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Variations in physician activity and general practice patterns

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Abstract

The objective of this study is to identify the practice profiles of different GPs in order to test the hypothesis of heterogeneity in physician behaviour.

We have established an extensive database consisting of about 4 700 GPs from two regions in France (Aquitaine and Burgundy) for the year 2000. Variables describe the volume as well as the structure of the physicians' medical activity, income level, personal characteristics, practice characteristics, socioeconomic and geographical environment.

We used two complementary methods to test the heterogeneity of the behaviour of private physicians: a cluster analysis to identify different practice profiles and econometric tests to display the determinants of the physicians' multidimensional activity.

Our results show that four different homogeneous groups can be identified, each one associating a physician's level of activity to his socioeconomic status. Econometric tests clearly distinguish the main determinants between the multidimensional medical activity of rural and urban GPs.

We conclude with the finding that there is no uniformity in the way GPs practice medicine. The level and type of medical activity vary greatly among physicians mainly due to the characteristics of the socioeconomic environment and other individual factors. An immediate consequence is that any cost-containment measure, such as regulating fees, which applies uniformly to all GPs, inevitably results in different outcomes according to the physicians' category type.

Key words : medical activity, practice profiles, general practitioner, cluster analysis, econometric test

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1 Introduction

One of the most debated issues in the health economics literature of the past two decades has been whether financial incentives influence physicians' decisions and whether physicians can induce demand for their services. However, the influence of non-financial determinants on physician activity is not often investigated in economic literature and the heterogeneity in physician behaviour is not taken into account.

The research design of this paper is adapted to the institutional setting of French private physicians, where both general practitioners (GPs) and specialists can choose private practice. They are paid on a fee-for-service basis. Physician federations and public health insurance funds negotiate a schedule of fees that is used as the basis for payments to physicians and reimbursements to patients. There are basically two types of physicians: 75% receive their income based on a fixed-fee-schedule only; this contract is called sector 1; 25% can charge fees above the fee schedule without restriction; this contract is called sector 2 (free-pricing).

Within this framework, private physicians can practice freely. They can perform a number of different acts such as providing consultations and making home visits (in the case of GPs), or providing technical services (particularly in the case of certain specialists). The physician basically decides on the volume of his own practice although it is also influenced by patient demand and the size of the clientele. Income depends on the volume, the structure of activity in sector 1 and the level of fees in sector 2.

A number of studies have provided descriptive statistics regarding the volume of physician activity (*cf.* for French physicians DREES n°9, 44, 83, 114, CNAMTS n° 23, 30, 108) and their income (*cf.* for French physicians DREES n°3, 15, 89, 146, 254, CREDES n°1321, CERC, 1994). Others have developed economic models focusing on the activity of physicians that can be explored through the traditional question of demand inducement (Grytten & al. 1995, Sorensen & al. 1999, Giuffreda & al. 2001, Delattre & al., 2000, Rochaix, 1993). The nature of the market for private medical services is another way to investigate physicians' decisions (Sloan, 1979, Wong, 1996). In France, the physician's choice of whether to respect a fixed-fee-or free-fee schedule has been studied (Carrère, 1991, Lancry, 1989, Dubec & al., 2003), as well as prescription decisions (Lancry & Paris, 1997).

In these studies, the analysis of physician activity is based on standard behaviour and performed through a one-dimensional variable, such as the number of acts, level of fees or annual income. A notable exception is Delattre's study (2000), which presents an indicator of activity that combines the proportion of technical acts and the level of fees. Nonetheless, in all cases, the question is then to

identify the economic determinants of the dependant variable. The standard behaviour hypothesis is no longer satisfactory once we recognise the diversity of behaviours inherent in medical specialisation, in patient characteristics (Scott & al. 1996), in motivations (Croxson & al., 2001, Hellinger, 1996, Davis & al., 2000), and in a medical and socioeconomic context (Westert & al. 1999, Mossé, 1995, Ryan, 1994, Darbon & al., 1989).

The purpose of our empirical study is to test an alternative hypothesis. We assume that private physicians are not homogeneous in their motivations, their practice decisions and their reactions to regulatory policies. We further assume that their activity cannot be explained through a one-dimensional model (Whynes and Baines 1996). The level of fees and the number of acts by physician are both indicators of activity as are the number of acts by patient, the structure of activity and the level of prescriptions. In addition, we assume that it is not only the economic determinants that influence a physician's decision but also professional rules and economic and medical factors.

In order to test our hypotheses, we performed an empirical study focusing on physicians in two regions of France (Aquitaine and Burgundy). We used two complementary methods to test the heterogeneity of the behaviour of private physicians: a cluster analysis to identify the different practice profiles and econometric tests to display the determinants of the physicians' multidimensional activity.

