive in relation to place of settlement, such as spouse's profession and origin where applicable, or the role of certain regional amenities such as multidisciplinary nursing homes (Chevillard & Mousquès, 2020). These regional analyses will undoubtedly benefit from being based on a more detailed geographical breakdown than the 28-zone approach used in our study. Lastly, it would be interesting to obtain information on the choice of location of doctors who do not work on a private basis, to broaden the scope of our results.

Our results suggest conclusively that a policy based on local recruitment of medical students from secondary school students in the regions needing more doctors could be effective. It would be a question of building on the fact that a number of doctors wish to settle near the places where they grew up. Such a policy could address the unequal distribution of training capacity in the region, for instance by building on inter-hospital type arrangements, allowing an intern to carry out certain placements in hospitals outside the zone of the university where they are placed. ☐

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APPENDIX 1

STABILITY OF THE DISTRIBUTION OF STUDENTS ADMITTED TO THE SECOND YEAR OF MEDICINE STUDIES

The scope of this study consists of general practitioners in private practice who started their internships in the 2004 to 2007 academic years. They began their second year of medicine between 2000 and 2003. The number of students admitted to continue their medical studies at the end of the first year was fixed by ministerial order for each university.

The total number of students admitted to continue their medicine studies beyond the first year grew between 2000 and 2003 (increase in *numerus clausus*), but their distribution among universities remained stable (Table A1).

Table A1 – **Distribution of second-year medicine students**

	2000-2001		2001-2002		2002-2003		2003-2004	
	%	#	%	#	%	#	%	#
Amiens	2.3	*89*	2.4	*98*	2.4	*112*	2.4	*122*
Angers	2.0	*77*	2.0	*81*	2.0	*93*	2.0	*101*
Besançon	2.1	*79*	2.1	*86*	2.1	*98*	2.1	*106*
Bordeaux	5.4	*208*	5.3	*218*	5.1	*242*	5.1	*262*
Brest	1.9	*72*	1.9	*78*	1.9	*89*	1.9	*96*
Caen	2.2	*85*	2.3	*93*	2.3	*107*	2.3	*117*
Clermont-Ferrand	2.3	*88*	2.3	*96*	2.3	*110*	2.3	*119*
Dijon	2.4	*94*	2.5	*102*	2.5	*117*	2.5	*127*
Grenoble	2.4	*92*	2.4	*98*	2.4	*112*	2.4	*121*
Lille	7.3	*281*	7.2	*294*	7.2	*337*	7.1	*364*
Limoges	1.8	*69*	1.8	*75*	1.8	*86*	1.8	*93*
Lyon	6.4	*248*	6.3	*257*	6.0	*283*	6.0	*306*
Marseille	5.2	*200*	5.1	*211*	5.1	*242*	5.1	*261*
Montpellier-Nîmes	3.3	*125*	3.3	*135*	3.3	*155*	3.3	*168*
Nancy	3.8	*146*	3.8	*156*	3.8	*179*	3.8	*193*
Nantes	2.7	*102*	2.6	*108*	2.6	*124*	2.6	*134*
Nice	1.9	*73*	1.9	*79*	1.9	*90*	1.9	*98*
Paris	23.4	*900*	23.2	*950*	23.4	*1,098*	23.3	*1,187*
Pointe-à-Pitre	0.4	*15*	0.4	*15*	0.5	*25*	0.6	*32*
Poitiers	2.2	*83*	2.2	*91*	2.2	*104*	2.3	*115*
Reims	2.3	*90*	2.4	*98*	2.4	*112*	2.4	*121*
Rennes	2.5	*96*	2.4	*100*	2.4	*115*	2.5	*125*
Rouen	2.7	*105*	2.7	*112*	2.7	*128*	2.7	*139*
Saint-Étienne	1.6	*63*	1.6	*65*	1.7	*80*	1.7	*87*
Saint-Denis de La Réunion	0.0	*0*	0.1	*6*	0.1	*7*	0.2	*10*
Strasbourg	3.4	*131*	3.4	*140*	3.4	*160*	3.4	*173*
Toulouse	3.7	*142*	3.7	*152*	3.7	*174*	3.7	*189*
Tours	2.5	*97*	2.6	*106*	2.6	*121*	2.6	*132*
Total	*100*	*3,850*	*100*	*4,100*	*100*	*4,700*	*100*	*5,098*

Notes: Medicine students in their second year in the 2000-2001 academic year sat the internship competition in 2004.
Reading note: In the 2000-2001 academic year, 2.3% of second-year medicine students were enrolled at the university of Amiens.
Source: Ministerial orders setting the number of first-year undergraduate medicine students authorised to continue their medicine studies following the final examinations of the academic year.

APPENDIX 2

REPRESENTATIVENESS OF THE DATABASE

The Direction de la Recherche, des Études, de l'Évaluation et des Statistiques (DREES) publishes, by five-year age groups, the distributions of general practitioners working on a private basis by region of practice and sex. We use the 2017 distribution for the 35-39 year old age group as a comparator. 93.3% of the doctors to whom the data used in this study relates were aged between 34 and 41 in 2017.

The regional distribution of general practitioners in private practice in our data is consistent with the distribution of all general practitioners in private practice (Table A2). The higher proportion of women in our data undoubtedly stems from the fact that our data and the DREES distributions have slightly different coverage. Our data does not include general practitioners in private practice born abroad (whether they qualified in France or abroad).

