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Medical Demography and Intergenerational Inequalities in General Practitioners' Earnings *

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Abstract

This article examines the link between restrictions on the number of physicians and general practitioners' earnings. Using a representative panel of $6,016$ French self-employed GPs over the years 1983 to 2004, we show that the policies aimed at manipulating the number of places in medical schools strongly affect physicians' permanent level of earnings.

We estimate an earnings function to identify experience, time and cohort effects. The cohort effect is very large: the estimated gap in earnings between "good" and "bad" cohorts may reach 25%. GPs beginning during the eighties have the lowest permanent earnings: they belong to the baby-boom numerous cohorts and faced the consequences of an unlimited number of places in medical schools. Conversely, the decrease in the number of places in medical schools led to an increase in permanent earnings of GPs who began their practice in the mid nineties. A stochastic dominance analysis shows that unobserved heterogeneity does not compensate for average

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differences in earnings between cohorts. These findings suggest that the first years of practice are decisive for a GP. If competition between physicians is too intense at the beginning of career, she will suffer from permanently lower earnings. To conclude, our results show that the policies aimed at reducing the number of medical students succeeded in buoying up physicians' permanent earnings.

JEL Classification : C2, D63, I18

Keywords:GPs, self-employed, longitudinal data, earnings, stochastic dominance

1 Introduction

Like many industrialized countries, France experienced a rapid increase in the total number of physicians after the Second World War. For general practitioners (GPs), the physician:population ratio increased continously until 2000 and it is currently one of the highest among OECD countries. Such an increase may be appropriate if there was a previous shortage in medical services. At some point, however, needs are fulfilled and an excessive number of physicians is likely to lower their earnings.

In France, GPs are paid on a fee-for-services basis. Since fees are fixed by bargaining, there is no market-clearing price for ambulatory care. Equilibrium can be reached with adjustments in care quality, such as changes in the duration of consultations. However, this kind of adjustment is necessarily limited: an excessive number of GPs leads to a situation where more doctors share a limited amount of demand. Consequently, each GP provides a lower quantity of services and receives lower earnings because of the fee-for-services payment system.

In France, the baby-boom led to a huge increase in the number of medical students at the end of the sixties and the beginning of the seventies. In order to regulate the supply of health care, a reform implemented in 1971 limited the number of new medical school graduates. Since then, the *numerus clausus* defines the annual number of students allowed to continue their medical studies after the first year.

By the end of the seventies, all the French physicians' associations had become aware that their earnings were threatened by an excessive number of physicians: they put pressure on the government for a sizeable reduction in the number of new practitioners. Afterwards, the *numerus clausus* was drastically cut. A severely restrictive policy was thus implemented as of 1979. Given that studies to become a GP last 9 to 10 years, its potential effects can be observed only for physicians who began to practice in the year 1988 or later.

It is politically difficult for governments to implement or reduce a *numerus clausus.* Indeed, they are immediately confronted with the dissatisfaction of first year medical students. Furthermore, the impact of such policies is not perceptible for a long time because of the duration of medical studies.

This article examines the link between regulation of the number of physicians in France and GPs' earnings. Using longitudinal data about French GPs, we estimate earnings functions to identify experience, cohort and time effects. The cohort is defined by the first year in practice. We focus on cohort effects to examine the relationship between changes in medical demography and earnings inequality among doctors. Did GPs' earnings suffer from an excessive number of new practioners for those who set up their practices during the eighties? Did subsequent cohorts benefit from restrictions in the *numerus clausus*? In other words, did the *numerus clausus* buoy up physicians' earnings?

Because of the 10 year time lag in the impact of such a policy, empirical evaluation calls for the use of a sample of physicians observed over a sufficiently long period. We have at our disposal a representative panel of $6,016$ French self-employed GPs observed over the $1983-2004$ period, which corresponds to $81,691$ individual-year observations, and to cohorts who began their practice between 1970 and 2001.

This sample is drawn from the administrative files on self-employed physicians collected by the public health insurance scheme. Reliable data on the earnings of self-employed workers in general are rare. French ambulatory care administration produces reliable data on physicians' earnings: the public health insurance scheme observes GPs' earnings because it reimburses patients for their payments to doctors.