In the present paper, we focus on general practitioners and comment on the results relative to the heterogeneity hypothesis. The data we consider concern 4 700 GPs from the two regions and their individual activity for the year 2000. Our results show different ways of practicing the same profession: for GPs, the cluster analysis shows that different groups can be distinguished according to their type of practice while econometric results show that two different models must be constructed to acquire an understanding of both rural GPs and urban GPs.

2 Methods and models

Our empirical study focuses on the supply behaviour in the private medical services market. The subject of our analysis is the individual activity of the physician, hereafter referred to as the GP. We assume that this individual activity is multidimensional. From an economic point of view, we can measure this multidimensional activity through the following variables: volume and structure of activity; fees and surcharges; biological and pharmaceutical prescriptions. The number of acts is measured both per physician and per patient. When measured per physician it is based on his workload, which depends on his personal work motivations, available time and the size of his clientele. The percentage of home visits also gives an indicator of the GPs workload and, moreover, of the structure of his activity. When measured per patient, the number of acts indicates the intensity of health care. It depends jointly on supply and demand determinants: in making medical decisions, physicians may respond to personal motivations (for example, according to the demand inducement

hypothesis, physicians can multiply the number of acts in order to increase their income) or to patients' demands and medical needs. Prescription decisions similarly depend on supply and demand determinants. For instance, we will see that physicians may adjust the length of consultation times and the length of prescription orders.

As stated above, we assume physician behaviour to be heterogeneous. Therefore, to understand their activity, we must take into account the diversity of their behaviour, diversity inherent in motivations, in clientele characteristics and in a social and economic context.

This diversity can be investigated through classifying variables such as specialization, gender (Bensing & al. 1993) or location. Since we assume that the behaviour, motivations and decisions of rural GPs differ from those of urban GPs, we construct different behaviour models for each type of physician. In the range of determinants assumed to affect physician behaviour, the influence and strength of one determinant may vary from one category of physician to another as well as in the different dimensions of their activity.

Another way to investigate the diversity of the behaviours is through different clustering methods. Non-hierarchical clustering methods can produce homogeneous sub-groups within a heterogeneous population: the aim is to identify these sub-groups according to a set of selected variables. For GPs, we undertake such a classification in order to draw different "practice patterns". To our knowledge, this method has never been used to study medical decision-making or physician activity. The variables chosen for the performance of the cluster analysis reflect the different dimensions of GP activity and supply. The classification is then interpreted and analysed through the variables known to affect this activity.

Cluster analysis

The classification has been performed using a dynamic clustering method (Diday, 1972) producing different homogeneous categories within a heterogeneous population. Clusters are formed by gradually maximising both the homogeneity of each cluster (Cubic Clustering Criterion) and the discrimination performed by the analysis (Pseudo F Criterion) (Chaudon &Pinson 1981, Chaudon & Dano 1997). The clustering process, during which close groups are merged and distant ones are divided, continues until stability is achieved for a predetermined number of clusters.

In our study, the clustering variables are indicators of GP activity. They reflect the volume and structure of the activities (number of acts, percentage of home visits), the GP’s clientele and the intensity of health care supplied per patient (clientele size, number of acts per patient, average total cost per patient) as well as prescription behaviour (percentage of patients with prescriptions in the period, average pharmacy cost per patient, average biology cost per prescription order).

The choice of the number of clusters depends not only on statistical criteria, but also on the plausibility and interpretability of the resulting patterns in terms of GP activity. In our cluster analysis, these criteria require the selection of 4 clusters. Non hierarchical methods provide several sets of clusters depending on the initialisation point. The analyst must choose one of them according to statistical criteria. All the results of our cluster analysis were convergent and exhibited the same characteristics.

The cluster analysis was performed on all GPs for each region separately. In the present paper, we will present the results for GPs living and working in Aquitaine.

The analysis provides 4 clusters of physicians who share the same practice patterns. These patterns represent dominant trends and not pure patterns. They must be interpreted by analysing the characteristics of each cluster through both clustering variables and other indicators known to affect medical activity. The individual characteristics of the physician (age, gender, seniority, contractual status), the characteristics of the clientele (age, percentage of non-paying patients, and so on), the socioeconomic context of the location (rural/urban, socioeconomic characteristics of the population), and the level of fees and surcharges have been used to analyse and specify each cluster.

Econometric analysis

An econometric analysis is used here to emphasize the regularities and correlations between variables that are presumed to influence the behaviour of physicians. We do not measure the parameters of a theoretical maximising model, supposed *a priori* to be true, however we draw and test what can be related to the activity decision. We therefore adopt one of the epistemological stands facing statistics described by Desrosières (2000). We used an econometric analysis in order to identify the determinants of GP activity and to test heterogeneity among rural and urban GPs. As noted above, we assume that the physician activity combines different decisions: decisions relative to workload, volume of activity income, willingness to accept home visits and prescriptions. For each category of GP, 5 models have been estimated by the OLS method using a stepwise regression to select the significant variables. The dependant variables are as follows:

- Annual number of acts per GP
- Average number of acts per patient
- Percentage of home visits
- Average pharmacy cost per patient with prescriptions
- Average pharmacy cost per prescription order

Independent variables reflect the individual characteristics of the GP, the characteristics and size of the clientele, and medical and economic contexts. In certain models, activity variables assumed to be effective are added to the independent variables. For instance, the total number of acts is assumed to affect the percentage of home visits: urban GPs may refuse to make home visits if their income and

workload are sufficient, whereas for rural GPs, their workload and proportion of home visits are positively connected since they cannot refuse home visits in rural areas.