Foreign-born general practitioners in private practice is a not well documented population. Le Breton-Lerouvillois *et al.* (2015) states that in the early 2010s, doctors who qualified abroad accounted for 10% of all doctors and that this group is 63% male. Further, they seem to be unevenly distributed across the country, with a particular concentration in Île-de-France, Auvergne-Rhône-Alpes and PACA. These are precisely the regions where the rate of women is higher in our data than in the comprehensive data.

Table A2 – **Comparison of distribution by region and sex of doctors in the data used for all doctors, for the 35–39 year old age group, in 2017**

	Breakdown by region				Proportion of women		
	Data		All				
Region	%	#	%	*CI 95*	Data	All	*CI 95*
Bourgogne-Franche-Comté	4.4	*144*	4.1	*[2.4; 5.9]*	63.9	57.5	*[49.1; 65.8]*
Brittany	7.0	*231*	6.4	*[4.6; 8.1]*	67.1	59.2	*[52.6; 65.7]*
Centre-Val-de-Loire	3.1	*102*	2.9	*[1.1; 4.6]*	61.8	60.1	*[50.2; 70.0]*
Corsica	0.3	*9*	0.2	*[-1.5; 2.0]*	22.2	45.7	*[12.4; 79.0]*
DROM	2.8	*93*	3.4	*[1.65; 5.15]*	51.6	64.1	*[53.7; 74.5]*
Grand-Est	8.0	*262*	7.8	*[6.1; 9.6]*	61.1	55.6	*[49.4; 61.7]*
Hauts-de-France	7.9	*259*	8.0	*[6.3; 9.7]*	47.5	44.1	*[37.9; 50.3]*
Île-de-France	12.6	*414*	13.8	*[12.0; 15.5]*	68.4	62.4	*[57.4; 67.3]*
Nouvelle-Aquitaine	9.2	*303*	10.1	*[8.4; 11.9]*	54.5	51.2	*[45.4; 56.9]*
Normandy	5.1	*166*	4.9	*[3.2; 6.7]*	63.3	58.9	*[51.1; 66.7]*
Occitanie	9.9	*325*	9.5	*[7.8; 11.3]*	66.2	63.5	*[58.0; 69.1]*
PACA	6.5	*214*	7.6	*[5.8; 9.3]*	59.8	56.0	*[49.2; 62.8]*
Pays de la Loire	7.3	*240*	6.5	*[4.8; 8.3]*	69.6	63.1	*[56.6; 69.6]*
Rhône-Alpes	15.7	*517*	14.8	*[13.0; 16.5]*	60.7	56.5	*[52.1; 60.9]*
Total	100	*3,279*	100		61.6	58.8	*[57.1; 60.5]*

Notes: (1) For doctors in the study data, the enrolment region is considered to be the region of registration in the SIREN directory. For national data, it is registration with the college of Physician (*Conseil de l'ordre des médecins*). These two approaches go hand in hand. (2) By construction, doctors born abroad are not included in our data. This may explain the differences observed, at least partially.
(3) To make this comparison, we include all doctors from our data practising in 2017 rather than all doctors in private practice twelve years after the beginning of the internship: the total number (3,279) is therefore not identical to that in the other tables.
Reading note: 4.4% of the doctors in our data aged 35 to 39 in 2017 practised in the Bourgogne-Franche-Comté region in 2017. This was the case for 4.1% of all general practitioners in private practice in this age group in 2017.
Coverage: General practitioners in private practice aged between 35 and 39 in 2017.

APPENDIX 3

ROBUSTNESS CHECKS

Table A3 below presents the estimates for the model in Section 4 :

1) By dividing up the country based on the administrative regions that existed before the 2015 territorial reform (robustness 1),
2) By calculating the proportions of interns on the sole basis of the doctors in our database identified as working on a private basis twelve years after the internship, rather than on the basis of placement orders.

The estimated coefficients are not significantly different from those in Table 2.

Table A3 – **Effect of distribution of interns on distribution of settlement – Robustness Checks**

	Robustness 1 The division of the country corresponds to the administrative regions in force before 2015				**Robustness 2** The proportions of interns are calculated on the basis of doctors working on a private basis 12 years after the internship			
	All zones		All zones except Paris		All zones		All zones except Paris	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Proportion of interns	0.38*** (0.07)	0.28*** (0.07)	0.43*** (0.08)	0.31*** (0.07)	0.54*** (0.06)	0.46*** (0.07)	0.57*** (0.06)	0.50*** (0.07)
Proportion of births	-	0.52** (0.10)	-	0.55*** (0.11)	-	0.24** (0.09)	-	0.21*** (0.10)
Controls (ECN ranking and proportion of women)	No	No	No	No	No	No	No	No
R^2	0.97	0.98	0.96	0.97	0.97	0.97	0.93	0.94
Observations	23 x 4	23 x 4	22 x 4	22 x 4	28 x 4	28 x 4	27 x 4	27 x 4

Notes: Settlement of each cohort of interns is observed twelve years after the beginning of the internship. The PACA and Corsica regions are grouped together. The DROM are grouped together, as West Indies-French Guiana and Indian Ocean. *** corresponds to significance thresholds at 1%, ** at 5%, and * at 10%.
Source and coverage: Internship placement orders, self-employed database (INSEE) and Sirene directory (INSEE). General practitioners in private practice who started their internship between 2004 and 2007.