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Main determinants of private physicians' location in Algeria: An empirical study

Ahcène ZEHNATI

Health economist, Researcher at Centre for Research in Applied Economics for Development
(CREAD), Algiers 16011, ALGERIA, e-mail : ahcene.zehnati@gmail.com

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Abstract

Background: In Algeria, private physicians settle much more in the northern regions of the country and preferably in the larger metropolises than in the rest of regions.

Objective: First, to analyze the inequality in — and evolution of — the geographic distribution of Algerian private physicians and secondly to estimate the main determinants of doctors' density.

Data sources: The data used come from multiple sources. Firstly, there are those relating to public and private healthcare provision drawn from the statistical yearbooks of the Health Ministry and Population (MSPRH) and other relevant information concerning the provision of healthcare in the wilaya (region). Secondly, the healthcare expenditures of insured persons and relatives were collected at the level of the National Social Insurance Fund (CNAS). Finally, those concerning the socio-demographic data come from the general census of the population and the habitat (RGPH) of different years.

Study design: The analysis of the geographic distribution of doctors is based on the ratio of general practitioners (GPs) and specialists to 1000 inhabitants. The inequality is measured using Gini index and coefficients of variation. The econometric models (static and dynamic) were estimated by ordinary least squares. The data used refer to 1998 and 2017.

Principal Findings: The overall disparities have slightly increased between 1998-2017. The same well-endowed wilayas continue to attract physicians'. The econometric estimation suggests that the population density, the social security expenditures per inhabitant, and the proximity to university hospitals are the main determinants of location choices both in the static and dynamic models.

Conclusions: The rising number of trained physicians does not automatically address the problem of their territorial distribution particularly in a context of characterized by the absence of any government policy towards the private sector.

Keywords: Physician, Location choice, Geographic inequality, Gini index, Algeria

INTRODUCTION

The unequal geographic distribution of physicians is not unique to Algeria. It concerns many countries around the world. Several studies address the issue of location disparities (1,2). They report a high concentration of health personnel in urban and affluent areas to the detriment of semi-urban and rural areas, described as "medical deserts" where under-medicalization is evident. While such studies have quantified the disparities in the spatial distribution of physicians (3, 4), little research has examined the determinants of physicians' location-related decisions. According to the World Health Report (5), current human resources problems in healthcare are worsened by the imbalances that exist between academic training and the real needs of the population. Such needs will increase in developing countries like Algeria. This latter faces a double demographic and epidemiologic transition.

In the Algerian health system, the patient has complete freedom to access a healthcare provider, whether public or private. Access to the public sector is free and user financial participation is very low. Conversely, the private sector is for-profit and access to it is chargeable and the care expenses are only partially covered. In the public sector, doctors do not choose their place of practice since it is the Ministry of Health that assigns them according to the needs of public hospitals. On the other hand, in the private sector, freedom of location is enshrined.

Algeria has made great efforts in training healthcare professionals. The reform of medical studies in 1971 loosened the constraints on access to medical school curriculum and enabled the expansion of the training supply of medical school. This has resulted in a significant increase in the number of trained doctors (general practitioners: GPs and specialists). In recent years, some major trends have emerged, especially after the expansion of the private healthcare activities. The dynamic of physicians' location concerns mainly the sector of specialized medicine. The specialists benefiting from larger social valuation of the population have widely invested the private sectors with its two components: ambulatory medicine and private clinics. We assist the rapid growth of private specialists whose number in certain specialties exceeds those of the public sector. The attractiveness of certain specialties (gyneco-obstetrics, haemodialysis, and surgery) in private practice is linked with the expected financial benefits (6).

The private physicians settle much more in the northern regions of the country and preferably in the larger metropolises than in the rest of regions. This situation contributes to the pronounced geographical disparities in the distribution of Algerian physicians. The freedom that Algerian private doctors have in choosing their practice location have probably affected their geographical distribution. The concentration of physicians in the big towns contrast with lack of doctors in more remote areas where the population is poorer and sparse. The absence of public policy to attract doctors to these areas is one of the weaknesses of the health policy in Algeria. Moreover, the feminization of the medical profession poses some difficulties for the health system as female doctors do not practice in remote areas far from the northern regions.

In spite, the increasingly important place occupied by the private sector in healthcare provision, no research has been devoted to inequalities in access to healthcare. The purpose of this study is to analyse the disparities in — and evolution of — private physicians' geographic distribution, and to estimate the main determinants of their population density. The paper is organized as follows: an overview of the literature is presented, followed by a description of data and methods. The results section presents and discusses the findings, followed by a conclusion and a discussion of the limitations of the analysis.