3 Data and variables

For the year 2000, we created a set of data concerning 4 695 GPs of the regions of Aquitaine (3 225 GPs) and Burgundy (1 470 GPs). This sample represents 95% of all private GPs registered in these regions. We concentrate only on GPs who began their activity before January 1, 1998, who are under 65 years of age, who don't work full-time in hospitals and who have a contract with health insurance funds. The data set is provided by the URCAM (health insurance groups) of Burgundy and Aquitaine. It includes individual characteristics of the physicians, activity variables and characteristics of the clientele. Data relating to spatial, medical, and economic factors was taken from a database supplied by the French National Statistical Institute (INSEE). Table 1 presents a list of the variables used in the cluster and econometric analyses.

Insert Table 1.

The health and medical contexts of Aquitaine and Burgundy are quite different. In the Aquitaine region physician density is very high (345 physicians of all categories per 100 000 inhabitants in Aquitaine, compared to 332 for the whole of France; 118.4 private GPs per 100 000 inhabitants in Aquitaine, compared to 102.6 for the whole of France). Burgundy, on the contrary, has a very low health service supply (private GP density is 97.4 per 100 000 inhabitants) and health care expenses are among the lowest. We will see later that, *ceteris paribus*, location in one or the other of these two regions affects the activity of GPs.

4 Results and comments

4.1 Cluster analysis

The cluster analysis we performed shows that, within the population of private GPs , 4 clusters of practice types can be distinguished. This result confirms that the hypothesis of standard behaviour is insufficient. For instance, physicians who have a very low volume of activity and a very limited clientele constitute one category (cluster 4) that represents a significant 23.5% of the whole sample. Almost half of these physicians are women and 75% of them are located in urban areas, however the incidence of part-time activity among them is no higher than for their colleagues. They also have very low levels of pharmacy prescriptions. The characteristics of cluster 4 express one particular way of

practicing general medicine. The results show that these physicians seem to attach more importance to the length of consultation than to the length of prescription order, and their particular type of practice is best suited to certain patient categories (more women and more adults in their clientele). Therefore, the structure of the clientele appears to be based on the type of practice chosen by the physician.

Another category (cluster 2 that represents 11% of the sample) is comprised of physicians who have very high volumes of activity. These physicians are more often located in rural areas and their practice style is associated with economic and sanitary constraints. They have many patients and must make frequent home visits. The demographic characteristics of their clientele and the local population, which are proxy variables of morbidity, explain the high prescription levels. Although these physicians have chosen their rural location, the ability to freely choose their volume of activity or the proportion of home visits appears to be restricted.

The four clusters provided by the analysis are briefly described below. Tables 2 to 10 present the numerical results of the cluster analysis. Clusters 1 and 3 of the sample are nearest to average while clusters 2 and 4 represent extreme behaviours.

Cluster 1:

This cluster represents 33% of the sample. Only 10% of these physicians are women (21% of the whole sample); 93% of them belong to a fully regulated sector (sector 1). The volume of their activity is higher than average (6 450 acts compared to 5 130 for the whole sample), and the number of acts per patient is also somewhat above average (4.15 acts per patient). Regional conditions are poor: the average distance to the nearest hospital is more than 13 kilometres, and GP density is somewhat lower than average. More than 60% of these physicians are located in urban areas. Their prescription behaviour slightly differs from the sample average. Their clientele includes a higher proportion of young patients than in the whole sample.

Cluster 2:

Cluster 2 is comprised of physicians who have a very high activity in all aspects: 9 303 acts per year, 2 336 patients (the average for the whole sample is nearly 1 500). This high activity is not balanced out by a lower number of acts per patient. On the contrary, there are 4.76 acts per patient per year (as compared to 4.15 in cluster 1 and 3.97 in the whole sample), and the costs of their pharmacy prescriptions are very high. The proportion of home visits is the highest (30% in-home consultations). Their income is also very high but they do not overcharge for their services. They are older and have more seniority than their colleagues. Only 4% of them are women. As they are located more often in rural areas (46%), the regional health care supply is quite poor: GP density is the lowest of the 4 clusters of Aquitaine, although we should note that density and medical supply remain high when compared to other regions, in particular, Burgundy. No single characteristic can explain such high

levels of activity. The characteristics of their clientele differ slightly from those of the whole sample, and they have the same proportion of young patients as in cluster 1.