Literature about physicians' earnings in industrialized countries is rare. Most studies focus on the impact of payment schemes on care provision (McGuire, 2000). More broadly, studies about self-employed professionals are rather scarce. Pioneering work was performed in 1945 by Friedman and Kuznets who compared physicians to other professionals (lawyers, dentists). Lazear and Moore (1984) studied careers of self-employed professionals using cross-sectional data. More recently, Ajayi-Obe and Parker (2005) compared earnings of British self-employed professionals and employees using longitudinal data, but without studying the career profiles. To our knowledge, no one to date has estimated the career profiles of self-employed professionals using longitudinal data. Our estimates of physicians' career profiles make it possible to understand why medical demography at the beginning of practice has so much influence on their permanent earnings. Moreover, our profile estimates might shed light on results relative to salaried workers. For the latter, the influence of seniority on earnings is thought to reflect human capital accumulation and productivity incentives implemented by firm managers (Lazear, 1981). The earnings profiles of self-employed physicians may be shaped by human capital accumulation, but there are no agency problems. Furthermore, they have more freedom than employees in the allocation of work time over their life spans.

This paper is organized as follows. The first section describes the French market for ambulatory care. Then we present the data and a descriptive analysis of fluctuations in medical demography resulting from general demographic change and the *numerus clausus*. The following section is devoted to the estimation of the earnings function, with identification of time, experience and cohort effects. In the next section we carry out a more thorough analysis in order to interpret cohort effects. In addition, we carry out a stochastic dominance analysis to find out whether or not average differences between GPs belonging to different cohorts could be cancelled out by individual unobserved heterogeneity. The final section concludes.

2 The French market for ambulatory care

2.1 Insurance coverage

In France, about 99% of the population is covered by the public health insurance scheme. For each service provided, there is a reference fee fixed by agreement between physicians and the health insurance administration. Public health insurance is mandatory and financed by income-related contributions. It covers about 70% of the expenses corresponding to the reference fees. In addition to the public system, individuals can take out voluntary private insurance or be covered through occupational group private insurance. These complementary insurance contracts cover the share of expenses not covered by public health insurance (30%). Through these different kinds of insurance schemes, reference fees for 80% of the population were fully covered until 2000. In that year, a reform (CMU, *Couverture Maladie Universelle*) was implemented to provide free complementary coverage to people with low incomes. Since the introduction of the CMU, reference fees have been fully covered for almost all the population. Hence, on the demand side, there is no financial limit to the use of ambulatory care. Moreover, patients freely choose the physician they consult and can change their physician for another one at any time. To avoid excessive use of ambulatory care, a gatekeeping system was introduced at the end of year 2004. In the period covered by our data ($1983 - 2004$), the activity of the observed GPs was not affected by this reform.

2.2 Physicians' payments and behaviour

In France, physicians providing ambulatory care are general practitioners or specialists. They are mainly self-employed and paid through a fee-for-service scheme. In this article, we focus on GPs, more than 90% of whom are exclusively self-employed. As stated above, reference fees are fixed for each service. More precisely, there are two sectors: in sector 1 overbilling is forbidden and in sector 2 it is authorized. GPs were allowed to join sector 2 only between 1982 and 1992. Currently, most GPs (87%) belong to sector 1 and are paid the reference fees. Therefore, their incomes depend only on the level and composition of their activity. The latter is mainly composed of office visits (82% in year 2004) and home visits (15%), the remaining part being composed of small procedures (3%).

The market for ambulatory care is characterized by a monopolistically competitive structure (McGuire, 2000). Physicians are not perfect substitutes and have some market power because of differences in location and care quality. Each physician is supposed to maximize her utility, subject to the production function and the demand function. The production function describes the provision of care services, which depends positively on the number of hours of work and negatively on visit duration.[1] Competition is more intense when the number of physicians increases: for each physician, the demand depends negatively on the number of physicians operating in the same area, and positively on visit duration (linked to care quality). Given the homogeneity of fees in sector 1 and the fact that patients are fully covered by insurance, fee levels have no influence on demand for services from a particular physician. When maximizing her utility subject to the production and demand functions, the physician sets the optimal quantity of services to provide, as well as the optimal number of hours of work and visit duration.