FACTORS INFLUENCING PHYSICIANS' LOCATION DECISIONS: OVERVIEW OF LITERATURE

A few studies have been conducted examining the determinants of physicians' location in different contexts (7, 8, 9, 10, 11). Most of these studies use cross-sectional data. Their results are miscellaneous. Some studies have highlighted the influence of market forces in the location-related decisions of physicians. With American data, Newhouse et al. (12) show that the inequities in the geographic distribution of physicians are related to the market's own functioning mechanisms. They conclude that the location decisions are a function of agglomerations size. As expected, larger cities are more likely than smaller cities to attract physicians in each specialty. In addition, the strong growth in the number of specialists translates into a faster diffusion in small towns and at the same time they lose their physicians more quickly. As the number of physicians has increased, medical and surgical specialists are more likely to locate in small towns in the United States (13). They also show that the increase in the number of physicians has had only a slight impact on the reduction of disparities observed in their geographical distribution.

Foster and Gorr (14), found that while an increase in the supply of physicians has affected the localization trends of GPs to the less endowed regions, the same trend has not occurred with specialists. Using data for Portugal from 1996 and 2007, Correia and Veiga (9) examined inequalities in the distribution of physicians. They estimate a static model and find a positive association between the size of population and the density of physicians, especially for specialists. Municipalities with a larger supply of public hospital beds tends to attract more physicians. This result confirms the hypothesis that the concentration of National Health System (NHS) resources generates a concentration of physicians. They also test a dynamic model to explain the percentage change in the number of physicians per 1000 inhabitants in each municipality. Their results show that at a certain degree of competitive intensity, physicians tend to avoid locating themselves in the same agglomerations. Nevertheless, the competition factor seems to have a less important effect on specialists than on GPs. This is consistent with the hypothesis of Newhouse and al. One of the explanations is the average age of GPs. It is likely that the majority of these young physicians are still in training and therefore more willing to spread geographically.

Gächter et al. (10) considers the density of private physicians (GPs and specialists) in the context of coexistence of public and private health care providers. Using a panel of data on 121 Austrian districts between 2002 and 2008, they analyse how the densities of private and public providers of outpatient care (GPs and specialists) are related to each other. Their results show that the density of private specialists is positively associated with the density of private GPs, but it is not significantly related to the density of GPs in the public sector. They also observe a negative effect in the relationship between the densities of private and public GPs and some private and public specialists, indicating the presence of competitive forces between the private and public sectors in the provision of ambulatory care.

According to health economic literature, the care market is far from competitive because physicians are able to induce their own demand to ensure an income that cannot be reduced by competition. They can therefore, continue to work, in very competitive and even saturated regions. In this situation, the market cannot therefore tend towards an equitable distribution of physicians. This market failure may argue for public intervention in order to encourage physicians to locate in underserved areas. Empirically, these incentive policies are not always effective.

A geographic concentration of income appears an important factor in explaining the uneven distribution of physicians. Neoclassical theory assumes that physicians seek to maximize their profit and therefore tend to practice in high-income areas. The existence of a positive relationship between the number of physicians and the level of income has been empirically

proven (15, 16, 17, 9, 18). This research concludes that the number of physicians per capita increases with the level of income in the region. The municipalities with high purchasing power attract physicians as they offer a larger potential market for private health care practice. As a result, a more equitable distribution of income between regions could contribute to reducing imbalances in the geographic distribution of physicians (9).

The strength of financial considerations for physicians' location-related choices should not minimize the effect of non-monetary factors. Several studies (16, 18, 19) show that physicians are not very sensitive to financial motivations and they appear as a secondary criterion in location choices, after non-monetary benefits (family proximity, recreational facilities, accessibility of knowledge, etc.). Indeed, physicians maximize their utility when choosing a practice location, not just their profits (14, 20). A number of studies have suggested that physicians would tend to settle in the region in which they studied medicine and defended their thesis (21, 22, 23, 17). This is explained by the knowledge of the working environment, the creation of professional networks and the easy access to the various medical services. The strong correlation between the location of physicians and the presence of medical schools can also be explained by the fact that university hospitals are attractive to physicians, particularly because of the availability of technology and faster diffusion of knowledge and innovation.

In the Algerian context, no study has been conducted to analyse the main determinants of physicians' location around the country. A microeconomic survey with a sample of 68 private specialists (24) shows that family attachment is a major factor in the location choice for 50% of the physicians. The same study found that 28% of them evoke personal motives and 13% refer to economic reasons (affordable rents and living cost). Finally, 9% of the respondents chose their location based on the opinions of colleagues. These results demonstrate the importance of family and cultural considerations for Algerian physicians in selecting the ultimate location of their professional practices.