Cluster 3:

Cluster 3 shows a particular practice style. These physicians have a small clientele and low levels of annual activity, but they perform more acts per patient than average (4.18 acts per patient as compared to 4.15 in class 1, 3.97 in the whole sample), and the cost of their pharmacy prescriptions is higher than average. They represent 32.2% of the sample. Their individual characteristics and socioeconomic environment are similar to average. The characteristics of the clientele explain the higher costs per patient: the percentage of both older patients and non-paying patients (i.e., patients with chronic or serious illnesses) is higher in their clientele than average.

Cluster 4:

As we have seen, cluster 4 is made up of physicians with low levels of activity (only 3.07 acts per patient and 22% home visits). Their fees are also low but the proportion of surcharges is higher in this cluster, where 20% of the physicians belong to the free-fees sector (sector 2). They are younger than their colleagues and their seniority is lower than average.

Insert Tables 2 to 10

We notice that physicians who perform a high annual number of acts also have high costs per patient. Their high activity appears not only in their workload but also in the intensity of health services and in the costs per patient or per prescription order. This can only be explained by the morbidity of the clientele, otherwise this result is unexpected. The economic context and the level of health service supply could explain these trends. However, it is well known that the length of consultations decreases as the doctor's workload increases (Deveugele & al. 2002); so, according to our results, one may assume that there is a trade-off between the length of the consultation and the prescription order and that physicians induce demand for their services. We shall comment on this hypothesis of supply induced demand (SID) in the next section which presents our econometric results.

4.2 Econometric results

Since we considered GP activity to be multidimensional, the aim was to estimate the determinants of each of the five dimensions taken into account. As such, five regressions have been estimated, first for all GPs, then for urban GPs and rural GPs separately. The results of the estimations (OLS) are given in table 11. The main results lead to the following comments where we first consider the results for all GPs, then the specific results for rural GPs only.

Results for all GPs

Individual characteristics of the GP

A GP's seniority has a positive influence on his activity (annual number of acts, average number per patient, % of home visits and pharmacy costs, respective t-values: from 3.27 to 11.6). It can be related to the different ways of practicing medicine over several generations of GPs. This effect of seniority is interesting, especially since our sample is censored at 65 years old and the decline in activity of older GPs is not taken into account. Since the age structure of the clientele is significant in these models and is a proxy variable for clientele morbidity, the positive effects of seniority reveal more about a GP's generational impact than the influence of clientele morbidity.

Our results confirm gender differences in physician activity (Bensing, 1993): *ceteris paribus*, women GPs have a lower annual number of acts than their male colleagues. Our results also show that women GPs have a lower number of acts per patient and a lower number of home visits, but the pharmacy costs both per patient and per prescription order are the same (the gender is not significant in these two last models).

When GPs are able to overcharge for their services (sector 2), this results in a lower number of acts per year and per patient; the percentage of home visits and pharmacy costs are lower as well. These results confirm the hypothesis of the GPs' target income (Evans, 1974): higher remuneration per act in sector 2 can explain lower activity in this contractual sector. Moreover, GPs in sector 2 more often have specialised training, such as homeopathy or acupuncture, which rarely requires pharmacy prescriptions.

Insert Table 11

Characteristics and size of clientele

The percentage of patients 70 year-old or older is significant in each regression while this percentage and that of non-paying patients are proxy variables for higher morbidity and demand. When a large part of a GP's clientele is old, he performs fewer acts although the number of acts per patient increases; physicians who have a larger share of older patients are also older, their clientele is somewhat smaller but have more serious illnesses and intense needs. This is why a large part of the GP's activity is conducted in the patient's home. Moreover, older patients also mean higher pharmacy expenditures. The percentage of non-paying patients affects activity as anticipated as a proxy variable of high demand.

Socioeconomic environment

The socioeconomic environment is taken into account through two variables: unemployment rate and average income tax in the GP's district *("canton")*.

Average income tax is an indicator of an area's wealth. It is significant and negative for the number of acts and significant and positive for the pharmacy cost per patient. These results are consistent with socioeconomic studies showing that households with above average incomes resort more often to specialists than GPs and have higher pharmacy consumption. The unemployment rate is negatively significant for the number of acts and the number of acts per patient. It is well known that the unemployed, despite being generally less healthy, consult physicians less often.

As an unexpected result, the unemployment rate is positively significant for the percentage of home visits; unemployment is associated with social and psychological hardships, which may lead the patient to require more home visits.

Medical supply and SID hypothesis

Two measures of GP density are used in the regressions: the GP density in the district *("canton")* and in the county *("department")*. They are both significant although they do not have the same influence. This surprising result needs to be explored.

District density is negatively significant for the number of acts and the number of acts per patient. When density is high in a small area around a GP's location, he performs fewer acts (because the patients of the district are divided among many physicians), and fewer acts per patient (because high density in a district means more medical facilities like hospitals and more specialists that will take away patients from the GP). This result suggests that there is a local market share between GPs and between GPs and other health providers.