For the purpose of our study, we do not need to define a more formal theoretical model. Our representation of the physician's behaviour is fully static. Within this framework, the physician's earnings depend only on the quantity of services provided. This quantity is influenced, on the demand side, by the number of physicians and visit duration and, on the supply side, by the physician's preferences regarding consumption and leisure. This representation is inspired by the model built by Bolduc *et al.* (1996) to study doctors' location choices. As in McGuire and Pauly (1991), we could add a term describing demand inducement. It would positively influence the demand for care and have a negative impact on the physician's utility.

[1] In France visit duration does not affect the level of payment for a visit, although a longer duration is likely to contribute to better care quality. Hence, in our production function the Gp's output is closely related to the number of consultations. For a given number of hours of work, the longer the visit duration, the lower the output.

2.3 The number of practicing physicians

The supply of physicians is defined by the number of students who successfully complete medical studies in France. There is no regulation of the number of new practitioners through practice licences: every trained student is allowed to set up anywhere in the country. European students trained abroad are allowed to practice in France, provided they speak French and are not forbidden to practice in their own countries. Actually, foreign GPs are rare: in 2006, they represent only 1,8% of all practising GPs.[2]

Until 1988, the studies to become a GP lasted 7 years. Afterwards, medical studies were lengthened to 8 years in 1988 and 9 years in 2001. An exam for all medical students (*Les épreuves classantes nationales- ECN*) was introduced in 2004, to better channel medical students into the various specialties, general practice being one of them. This reform has substantially altered the process of choice for general practice. A student with a high rank can now choose another specialty while, before the reform, she had to plan in advance whether she wanted to become a GP or not. In addition, this reform led many students to choose to repeat a year in order to reach a rank which would give them access to the specialty of their choice. Together with the selection introduced earlier by the *numerus clausus*, which obliged many students to repeat the first year, these individual strategies have lengthened medical studies to 9 or 10 years.

Places in medical schools have been regulated since 1971 *via* the *numerus clausus,* which introduced severe selection at the end of the first year. Depending on the year considered, only 10% to 20% of the students are allowed to continue with their medical education after the first year. The goal of earnings' improvement was not made explicit in France. Current government reports claim that the aim of this policy is to limit the number of physicians (Sénat, 2007) in order to help monitor the supply of health care and contain health expenditure growth.

The *numerus clausus* defines the annual number of students allowed to continue their medical studies after the first year. It was initially set at about 8,500 places. After its introduction it remained

[2] According to data from the *Conseil National de l'Ordre des Médecins.*

fairly constant for several years. At the end of the seventies, all the French physicians' associations had become aware that their earnings were threatened by an excessive number of physicians: they put pressure on the government for a sizeable reduction in the *numerus clausus* (Deplaude, 2007). Afterwards, the latter was continuously reduced during about two decades, until 1999. During the nineties, it was set at a rather low level of 3,500 places.

This reform is similar to the action of the American Medical Association in the United States at the beginning of the twentieth century. Following the Flexner Report in 1910, the number and capacity of medical schools was decreased. According to McGuire (2000), the decrease in the physician: population ratio that occurred between 1910 and 1965 contributed to elevate physicians' economic position. Today, American physicians have very high earnings relative to other professionals compared to their collegues in other OECD countries (OECD, 2006).[3]

The potential influence of the *numerus clausus* is twofold: (i) it contributes to a decrease in the number of new practioners, thus increasing potential demand for each physician; (ii) the selection introduced by the *numerus clausus* sets up a tournament between first year students, which may lead to an improvement in the average ability of physicians. This paper examines whether the decrease in the number of new doctors caused by the *numerus clausus* contributed to an increase in physicians' earnings.

2.4 Recurrent problems in French ambulatory care regulation

In France, the regulation of ambulatory care is beset with recurrent problems which might eventually create serious difficulties. For GPs, the physician:population ratio increased until 2000, and is now one of the highest among OECD countries (in second place after Switzerland, HCAAM, 2007). The geographic distribution of doctors in very uneven, which induces inequalities in access to care. Moreover, there is empirical evidence of supply-induced demand for French GPs (Delattre and Dormont, 2003). This behaviour is more prevalent in locations where the level of the physician:population ratio is high

[3] On average, their income is 4.2 higher than GDP per capita for GPs and 6.6 higher for specialists. US is at the first row among developped countries for these proportions. For France, the corresponding figures are 2.8 for GPs and 4.6 for specialists.