Most studies carried out on this thematic distinguish between GPs and specialists. In general, we can assume that the GPs regard other GPs and specialists as competitors. In contrast, specialists' top competitors tend to be physicians in the same specialty (9).

MATERIALS AND METHODS

Data

The data used come from multiple sources. Firstly, there are those relating to the public and private healthcare provision drawn from the statistical yearbooks of the Health Ministry and Population (MSPRH). The data include information about the number of physicians (GPs and specialists) per wilaya, and other relevant information concerning the provision of healthcare in the wilaya. Statistical series were reconstructed and other data calculated. Secondly, data relating to healthcare expenses of insured persons and relatives were collected at the level of the National Social Insurance Fund (CNAS). Finally, those concerning the socio-demographic data come from the general census of the population and the habitat (RGPH) of different years.

The main limitation of data is the absence of information about purchasing power in each wilaya. If these data already exist, we can apprehend and decipher the financial attractiveness of the location especially that the focus of the study is on the private healthcare where the patients do not benefit from the full collective insurance coverage.

This induces a strong financial constraint for the population in accessing private care providers. We consider the population size as a measure of care market size. We expect a positive relationship between physicians' location decisions and population size.

Variable(s) of interest

Generally, the variable used to study the geographical distribution of physicians is the number of physicians per 1000 inhabitants. It is easy to build it. Ordinarily, it is common to

distinguish between GPs and specialists. In general, we can assume that the GPs regard both other GPs and specialists as competitors. In contrast, for specialists the competitor tends to be a physician in the same specialty. These differences suggest that we should examine the determinants of the location of the two types of physicians separately (9).

Measuring geographical inequalities

Gini index

The Gini index is an indicator often used to synthesize inequalities in income (standards of living, etc.). The Gini index ranges from 0, indicating perfect equality (where everyone receives an equal share), to 1, perfect inequality (where only one recipient or group of recipients receives all the income). When the value of the Gini index falls between two periods, this indicates an overall decrease in inequality. Conversely, an increase in the value of the index reflects an overall increase in inequality. In our case, we calculated the Gini index for the years 1998 and 2017 to confirm the reduction or widening of physicians' geographical inequalities. The following formula is used for this purpose (25).

$$G = 1 - \sum_{i=0}^{k-1} \{Y_{i+1} + Y_i\} \{X_{i+1} - X_i\}$$

G: Gini index

Y_i : Cumulative proportion of the physicians (total, GPs, specialists) in the *i*th wilaya

X_i : Cumulative proportion of the population variable in the *i*th wilaya

k: total number of wilaya

In the operationalized using of this formula, Gini index were derived from the Lorenz curve by plotting the wilaya having the highest population per physician (starting from the worst to the best among the 48 wilayas) and the corresponding cumulative population ratio of the region to the cumulative physician number of that wilaya.

Coefficient of variation

The coefficient of variation (*CV*) is the ratio of the standard deviation to the mean. A higher coefficient of variation signifies a greater level of dispersion around the mean. It is generally expressed as a percentage. Without units, it allows for comparison between distributions of values whose scales of measurement are not comparable.

Econometric models

We conduct econometric modelling to analyse the main determinants of the geographical location of GPs and specialists in private practice in Algeria. Two types of models were tested: (1) a “static” model to understand the physicians' distribution in 1998 and 2017. (2) The “dynamic” model assess changes in the distribution of physicians over the period 1998–2017. The models were estimated by ordinary least squares (OLS). Cook-Weinberg diagnostic tests revealed heteroskedasticity. Therefore, the standard errors (SEs) were corrected using the Huber-White method. Multicollinearity was explored using the regression diagnostic measure variance inflation factor (VIF). All statistics treatment were done with the STATA® software 15.1.

The following sections (Static models and Dynamic models) describe the variables considered in the models.

Static models

Static model is presented in the equation (1)

$$\ln PHYSIC(i, j) = \alpha + \beta_1 \ln POP + \beta_2 \ln SSE + \beta_3 \ln BEDSPUB + \beta_4 \ln BEDSPRIV + \beta_5 \ln PRESUH + \mu_i \quad (1)$$

Where PHYSIC denotes the ratio of the number of GPs and specialists per 1000 inhabitants for every wilaya, for GPs and specialists, and $j=G, S$ (GPs, specialist), $i=$ wilaya.