County density is also significant, although positively, for the number of acts per patient and the percentage of home visits. When density is high in a larger area around a GP's location, *ceteris paribus*, physicians have a higher number of acts per patient and their activity is composed of more home visits. This reaction could be a response to perceived competition by physicians and restores the usual SID hypothesis.

The distance to the nearest hospital has an expected impact in each regression. A GP far from a hospital must care for more patients; these patients have more serious pathologies requiring home visits and expensive pharmacy prescriptions.

Regional standards

The dummy variable that specifies the GP's location in Aquitaine or Burgundy is significant for the percentage of home visits, the pharmacy cost per patient and the pharmacy cost per prescription order. GPs in Aquitaine make more home visits and write more expensive prescription orders. Usually, spatial variations in medical activity should be explained by demand variations. However, in our results for these three dependant variables, the presence of significant variables related to the number

of acts, the characteristics of the clientele and the socioeconomic context leads us to conclude that there are regional local standards for home visits, part of a GP's activity, and for prescription orders and costs. Our results confirm the preceding ones of Lancry and Paris revealing local standards in pharmacy prescriptions (Lancry & al. 1997).

Target income and financial incentives

The number of patients has been introduced as an independent variable in the number of acts per patient model. It is negatively significant (the t-statistic of this variable is -17.7). *Ceteris paribus*, a GP performs more acts per patient when he has fewer patients. In this case, we can conclude that either the GP has enough time to see his patients as often as they need or patients are seen more often than needed in order for the physician to reach a target income.

In the percentage of home visits model, the number of acts is negatively significant. When the number of acts increases, the percentage of home visits decreases; when the workload (or the income) is sufficient, the GP refuses or dissuades home visits. When the workload is insufficient, home visits are a way to attract new patients.

In pharmacy cost regressions, the number of acts is positively significant. The pharmacy cost grows with the number of acts. We can assume that the length of consultation decreases with the number of acts and that there is a sort of trade-off between the length of consultation and pharmacy prescriptions. These results suggest that financial incentives affect a physician's decision regarding the structure of his activity (% of home visits, length of consultations and level of prescriptions).

Rural GPs

Regressions for rural GPs show that the strength and the nature of the determinants of their activity are specific.

The individual characteristics generally remain significant but their t-statistics are slightly lower. Two variables are no longer significant; the contractual sector in the number of acts per patient regression and the seniority in the pharmacy cost regression.

Insert Table 12

Rural practice patterns with a high percentage of home visits

In each regression, distance to the nearest hospital is no longer significant. This distance has a higher average and less variability in rural areas compared to urban areas. Hospitals in rural areas are always farther away, therefore the GP's activity includes hospitalisation opportunities.

GP densities do not have the same influence in the percentage of home visits model. For all GPs, the county density is positively significant. For rural GPs, it is no longer significant however the district density becomes negatively significant. In rural areas, accepting or promoting home visits are not a

response to perceived competitive surroundings but a medical duty, the strength of which depends on the nearby medical density.

Moreover, in the rural GPs home visits model, the number of acts is still significant, but positively. For all GPs we saw that the percentage of home visits decreases with the number of acts; for rural GPs, when the number of acts grows, the percentage of home visits also increases. In rural areas, the GP must make more home visits in order to increase his activity. The home visits regression is the model that changes the most when only rural GPs are taken into account. It appears that rural GPs do not have the opportunities to freely determine the level and structure of their activity.

Regional standards

The dummy variable relative to the GP's location in Aquitaine or Burgundy keeps the same sign but has a larger coefficient and is more significant (considering t-statistics) in the number of acts per patient and in the percentage of home visits models. *Ceteris paribus*, the difference is greater between rural GPs from Aquitaine and Burgundy than between urban GPs from these two regions. Regional practice standards are stronger and more specific in rural areas while urban practice standards are more similar throughout all regions. Rural GPs are less apt to continue their education and training and they have less contact with distant colleagues, specialists, and hospitals. Their practices are built and change according to local influences. This result for rural GPs strengthens the preceding ones concerning all GPs and confirms our conclusion regarding the local standards of practice patterns of GPs.

5 Discussion

Our results support our hypotheses in several ways. The econometric results prove that the activity determinants arise from different factors that the physicians must come to terms with: his individual characteristics, the characteristics of his clientele and the socioeconomic environment. Individual preferences regarding the practice of medicine, use of time or income, medical constraints and professional standards are all influential. Through the influence of these determinants, some of the physician's decisions are his own while some are forced upon him. These findings confirm previous studies: Davis & al. (2000) show that both economic incentives and clinical constraints influence a physician's decisions; Groenewegen and Hutten (1995) also show that supply- and demand-related factors have an influence on a GP's workload. Moreover, the hypothesis of multidimensional activity is supported by our econometrics results and confirms previous studies (Whines and Baines 1996): our results prove that each dimension of GP activity has its own determinants or its own relationship to a particular determinant.