(more than 110 GPs per 100,000 inhabitants).

Finally, there seems to be a decline in the attractiveness of the self-employed GP profession. Indeed, the 2004 reform in medical education (introduction of *ECN*) has revealed that many students prefer not to specialize in general practice: 14% of the available GP positions were not chosen in 2006; in 2005, this proportion reached 40% (Billaut, 2006). Furthermore, fewer students are willing to become self-employed; many choose to be salaried at the end of their studies (Bourgueil, 2007).

The issue of the attractiveness of the GP profession is beyond the scope of this article. However, the shortage of candidates for GP positions is a symptom of problems attached to this profession. Our study examines whether there are substantial generational differences in GPs' earnings.

3 Basic features of the data

3.1 The sample

We have at our disposal a 10% random sample of self-employed GPs practicing in France between 1983 and 2004. It is drawn from an administrative file collected by the public health insurance scheme (*Caisse Nationale d'Assurance Maladie des Travailleurs Salariés*, CNAMTS). Given that public health insurance is mandatory and universal in France, this sample is drawn from an exhaustive source of information about self-employed physicians.[4]

The panel is unbalanced: each physician i is observed for a period T_i, which can begin after 1983 (for a physician who goes into practice after 1983) or end before 2004 (for a physician who retires before 2004). For each physician i at year t, we have information about age, gender, year of PhD, year of the beginning of practice, level and composition of activity (office visits, home visits, surgery or radiology), location (95 *départements* in 22 *régions*), and practice earnings.

We decided to focus on sector 1 GPs. Sector 2 GPs represent a small proportion of total GPs: 13%.

[4] Self-employed physicians account for 84% of physicians engaged in ambulatory care, the others being salaried doctors who work in schools or within firms.

We define each cohort by the first year in self-employed practice. Our complete dataset provides information about GPs belonging to cohorts 1945 to 2003. This information has been used in the descriptive analysis of the cohort pyramid in the next subsection. In the econometric analysis, however, we selected GPs belonging to cohorts 1970 to 2001. Indeed, the number of GPs belonging to older cohorts was too small to allow for relevant statistical inference[5].

The final sample used for the econometric analysis consists of $6,016$ GPs with a total of $81,691$ individual-year observations from 1983 to 2004. We observe 32 cohorts and 95 to 290 physicians per cohort. Experience ranges from 1 to 34 years (Table 1).

Basic features of the data are displayed in table 2. The proportion of female physicians increases rapidly over the period, from 13% in 1983 to about 25% in 2004. The average experience level triples between 1983 (5.8 years) and 2004 (17.6 years). This reflects the ageing of the physician population, due to the combined effects of the baby-boom and of the policies implemented from the mid $70s$ to reduce the number of physicians.

Earnings are calculated on the basis of the total fees received by the GP during the year. By matching our database with fiscal records, we were able to compute earnings net of expenses (rent for the office, payments for the secretary, etc.) at the individual level for years $1993-2004$. In 2004, average earnings net of expenses equal € $62,024$. Earnings of French GPs appear to be rather moderate. Using the OECD Health Database (2006) we find that earnings of American, Swiss, Canadian and British self-employed GPs are, respectively, 91%, 29%, 26% and 12% higher than earnings of their French counterparts (in US $ PPP).

[Insert Table 1 about here]

Table 1: Structure of the sample

[Insert Table 2 about here]

Table 2: Basic features of the data

[5] In addition, these doctors are not representative, since their observability derives from the fact that they are not retired yet, despite their age.

3.2 The cohort pyramid

Figure 1 displays the "cohort pyramid" drawn from our dataset, each cohort being defined by the first year in practice. This pyramid has a very chaotic shape, which results from the combined effects of demographic changes and the *numerus clausus*.

To illustrate demographic changes, we have drawn the curve of the number of births 30 years earlier (on average, GPs begin their practice at age 30). Some typical cohorts are labelled but all cohorts are analysed in our study. Figure 1 shows a huge increase in the number of physicians for cohorts 1974 to 1978 : this is due to the baby-boom, given that the number of places in medical schools was not regulated for these cohorts.