The variable(s) of interest is the logarithm of the ratio of GPs and specialists number per 1000 inhabitants per wilaya [\ln (GPs) and \ln (specialists)]. The size of the resident population is a measure of the market care size and the volume of demand in the wilaya. We expect the (logarithm of) population size ($\ln POP$) to be associated positively with the location of physicians, particularly for specialists. The attractiveness of the healthcare market in the wilaya is reflected by the (logarithm of) social security expenditures per inhabitant ($\ln SSE$). This variable measures the market solvency which can increase the demand for physicians' services. We expect the sign to be positive for GPs and specialists.

The (logarithm) provision of beds per 1000 inhabitants in public health facilities ($\ln BEDSPUB$), in private sector ($\ln BEDSPRIV$), and the presence of a University Hospital ($PRESUH$), reflect the scale of public and private healthcare resources in the wilaya. We expect the estimated coefficients of the first variable to be negative and those of the second and third variable to be positive. In Algeria, all the University Hospitals are located in wilayas with a medical school. The presence of UHs positively affects physicians' location decision behaviors as result a fairly high number directly targets these structures, which seem to be encountering greater difficulties to fulfilling and responding to this increasing demand. Private providers could serve as a second resort for patients who have not been admitted to public hospitals. In addition, $PRESUH$ may capture the attractiveness of the wilaya in terms of access to knowledge, technology, and private medicine.

Dynamic models

The dynamic model is specified in order to examine the effects of observed variations over the period 1998-2017 on physicians' location choices. The model is written as follows:

$$TPHYSIC(j, i) = \alpha + \beta_1 DENSITY98 + \beta_2 DENSITY98 SQUARRED + \beta_3 VARPOP + \beta_4 VARSSE + \beta_5 VARBEDSPUB + \beta_6 VARBEDSPRIV + \beta_7 VARPRESUH + \mu_i \quad (2)$$

where $j = G, S$ (GPs, specialist), $i = 1, \dots, 48$.

$TPHYSIC$ is the dependent variable which denotes the percentage change in the number of physicians per 1000 inhabitants in each wilaya. We take into account all the variables of the static model and we calculate the variation between 1998 and 2017.

$DENSITY98$ tells us about medical density in the beginning of the period and its effect on the new physicians' practices, locations, and choices. Before making any location-related decisions, doctors are interested in knowing the existing number of doctors in their field of specialty or the high presence of their colleagues (GPs) in the wilaya. The concentration of physicians should have a negative influence on location-related decision-making. When the number of physicians in cities is already high, fewer new physicians choose to locate there in order to avoid competition between colleagues. This situation is not observed for doctors who practice in complementary specialties. The opposite effect can also occur when we refer to the theory of supplier-induced demand in healthcare: physicians tend to settle in regions with a higher medical coverage rate (26). For instance, in France, it is shown that when the density of GPs in conventional sector increase in their practice area, doctors compensate for the decrease in the number of patients by increasing the volume of care that they deliver during each

consultation. These behaviours are more marked in departments where the density is high (27,28).

The growth rate of the civilian population in the wilaya between 1998 and 2017 (*VARPOP*) addresses the importance of demand growth in location decision-making. The effect of non-medical population growth on the increase in medical density is theoretically ambiguous. Nonetheless, we expect it to be positive in the specialists' regressions and negative for GPs', reflecting the competition/substitution between them (13,29): specialists tend to locate in growing and larger municipalities while GPs may avoid settling in growth areas because of increasing competition from specialists.

During the covered period of time, the health care basket covered by the social security fund has been widened. The variable *VARSSSE* is expected to have a positive effect on the density of GPs and specialists as long as social security coverage facilitates access to health professionals. *VARBEDSPUB* stands for the percentage of the variation in the number of beds in the public sector per 1000 inhabitants in the wilaya between 1998 and 2017. Those wilaya with a dense public supply can discourage the private physicians from settling there, principally for GPs. The variable (*VARBEDSPRIV*) can have a very positive effect on physicians' location. The better endowed the wilaya is with private hospital beds, the more private physicians will tend to settle there. This observation is valid especially for physicians in surgical specialties, who earn the most significant part of their income from their activities in private clinics.

VARPRESUH is a dummy variable indicating whether the wilaya acquired a new central hospital during the period. These variables are thought to capture the effects of changes in the availability of public health resources. We expect this variable to have positive signs, since the private healthcare dynamics feed on the dysfunctions of the public sector. Therefore, the availability of public resources should attract private physicians.