Our results show the heterogeneity of GP activity in several ways. The econometric results prove that each category of GP can have specific determinants. The results concerning rural GPs show that the nature and the strength of these determinants vary between all GPs and rural GPs. For instance, the influence of physician density on the percentage of home visits is negative for rural GPs while the number of acts has a positive influence. This suggests that medical demand has a greater impact than perceived competition on rural GPs decisions concerning home visits. Scott and Shiell (1997) also show that the effect of competition on GP behaviour depends on medical conditions. In rural areas, home visits are neither a choice nor a strategy; they are an integral part of a GP's activity.

The cluster analysis results also show that the practice of general medicine is not uniform. It depends both on a physician's individual choices and the constraints that must be respected, especially in rural areas. Usual variables known to determine the professional choices of GPs such as gender or age cannot take into account the entire diversity of individual choices. The cluster analysis can reduce the complexity and diversity of individual decisions and situations: each practice pattern indicates one dominant trend in a heterogeneous population of GPs. Also, using a cluster analysis, Contandriopoulos & al. (2001) show that six GP practicing patterns can be distinguished in Quebec., The findings of G. de Pouvourville & al. (2004), based on a cluster analysis, show that ophthalmologists make individual choices about their workload and the technical structure of their activity. Demographic projections regarding this speciality must take this result into account: the relative shortage (scarcity) perceived by patients can be the result of strategic choices made by the physicians themselves. Using principal components and a hierarchical cluster analysis, Damon & al. (2004) show that cardiologists were divided into eight classes showing different types of activity. Using qualitative investigations, Jaye and Tilyard (2002) show that three GP prescription patterns can be distinguished in New Zealand. These results illustrate that we can no longer consider that a particular medical speciality constitutes a homogeneous category.

Kristianson and Mooney (1993) show that medical conditions appear to have a greater influence than the remuneration system (fee-for-service or salary) on a physician's use of time. Taking into account different practice patterns and the heterogeneity in the type of GP activity, our results suggest that, for certain categories of GPs (rural GPs, cluster 1 and cluster 2 GPs) medical conditions would have more influence on a GP's use of time and activity decisions than financial incentives. In the other respect, financial incentives, competitive surroundings and the type of remuneration would have a greater influence on urban GPs and cluster 4 GPs individual decisions.

6 Conclusion

In conclusion, we would like to point out the necessity of future research into the heterogeneity of physicians at different levels. First of all, empirical studies of the motivations of individual choices are

required. It is well known that financial incentives are influential; however, the role of medical determinants and the socioeconomic environment is not well understood. Secondly, analyses of the heterogeneity in the level and the structure of physician activity should be performed. The first results, based on cluster analyses (our study, A.P. Contandriopoulos' 2001 study about GPs, G. de Pouvourville's 2004 study about ophthalmologists, Damon & al.'s 2004 study about cardiologists), reveal the need for such statistical analyses. Finally, these empirical studies should explore and test different theoretical models of physician decisions and different ways of policy making.

Policy makers should take into account the heterogeneity in GP practice patterns in order to understand physician behaviour and reactions to policy incentives. If an increase in regulated fees or an incentive policy is enacted assuming standard behaviour for all GPs, each category of physician will react in a particular way. Therefore, the effective outcomes of the decision would not be as expected.

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Table 1: Variable definitions and origin

GP's individual characteristics			
Age	Age of the GP	Years	Health insurance funds database
Seniority	Seniority	Dummy variable 1 (less than 3 years) 2 (from 3 to 8 years) 3 (from 8 to 20 years) 4 (more than 20 years)	Health insurance funds database
Gender	Gender	Dummy variable 1 (men) 2 (women)	Health insurance funds database
Contract	Contractual sector	Dummy variable 1 (sector 1) 2 (sector 2)	Health insurance funds database
% time	Type of practice	Dummy variable 1 (full-time private physician) 2 (part-time private physician)	Health insurance funds database
GP activity			
ACT	Annual number of acts	Number of acts	Health insurance funds database
%V	% of home visits	%	Health insurance funds database
CTT	Clientele size	Number of patients	Health insurance funds database
ACT/P	Annual number of acts per patient	Number of acts	Health insurance funds database
%PRESPAT	% of patients with prescription order	%	Health insurance funds database
BIOCOST	Cost of biology per prescription order	euros	Health insurance funds database
DRUGCOST	Cost of drug prescriptions per patient	euros	Health insurance funds database
DRUG/ORDER	Cost of drugs per prescription order	euros	Health insurance funds database
COST	Total costs of acts and prescriptions per patient	euros	Health insurance funds database
FIXFEES	Regulated fees	euros	Health insurance funds database
FEES	Total amount of fees	euros	Health insurance funds database
EXFEES	% of surcharges	%	Health insurance funds database
Clientele characteristics			
YOUNG	% of less than 16 years old patients	%	Health insurance funds database
ADULT	% of 16 to 59 years old patients	%	Health insurance funds database
OLD	% of 60 to 69 years old patients	%	Health insurance funds database
VOLD	% of more than 70 years old patients	%	Health insurance funds database
%NONPAYING	% of non-paying patients	%	Health insurance funds database
%HOSP	% of hospitalised patients	%	Health insurance funds database
Economic and medical context			
DIST	Distance to the nearest hospital	Average distance by district (canton)	INSEE
HOSP	Presence of a hospital	Dummy variable 1 (yes) 2 (no)	INSEE
DENS/DIS	GP density/district (canton)	Number of GP/100 000 inhabitants	INSEE and Health Insurance funds database
DENS/CO	GP density/county (département)	Number of GP/100 000 inhabitants	Eco-santé (CREDES)
UNEMP	Unemployment rate	% per district	INSEE
TAX	Average income tax	Per district	INSEE
SALARY	Average wage-earnings	Per district	INSEE
RURAL	Type of the GP location	Dummy variable 1 (urban area) 2 (rural area)	INSEE
REGION	Region of the GP location	Dummy variable 1 (Burgundy) 2 (Aquitaine)	Health insurance funds database