The *numerus clausus* introduced a discrepancy between changes in the number of new GPs and general population growth, as shown on the right side of the figure. We have displayed the value of the *numerus clausus* 9 years before the beginning of the practice (this interval corresponds to the average duration of medical studies). The pattern of the *numerus clausus* curve is noteworthy. It was fairly constant after its introduction and decreases at the end of the seventies only. A genuinely restrictive policy was implemented only from 1979 on: its effects can be observed only beginning with the 1988 cohort.

The small number of physicians belonging to pre-1970 cohorts is due to retirements (left side of figure 1).

[Insert Figure 1 about here]

Figure 1: Cohort pyramid, number of births 30 years before and value of *numerus clausus*

Figure 2 displays average GPs' earnings (in 2004 Euros) by cohort in relation to experience. To improve the readability, we show only cohorts 1972, 1977, 1985, 1993 and 1999 (which are labelled in figure 1). In such a figure, cohort, time and experience effects are intertwined. For instance, recent cohorts are situated at a relatively high level because they benefited from increases in reference fees that occurred regularly over the period, while older cohorts were by definition excluded from these increases. Econometric estimation makes it possible to disentangle cohort, time and experience effects.

[Insert Figure 2 about here]

Figure 2: Average earnings by cohort as a function of experience

4 Estimating the earnings function

4.1 Empirical specification

Consider y_{ict} the log of earnings (in 2004 euros) in year t of the physician i belonging to cohort c. Our specification is the following:

$$\begin{aligned} & y_{ict} = a + D'_{ict}b + Z'_{ic}d + \eta_r + \alpha_e + \delta_t + \gamma_c + \varepsilon_{ict} \quad , \\ & \text{with } i = 1, ...N;\ c = 1....C;\ t = 1....T;\ e = 1....E;\ r = 1, ...R. \end{aligned} \tag{1}$$

Vector D'_{ict} comprises two indicators of medical density: the number of GPs and the number of specialists per $100,000$ inhabitants in the *département* where physician i works. GP density provides a measure of competition intensity between physicians. Z'_{ic} includes time-invariant variables such as gender, the number of years between attaining a PhD and the first year of practice, the type of practice (full-time or part-time), *MEP* physician[6] or not, type of location (town, suburbs, urban sprawl or rural area).

Experience is defined as the number of years that have past since the first year of practice. The influence of experience cannot reflect returns on human capital since all GPs have the same education level. The effect of experience on a doctor's earnings results more from changes over time in the number

[6] A *MEP* is a generalist who practices certain specific activity: acupuncture, homeopathy, dietetic, etc. These kinds of specializations are not recognized by the health insurance scheme through specific reference fees.

of patients than from an increase in productivity due to human capital accumulation. At the beginning of her career, a physician has to attract a sufficient number of patients. The effect of experience can reflect this process of patient recruiting. After the beginning of the career, the total number of patients may have a link with the physician's earnings through two mechanisms: (i) it can act as a signal of the doctor's ability and thus stimulate demand; (ii) it can directly improve human capital: the larger the number of patients, the more intense the daily training in medical practice. Moreover, the effect of experience can reflect changes over time in the physician's preferences regarding consumption and leisure. Indeed, self-employed professionals have more freedom than salaried workers in the allocation of hours of work over their life spans.

Our data set allows us to use a more flexible specification of the impact of experience than the traditional polynomial function. We simply consider experience fixed effects α_e , $e = 1, ..., 34$. Similarly, δ_t , $t = 1983, ..., 2004$ and γ_c , $c = 1970, ..., 2001$ are time and cohort effects. As stated above, a cohort is defined by the first year of practice. We also specify regional fixed effects η_r , where r refers to the region of practice (there are several *départements* within each region).

The extensive use of various fixed effects raises identification problems. Our specification is not identifiable unless we add linear restrictions. We used the following constraints:

$$\sum_r \eta_r = 0, \ \sum_e \alpha_e = 0, \ \sum_t \delta_t = 0 \ \text{ and } \sum_c \gamma_c = 0 \tag{2}$$

$$\sum_c c * \gamma_c = 0 \tag{3}$$

Constraints (2) come down to defining a reference category for each effect. The reference category is Île-de-France (Paris area) for the regional fixed effects η_r. The reference category is 7 years for experience and 1983 for time. For cohort effects, we imposed constraint (2) that effects γ_c sum to zero. Constraint (3) deals with another source of colinearity: for each physician i, one has $t = c + e$. For instance, in the year 1990, GPs of cohort 1970 have 20 years of experience.[7] This colinearity problem can be solved by the use of one additional linear constraint which can be specified in numerous ways (Deaton, 1997). The empirical literature generally focuses on the choice between constraint (3) and the following constraint:

$$\sum_t t * \delta_t = 0 \tag{4}$$

Constraint (3) imposes that there is no trend in cohort effects, whereas constraint (4) imposes that there is no trend in time effects.