RESULTS

Evolution of the number of physicians in Algeria

Overall, the number of practitioners has increased constantly during the period 1991-2017. It has tripled in 26 years from 19 930 in 1991 to 66 270 in 2017 (Table 1). The coverage ratio of the population is steadily improving. It passed from 0,75 doctors per 1000 inhabitants in 1991 to 1,59 doctors in 2017. The improvement in coverage ratios is due to the combined effects of the creation of new jobs in the public sector within the health system development program and the dynamics of private doctors' location. It is therefore 53% of physicians who are GPs in 2017 of which a strong majority work in the public sector. On the other hand, specialized medicine knows a strong dynamic mostly drawn by the private sector.

Year	Number of physicians	Annual growth rate (%)	Population (10 ³)	Annual growth rate (%)	Physicians per 1000 Inhabitants	Annual growth rate (%)
1991	19 930		26 500		0,75	
1995	23 428	4,13	28 758	2,07	0,81	2,02
1998	25 710	3,15	30 193	1,64	0,85	1,49
2001	28 755	3,80	31 452	1,37	0,91	2,40
2006	31 927	2,11	33 481	1,26	0,95	0,85
2010	42 326	7,30	35 978	1,81	1,18	5,39
2013	50 326	5,94	38 297	2,10	1,31	3,76
2015	55 656	5,16	39 963	2,15	1,39	2,95
2017	66 270	9,12	41 721	2,18	1,59	6,80

Table 2 indicates that the greatest increase in the size of the private physicians' workforce between 2008–2017 occurred among specialists. The number of specialists doubled during the observed period. As a result of the increase in medical education towards specialization, specialists accounted for more than 60% of the total number of private physicians in 2017. On the other hand, general medicine knows a limitation in its extension (6).

Table 2: Evolution of the number of specialists and general practitioners (GPs) in private sector and population size in Algeria

Year	Specialists	Growth rate (%)	Percentage of total (%)	GPs number	Growth rate (%)	Total
2008	6 645		50,40	6 548		13 243
2009	7 032	5,82	51,60	6 598	0,76	13 630
2010	7 491	6,53	52,55	6 764	2,52	14 255
2011	7 650	2,12	52,72	6 860	1,42	14 510
2012	8 864	15,87	57,85	6 458	-5,86	15 322
2013	9 429	6,37	59,26	6 482	0,37	15 911
2014	10 116	7,29	60,32	6 654	2,65	16 770
2015	11 001	8,75	59,54	7 477	12,37	18 478
2016	12 031	9,36	60,14	7 974	6,65	20 005
2017	13 054	8,50	60,40	8 557	7,31	21 611

However, the statistics presented above hide disparities between the wilayas, which we will measure in the next section.

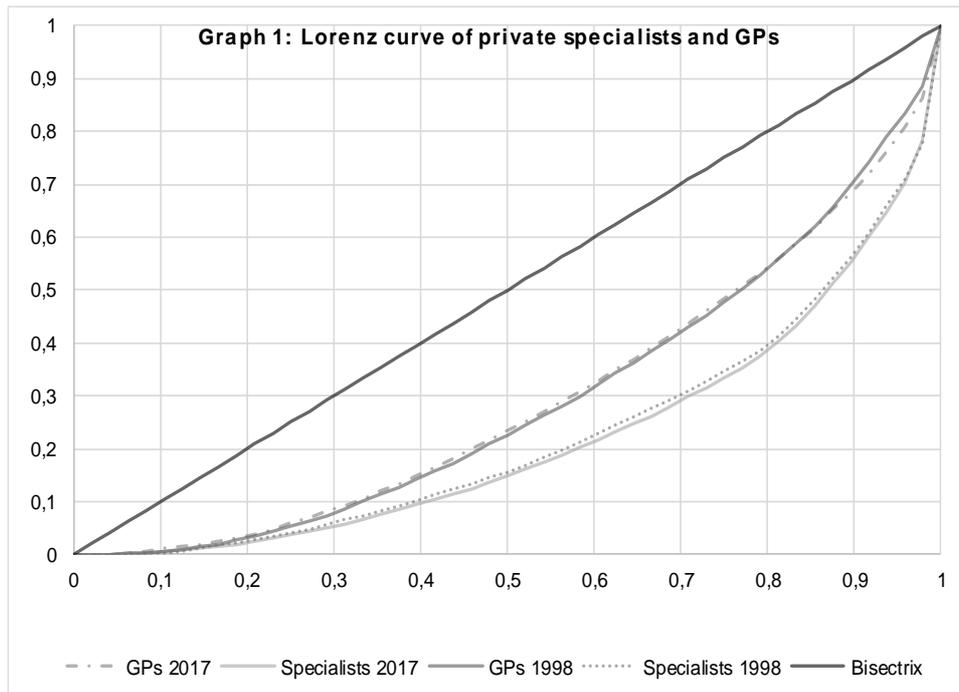
Inequalities in distribution of physicians

For all private physicians, the inequalities between the wilayas were widened between 1998 and 2017. The estimate of the Gini index increased from 0,47 to 0,5 and even suggests a slight increase in the inequality in the distribution of physicians. Greater inequality in the distribution of physicians is observed among specialists rather than among GPs.