Table 2: Cluster analysis of GPs from Aquitaine (average values per cluster), n=3225

	Number of acts	Number of patients	% of patients with prescription order	Annual number of acts per patient	Cost of biology per prescription order	Total costs per patient	Cost of drug prescriptions per patient	% of home visits
Cluster 1	**6450.63**	**1833.09**	**90.69**	**4.15**	**175.21**	**2383.18**	**1290.33**	**0.29**
Cluster 2	**9302.91**	**2336.65**	**92.10**	**4.76**	**185.73**	**2785.49**	**1507.11**	**0.30**
Cluster 3	**4381.35**	**1266.54**	**90.72**	**4.18**	**177.86**	**2553.66**	**1372.76**	**0.29**
Cluster 4	**2410.56**	**1051.45**	**81.27**	**3.07**	**183.97**	**1374.25**	**707.36**	**0.22**
TOTAL	**5130.67**	**1517.40**	**88.53**	**3.97**	**179.29**	**2240.37**	**1200.58**	**0.77**

Table 3: Activity and fees (average values per cluster)

	Annual amount of regulated fees	Total amount of fees	% of surcharge
Cluster 1	**759228**	**774118**	**1.65**
Cluster 2	**1080660**	**1094012**	**1.04**
Cluster 3	**517295**	**536687**	**2.81**
Cluster 4	**333277**	**365772**	**7.33**
TOTAL	**614497**	**634856**	**3.33**

Table 4: Gender (% of women, % of men per cluster)

	% of women	% of men	Total
Cluster 1	**10.0%**	**90.0%**	**100%**
Cluster 2	**4.0%**	**96.0%**	**100%**
Cluster 3	**21.4%**	**78.6%**	**100%**
Cluster 4	**43.9%**	**56.1%**	**100%**
TOTAL	**21.0%**	**79.0%**	**100%**

Table 5: Contractual status (% sector 2, % sector 1 per cluster)

	% of sector 2	% of sector 1	Total
Cluster 1	**6.4%**	**93.6%**	**100%**
Cluster 2	**4.0%**	**96.0%**	**100%**
Cluster 3	**10.9%**	**89.1%**	**100%**
Cluster 4	**20.6%**	**79.4%**	**100%**
TOTAL	**21.0%**	**79.0%**	**100%**

Table 6: Age, seniority (years per cluster)

	age	seniority
Cluster 1	**46.68**	**15.99**
Cluster 2	**47.19**	**17.48**
Cluster 3	**47.16**	**15.95**
Cluster 4	**46.26**	**13.48**
TOTAL	**46.79**	**15.54**

Table 7: Type of location (% of each type per cluster)

	Rural	Urban	Total
Cluster 1	**37.8%**	**62.2%**	**100%**
Cluster 2	**45.9%**	**54.1%**	**100%**
Cluster 3	**29.0%**	**71.0%**	**100%**
Cluster 4	**18.0%**	**82.0%**	**100%**
TOTAL	**31.2%**	**68.8%**	**100%**

Table 8: Economic and medical context (average values per cluster)

	Distance to the nearest hospital	Average income tax	Average wage-earnings	Unemployment rate	GP density per district (canton)	GP density per county (département)
Cluster 1	**13.22**	**7458.44**	**104297.39**	**0.9**	**138.27**	**118.31**
Cluster 2	**14.75**	**7096.21**	**102883.61**	**0.09**	**126.68**	**117.32**
Cluster 3	**10.44**	**8054.47**	**106547.65**	**0.09**	**147.62**	**118.67**
Cluster 4	**7.09**	**8578.26**	**108626,.8**	**0.10**	**172.09**	**119.74**
TOTAL	**11.02**	**7886.36**	**1055896.77**	**0.09**	**148.20**	**118.65**