Estimates of time, cohort and experience effects differ greatly depending on whether constraint (3) or (4) is adopted.[8] The history of the period 1983-2004 shows that (i) reference fees rose steadily because of general agreements; (ii) the baby-boom and the *numerus clausus* induced large fluctuations in medical demography. These facts suggest that disallowing a trend in time effects would be overly restrictive. They give support to the idea that there is no trend in cohort effects. We used alternative strategies to eliminate the colinearity between time, cohort and experience. They validated the absence of a trend in cohort effects (constraint (3)).[9]

4.2 Econometric issues

Since some GPs leave the sample for reasons other than retirement, our estimates may be affected by a selection bias. An examination of our dataset reveals that some GPs leave the sample either permanently (9% of observations) or for a transitory break (6% of observations). The reasons why doctors leave the sample are only partially observed. Some of them move from sector 1 to sector 2, where overbilling is allowed: it concerns 34% of permanent departures and 26% of transitory breaks. Some move to another location (17% of transitory breaks). Other reasons for departures are not

[7] This is not true for all GPs of the sample, given that some of them experience a temporary break in their career. In this case, we substracted the duration of the break to compute experience. Only 6% of the observations are concerned: t is still strongly correlated with $c + e$ and we cannot base identification on these exceptions.

[8] The experience profile is strongly affected by the choice of constraint (3) or (4). Imposing (4) prevents any raise in reference fees from being incorporated into the estimated time effects. The experience effects then capture part of the time effects (Dormont and Samson, 2007).

[9] For example, we agregated cohorts into 5 groups and estimated fixed effects for groups of cohorts. Colinearity is eliminated since $t \neq (groups\ of\ c) + e$. The pattern of the cohort effects estimated with constraint (3) is very similar to the pattern of the curve corresponding to specification in terms of groups of cohorts (see figure 6 below).

observed. Physicians who leave the sample have lower earnings than the others, suggesting a possible selection bias.

We cannot deal with this problem by using Heckman's sample selection model. Because GPs who leave the sample do so for several reasons, participation in the sample cannot be specified by a single participation equation. Following Verbeek and Nijman (1992), we simply added five dummy variables indicating if the GP has left the sample permanently or temporarily, to switch sectors, to change locations or for another reason. This procedure does not provide a correction for attrition bias but allows to check for its existence.

All dummies are negative and significant, revealing a selection bias. For example, we find that GPs who experience a temporary break had lower earnings prior to the break (-12% if the break was due to a sector change, -17% for a location change). However, this bias does not affect our main findings: some coefficients are slightly affected by the introduction of participation dummies,[10] but this is not the case for estimates of experience, time and cohort effects. This appears clearly in figures 3, 4 and 5.

Our specification does not control for unobserved heterogeneity among physicians. Indeed, considering an error-component model with a GP-specific effect would prevent us from identifying the cohort effects we are interested in. The model is estimated by ordinary least squares subject to constraints (2) and (3). This comes down to assuming that variables such as the physician:population ratio or the type of location (town, suburbs, urban sprawl, rural area) are exogenous. This is questionable: Bolduc *et al.* (1996) have shown doctors' location choices are influenced by expected earnings in each location.