Table 3: Inequality measures of geographic distribution of physicians per 1000 inhabitants. CV Coefficient of variation

	1998	CV	2017	CV
	Gini		Gini	
Physicians	0,47	1,16	0,5	1,35
GPs	0,41	0,89	0,41	0,99
Specialists	0,54	1,59	0,56	1,58

Nonetheless, the distributions of both GPs and specialists per 1000 inhabitants have become slightly more unequal. The estimated CVs also suggest that inequality did not change dramatically during the period. These results confirm the conclusion of similar analyses conducted in other countries (30, 31). Despite the increase in the number of physicians, the overall inequality in geographic distribution has not decreased. Graph 1 does not provide further information but it makes inequalities visible. We note that the geographic distribution of GPs is better balanced than that of specialists. The curve of GPs is closer to the bisectrix than that of specialists.



The two curves in 1998 and 2017 coincide, evidence of a lack of improvement in the distribution of specialists and GPs. Graph 1 shows that 80% of the wilayas (39) locates only 48% of specialists (versus 55% for GPs). The nine remaining wilayas concentrated 52% of the total (versus 45% for GPs). The inequalities' distribution increased slightly over the period considered. This can be explained (among other factors) by the total freedom that the private doctors have in the location choices. This principle contributes to the retention — even aggravation — of geographic distribution of private doctors.

Determinants of physicians' location

Static models

The results of the static model of GPs and specialists for 1998 and 2017 is presented in table 4. The most important variable for the distribution of physicians is population and SSE, while *BEDSPRIV* are relatively more important than the remaining variables in both regressions. A positive association exists between the population size (market size) and the number of physicians per 1000 inhabitants (GPs and specialists). In fact, the population size impacts the location decisions of specialists slightly more than those of GPs. This result is in line with expectations, since the financial profitability of some specialties requires a high population base. In Algeria, the specialists are very concentrated in larger urban areas. Even if they practice in some towns with a lower density of population, they still prefer to settle in the principal town of the wilaya. Some of them concentrate between 80 and 100% of specialists, thus contributing to the increase in intra-wilayas inequalities.

Table 4: Location decisions—ordinary least squares (OLS) regression				
Estimates Static model (1998 and 2017)				
	1998		2017	
	ln (GPs)	ln (Specialists)	ln (GPs)	ln (Specialists)
ln POP	0.319*** (0.107)	0.472*** (0.0867)	0.230*** (0.0791)	0.278** (0.115)
ln SSE	0.487** (0.193)	0.842*** (0.129)	0.133** (0.0494)	0.417*** (0.0715)
ln BEDSPUB	-1.060** (0.406)	0.0676 (0.238)	-0.124 (0.150)	0.112 (0.217)
ln BEDSPRIV	0.113* (0.0667)	0.0358 (0.0375)	0.111*** (0.0302)	0.143*** (0.0438)
PRESUH	0.204* (0.337)	0.321** (0.184)	-0.0881 (0.114)	0.214** (0.165)
Constant	-8.042*** (1.963)	-13.77*** (1.446)	-5.552*** (1.201)	-8.555*** (1.740)
Observations	48	48	48	48
R-squared	0.751	0.762	0.734	0.834

Robust standard errors (SEs) are in parentheses ***p<0.01, ** p<0.05, * p<0.1

The number of beds per 1000 inhabitants at hospitals (public and private) is chosen as a proxy that reflects physicians' choices about the distribution of healthcare resources across wilayas. We distinguish between public and private sectors essentially because we anticipate a strong relationship between the private specialists' density and the availability of private healthcare resources. The proximity of performing technical platforms for specialists is very important for their location choice. The private specialists prefer to care for their patients at private clinics with higher financial compensation. They are very sensitive to financial incentives (32). The estimated coefficients indicate that wilayas with larger supplies of private beds tend to attract, on average, more physicians per 1000 inhabitants. This result is consistent with the hypothesis that the concentration of private healthcare resources tends to generate a concentration of private physicians particularly in surgical specialties. However, the magnitude of the estimated coefficient indicates that the elasticity is small. The number of public sector beds per 1000 inhabitants was only significant for GPs in 1998 with a negative coefficient. The social security expenditures (*SSE*) per inhabitant is an important factor in explaining the location decisions of physicians. This result is more relevant for the distribution of specialists than that of GPs. The specialists are more sensitive to differences in *SSE*. The wilayas with higher *SSE* tend to offer a larger potential market for private health care practice. The presence of UH positively impacted specialists' location in both 1998 and 2017. The GPs were influenced positively only in 1998. The private supply at the beginning of the period is low. Consequently, limits competition between them. As we reported in the literature review, private doctors prefer to locate in large cities with UH for professional reasons but also for personal considerations. A higher population density (potential market) with a significant purchasing power, spouse employment (for married physicians), and social amenities are factors taken into consideration before defining a utility function reflecting location choices of doctors.