Table 9: Clientele characteristics (% of each category per cluster)

	% of 16 or younger	% of 16 to 59 years old	% of 60 to 69 years old	% of 70 or older	%of non-paying patients
Cluster 1	**20.60**	**55.09**	**9.78**	**14.53**	**21.39**
Cluster 2	**20.59**	**55.03**	**9.63**	**14.75**	**22.16**
Cluster 3	**18.98**	**54.98**	**9.99**	**16.05**	**22.43**
Cluster 4	**18.62**	**58.75**	**9.82**	**12.88**	**20.56**
TOTAL	**19.61**	**55.91**	**9.85**	**3.97**	**21.62**

Table 11: Econometric results. OLS regressions with 5 dependent variables. All GPs, n=4625
Parameter estimate
t value (ns: non significant)

	Number of acts	Number of acts per patient	% of home visits	Pharmacy cost per patient	Pharmacy cost per prescription order
Intercept	8343 25.19	3.24 10.08	-0.252 -7.13	105.5 1.6	96.18 13.5
Seniority	20.45 4.83	0.017 7.21	0.0011 4.33	9.88 11.6	0.354 3.27
Gender	-1588 -20.6	-0.41 -9.03	-0.075 -14.79	ns	ns
Contractual group	-505.25 -10.34	-0.11 -3.98	-0.0483 -15.31	-59.91 -5.84	-7.29 -5.6
GP density/district	-2,74 -7.05	-0,017 -8.05	ns	-0,65436 -8.1	ns
GP density/county	ns	0.015 4.49	0.00102 2.69	ns	ns
Distance to the nearest hospital	12.02 3.39	0.0094 5.25	0.00048 2.21	3.27 4.49	0.879 10.83
Number of patients		-0.00047 -17.71			
Number of acts			-18.10^{-7} -1.96	0.068 23.55	0.0019 4.82
Number of acts per patient					8.46 12.42
% 16 or younger	22.51 4.16	-0.0241 -7.6	0.00913 26.87	2.15 1.92	0.9 6.33
% 70 or older	-22.62 -4.28	0.0164 4.92	0.00727 19.81	26.87 22.61	2.85 18.88
% non paying patients	ns	0.0226 8.27	0.0049 16.37	6.42 6.56	0.78 6.38
Urban/rural	ns	ns	ns	ns	ns
Unemployment rate	-3942 -2.98	-3.16 -4.11	0.467 5.47	-412.25 -1.47	-245.10 -7.03
Income tax	-0.086 -6.33	ns	$5\ 10^{-6}$ 5.5	0.0068 2.41	ns
Region	111.80 1.62	0.147 1.91	0.0385 4.39	69.44 4.9	10.12 5.8
R^2 F	0.18 99.58	0.24 121.22	0.38 239.05	0.36 231.74	0.31 211.21

Table 12: Econometric results. OLS regressions with 5 dependent variables. Rural GPs, n=1469
Parameter estimate
t value

	Number of acts	Number of acts per patient	% of home visits	Pharmacy cost per patient	Pharmacy cost per prescription order
Intercept	8290 12.91	3.36 7.26	0.15 -4.28	185.97 3.01	65.84 4.15
Seniority	23.01 7.38	0.0095 2.93	0.0015 4.4	1.9 1.5	ns
Gender	-1692 -11.25	-0.427 -6.24	-0,047 -6,59	ns	ns
Contractual sector	-500.6 -4.47	ns	-0.0372 -7.13	-43.90 -2.2	-12.67 -4,64
GP density/district	-2,32 -2.89	-0,0012 -3.19	-0,0001 -3.05	-0,643 -4.71	ns
GP density/county	ns	0.0082 2.02	ns	ns	ns
Distance to the nearest hospital	ns	ns	$43\ 10^{-5}$ 1.72	ns	ns
Number of patients		-0,00037 -9.41			
Number of acts			39.10^{-7} 3.31	0.060 13.55	ns
Number of acts per patient					9.08 6.6
% 16 or younger	26,33 1,74	-0.0273 -4.10	0.0059 8.58	ns	1.37 3.82
% 70 or older	-56.52 -4.47	0.0142 2.27	0.0074 11.39	31.93 15.69	4.05 12.09
% non paying patients	ns	0.0329 5.89	0.0051 8.98	17.22 7.93	1.14 3.71
Unemployment rate	ns	-1,87 -1,49	ns	ns	-151,67 -2.34
Income tax	ns	ns	$4\ 10^{-6}$ 3.35	ns	0.00402 6.34
Region	196.19 1.61	0.35 3.70	0.0618 11.01	ns	14.89 5.08
R^2 F	0.13 30.2	0.28 56.52	0.33 66.38	0.31 211.21	0.26 65.42