We decided to perform a Hausman test to check for exogeneity of the GP:population ratio. Indeed, each physician chose to set up practice in an area characterized by a given GP:population ratio. Variables explaining demand for care services in each *département* are good candidates to serve as instruments. Only two variables had a significant impact on the GP:population ratio: the proportion of women in the population of the *département* and the logarithm of average household income in

[10] One change concerns the estimated coefficient of the GP: population ratio, which is equal to -0.0025 for the specification without participation dummies versus -0.0026 with dummies. For the coefficient of the gender dummy (female), we obtain -0.343 without participation dummies versus -0.336 with dummies. These slight changes are the biggest we observe.

the *département*.[11] Using these two instruments, the Hausman test led to non rejection of the assumption that the GP:population ratio is exogenous ($p = 0.90$). Moreover, a Sargan test validated the instruments' exogeneity ($p = 0.22$). Another exogeneity test can be performed by introducing a slight change in the model specification. Since the specialist:population ratio is never significant, we moved this variable from model (1) and added it to the instrument list. This enabled us to test for the exogeneity of both GP density and the type of location (aggregated into three categories). The Hausman's test led to non rejection of the null hypothesis that these variables are exogenous ($p = 0,26$) and the Sargan test validated the instrument exogeneity.[12] Our finding that GP density and location type are exogenous is rather surprising. Actually, our tests are limited by the small number of available instruments. Therefore, we were not able to carry out an exogeneity test for the regional dummies, which are also related to location choice. These variables are among the explanatory variables of the model used for the Hausman tests.

4.3 Results

We estimated three versions of model (1), one for each dependent variable: log of earnings, log of physician's activity or log of net earnings. Activity is defined as the total number of encounters between the physician and patients, where every encounter is counted as one (office visit, home visit or small procedure). For a given activity level, earnings level depend on the composition of activity and the values of reference fees. In what follows, we discuss our results relative to the specification explaining the log of earnings. When appropriate, we comment on results obtained on activity or net earnings.

The experience, time and cohort effects estimated on the specification explaining the log of earnings are reported in figures (3) to (5). The other estimated parameters are presented in table 3.

On average, female GPs earn 34% less than male GPs. Since reference fees are the same for all, this gap is entirely due to differences in activity: in the specification explaining the log of activity, we find

[11] These two instruments are jointly significant in the first-step regression (p<0.0001).

[12] The instruments are jointly significant in the three first-step regressions (p<0.0001 for each regression). Interestingly, the specialist:population ratio has a positive influence in the first-step regression explaining the GP:population ratio: these two types of practitioners appear to be complements rather than substitutes.

that female GPs' activity is 33% lower than males'. Why do female GPs have fewer encounters with patients than males GPs? Is their patient number smaller? Is their average visit duration longer? Do female doctors have a preference for leisure leading to a lower number of hours of work? Unfortunately, our database does not provide any information on visit duration, hours of work or doctors' household compositions. Rizzo and Zeckhauser (2007) addressed these questions using US data relative to young physicians. They found about the same gender gap in earnings: 33% in 1990. Exploring possible explanations, they show that differences in preferences and behaviour account for the entire differential: the reference income of female doctors is 26% lower than the reference income of their male colleagues. In addition, male physicians take action if their incomes falls short of their reference income: they do not raise their hours of work, but they spend less time per patient and focus on more lucrative procedures to compensate for an income shortfall.

The GP:population ratio provides a measure of competition intensity between physicians within each *département*. For patients, the time cost of switching to another GP is smaller when there are many doctors in the neighbourhood. For GPs, an increase in the number of colleagues practicing in the area lowers the number of potential patients for each doctor. Our estimates reveal a sizeable impact of competition between GPs: a rise in the level of the GP:population ratio, for example from 100 to 110 per $100,000$ inhabitants, leads to a 2.5 percentage point drop in their earnings (table 3). Conversely, GPs do not seem to compete with specialists: the specialists:population ratio is not significant.[13]

The negative influence of GP density comes on top of regional effects. Given that our specification includes regional fixed effects η_r, the estimated elasticity of the GP:population ratio is actually a within-region elasticity. Regional fixed effects capture the time-invariant impact on GPs' earnings of certain characteristics of regions: amenities, average GP:population ratio and determinants of demand for care services. Our results show for example (table 3) that physicians in the $PACA$ region (the Côte d'Azur in the south of France) earn on average 8% less than GPs in the Paris area (the reference

[13]This is why this variable was used as an instrument in the exogeneity test discussed above (performed on a version of the model excluding the specialists:population ratio). Nevertheless, table 3 presents the estimates of model (1), which includes the specialists:population ratio, as the non-significance of this variable is an interesting result.

region). In constrast, physicians in the region *Nord* (North) earn 21% more than physicians in the Paris region. On the demand side, these differences stem from the fact that more GPs share a given number of potential patients in *PACA,* where medical density is very high, than in region *Nord,* where it is relatively low. On the supply side, these earnings disparities reflect differences in expected utility attached to each region when GPs chose their location (Bolduc *et al.*, 1996). In other words, some GPs are willing to earn 8% less in the south, where they work less and enjoy the sun. In the north, they need 20% extra earnings to compensate for more work and a bad climate.