Previous studies show a relatively low mobility of doctors once they have settled within one particular region (33,7). As a result, variation in the number of physicians per 1000 inhabitants within wilayas tends to be small and explained mainly by the entry of new graduates. For this reason, we estimated a model regressing data from 1998 for the (log) number of GPs and specialists per 1000 inhabitants in 2017 (Table 5).

Table 5: Location decisions – Ordinary least squares (OLS) regression estimates		
Static model (2017 with data of 1998)		
	2017	
	ln (GPs)	ln (Specialists)
ln POP98	0.384*** (0.0560)	0.629*** (0.104)
ln SSE98	0.319*** (0.0834)	0.647*** (0.154)
ln BEDSPUB98	-0.228 (0.153)	0.0682 (0.284)
ln BEDSPRIV98	0.0376 (0.0242)	0.0381 (0.0448)
PRESUH98	0.102 (0.119)	0.185** (0.220)
Constant	-8.450*** (0.934)	-13.78*** (1.727)
Observations	48	48
R-squared	0.726	0.734

Robust standard errors (SEs) are in parentheses*** p<0.01, ** p<0.05, * p<0.1

The estimation reveals that 1998's variables explain a large share of the physicians' geographic distribution. The results are comparable to those exposed in Table 4. Meanwhile, the population size and social security expenditures per inhabitant have a stronger impact on physicians' location decisions in 1998 than in 2017. The number of beds per 1000 inhabitants in the private sector is not significant because of the weak number of private clinics in 1998. These findings seem to confirm the relatively low mobility of physicians.

Dynamic models

The estimation results for the dynamic models is presented in Table 6. The results suggest that competition factors into physicians' location decisions during the period of time under review. The coefficient of the variable *DENSITY98* is negative and statistically significant, supporting the hypothesis that, at least from a certain degree of competitive intensity, the physicians tend to avoid locating themselves in these areas. However, competition seems to have a slightly stronger effect on GPs than on specialists. This result is as in line with what was envisaged in our initial hypothesis and in the literature (12,29).

Table 6: OLS Regression estimates-Dynamic model (1998-2017)		
	GPs per 1000 inhabitants	Specialists per 1000 inhabitants
DENSITY98	-5,285*** (1.159)	-4.916*** (1.490)
DENSITY98 SQUARED	8.208*** (2.128)	8.5713*** (2.720)
VARPOP	-1.038** (0.390)	-3.229*** (0.499)
VARSS	-0.0226 (0.0374)	-0.0943** (0.0458)
VARBEDSPUB	0.578*** (0.167)	-0.300 (0.222)
VARBEDSPRIV	0.000730 (0.00100)	0.00264** (0.00122)
PRESUH	0,00672 (0.104)	0.169** (0.127)
Constant	1.074*** (0.230)	1.878*** (0.282)
Observations	48	48
R-squared	0.508	0.548

Robust standard errors (SEs) are in parentheses ***p<0.01,** p<0.05,* p<0.1

One possible explanation is that the majority of GPs are better able to spread out geographically due to competition and their relative youth compared to specialists, where family constraints are more burdensome. In any case, this question deserves to be explored further.

The growth in the population seems to have adversely affected the growth in the number of GPs and specialists. The estimated coefficient is significant for GPs and much more so for specialists. There is no evidence of adjustments in the number of GPs per 1000 inhabitants following variations in the installed capacity of the national health system in the public and private sectors. In the same direction, the specialists' location decisions appear not to reflect changes in the installed capacity. The number of specialists per 1000 inhabitants appears to have grown in the most prosperous wilayas with a higher purchasing power.

The variation in the density of specialists is negatively affected by the variable *SSE*. The estimated coefficient is significant only for specialists although its magnitude is small. *SSE* appeared to have a lower impact on the variation in specialists' density than we would expect. Despite the expenses associated with private clinics, populations turn to private sector, populations turn to it out of necessity, especially in regions where the public sector alternative is failing. Moreover, the main claim of private doctors and the founders of private clinics in Algeria remains the establishment of contractual relations between social security funds and private clinics, which will allow a widening of the market for these care providers. The variation of beds in the public sector positively affects only the variation of the GPS density. Alternately, the specialists' location decisions are positively associated with hospital beds in the private sector. However, the estimated coefficient is small. Finally, specialists' location decisions appear to reflect changes in the installed capacity of the public sector through the presence of

UH. On the contrary, the number of GPs per 1000 inhabitants is not affected by the variations in availability of the UH.

DISCUSSION

The emergence and expansion of private healthcare has been more concentrated in northern wilayas, to the detriment of those in the highlands and southern regions. The liberalization process of the health sector has not been accompanied by measures that would force private doctors to settle in the underdeveloped regions. Freedom of location is therefore total. This (with other factors) seems to have contributed to the retention, even to the accentuation of regional disparities. This problem is not of great importance if the public supply compensates for the deficit of the private supply. In Algeria, the distribution of specialists is uneven and disparities persist in the absence of a coercive or incentive policy in favour of private physicians. It is true that even in the case of other countries, despite the establishment of incentive public policies in favour of private physicians, these have not made it possible to reduce inequalities substantially. The most common measures concern financial incentives at different stages in the career of health professionals: initial training, installation, and retention. Studies in the literature (34) show that a policy of saturation of supply through the increase in overall numbers (a generous *numerus clausus*) does not solve the problem of geographical inequalities. Even the financial incentive schemes put in place have had only a moderate effect on location decisions. However, the granting of financial aid during initial training through the allocation of scholarships, loans on preferential terms, etc., accompanied by the obligation to practice in under-developed regions exerts a positive effect in the short term and a negative effect in the long term. "This system is not exempt from perverse effects; doctors buy back the credit before term or leave the place of practice after the obligation to service comes to an end" (34).

Besides, it is legitimate to wonder about the prospect of expanding private healthcare. Two arguments can be discussed. First, we can say that medicine, which was essentially public in the past, has today become a public-private mix. Even if the public sector remains globally dominant, is the state also intended to manage the private supply? Should the state be content to manage the public sector and allow private doctors to settle freely? If so, the state cannot be criticized for having no public policy towards the private sector. We should ask ourselves whether it is problematic in the long term or not. Second, we can say: in the case that inequalities are increasing, whether there are public-private arbitrage effects and whether in the future private supply will be more reimbursed, at that time, there is reason to be worried about imbalances in the geographic distribution of doctors. If action is not taken today, in the future it will be difficult to remedy it. We should have a policy even if we know that elsewhere in other contexts, it is already complicated to implement.

To our knowledge, the current study is the first to document the geographic imbalances in private physicians' density in Algeria. The results of this study must be taken with caution due to the lack of data on socio-economic indicators to assess the attractiveness of wilayas. Data such as the GDP per wilaya and the unemployment rate per wilaya, for example, would have been very interesting in analyzing the determinants of private physicians' decision regarding location, particularly since this study is directly linked to the private healthcare market. Also, data about the epidemiological situation of the population by wilaya may be taken into consideration in the study and which may impact the location-related decisions of doctors. Unfortunately, this type of data is not available.

CONCLUSION

Algeria presents inequalities in the geographic distribution of private physicians. It is very concentrated in larger cities at the expense of the wilayas of the highlands and the south. The

coverage of the population varies widely from one region to another. As is the case in many countries, the increase in the number of trained doctors does not precipitate an automatic rebalance of their distribution, particularly in the absence of a public policy towards the private sector. Despite the rapid growth in the number of private doctors, their geographic distribution is still highly uneven. The distribution of specialists is more unequal than that of GPs.

The econometric analysis of the variation in the number of physicians per 1000 inhabitants suggests that there are competitive forces in the market for physicians' services. For the moment, the competition is not strong enough to generate significant reductions in physicians' distribution inequalities mainly for specialists. The presence of specialists seems to exercise a crowding-out effect on GPs. Some wilayas continue to attract new doctors. The situation remained unchanged over the period under review. Improvements can be made if the social security fund widened the health care basket cover for better medical coverage of the population.

Finally, it is imperative for the public authorities to integrate the private sector in the national health strategy, considering the growing share that it represents in the care supply. Incentive measures to attract doctors to deficit areas are also desirable. There is no miracle recipe, but at least some experimental measures, such as scholarships for students from underserved regions to pursue medical training with the obligation to return to their region at the end of their training. Such measures give the opportunity to GPs practicing in these regions to access a medical or surgical specialty of their choice, one of many measures which can contribute to the reduction of regional disparities.

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