We now come to our estimates of time, experience and cohort fixed effects.

[Insert Table 3 about here]

Table 3: Estimates of the earnings function

Experience effects

As shown in figure (3), earnings are a reversed u-shaped function of experience. The pattern of GPs' career profiles is different from the increasing and concave function of experience usually observed for salaried workers. Firstly, there is a huge increase at the beginning of the practice. Between the first and the seventh year (the reference year), earnings growth is 37%. Secondly, no stabilisation is observed after the beginning of the career, unlike salaried workers whose earnings remain fairly constant for much of their careers: GPs reach their maximum earnings after 12 years and then their earnings decrease rapidly. In comparison with the level of earnings reached after 7 years, the gap amounts to -12% after 25 years of practice and - 24% after 30 years.

To interpret this result, it is important to keep in mind that GPs' earnings are closely related to their level of activity. The first stage of the GPs' career is characterized by a process of patient recruitment, which translates into the huge earnings increase observed in the first years of practice. After reaching a peak with 12 years of experience, GPs' activity and earnings drop continuously.

There are numerous debates among labour economists about the influence of age and experience on individual productivity. Our results on self-employed doctors shed light on the behaviour of professionals whose work hours are mostly determined by individual preferences, contrary to salaried workers who are less free to choose their number of work hours. Our results indicate that GPs take advantage of the freedom offered by self-employment by reducing their level of activity early in their career. They concentrate their activity in the first 12 years of practice.

Edward P. Lazear (1981) has theorized that firm managers set up earnings profiles designed to provide productivity incentives for salaried workers. Lazear and Moore (1984) argue that such incentives are not necessary for self-employed workers. They predict a flatter earnings-profile for the self-employed than for salaried workers and produce empirical evidence in support of this prediction. However, their results derive from estimates performed on cross-sectional data, which do not enable them to disentangle cohort and experience effects. Our findings on longitudinal data do not confirm Lazear and Moore's prediction. GP's activity decreases rapidly after 12 years, revealing a preference for leisure.

Time effects

Our estimates show that there was large and constant growth in GPs' real[14] earnings between 1983 and 2004 (figure 4). For 2004, the estimated effect equals 0.408, which corresponds to an average yearly growth rate of 1.6% on period 1983-2004 (1983 is the reference year). In comparison, average real wages of salaried workers grew by 0.6% over the same period.

Figure 4 also displays time effects estimated on the model explaining GP's activity, *i.e.* the annual number of encounters between the physician and her patients. The gap between the two curves is due (i) to rises in fees granted by health insurance administration after bargaining with physicians' associations; (ii) to changes in activity structure over the period. Actually, changes in activity structure that occurred between 1983 and 2004 should induce a decrease in earnings: GPs cut back the proportion of their home visits in favour of office visits. Therefore, all the positive gap observed between earnings and activity fixed effects in figure 4 is a lower bound of the effects of changes in reference fees. The main increases were obtained in 1988, 1995, 1998, 2002 and 2003. Adjusting the earnings growth for the increase in activity over the period, we obtain a lower bound for the pure effect of increases in

[14] Adjusted for inflation.

reference fees on real earnings: over the period, we find a yearly growth rate equal to 0.99%.

Cohort effects

Estimated cohort effects are very large: the gap in earnings between cohorts reaches up to 25% (figure (5)). The cohort effect is large for cohorts prior to 1978. It drops for cohorts of the eigthies and early nineties. Cohorts of GPs beginning practice during the eighties have the lowest permanent earnings. For example, GPs who began their practices in 1985 earn 19.6% less than cohort 1972. Earnings improved for GPs who set up their practices from the mid-nineties on: *ceteris paribus,* the cohort who began in 1999 earns 16.8% more than cohort 1985.[15]

[Insert Figure 3 about here]

Figure 3: Experience effects on GPs' earnings

[Insert Figure 4 about here]

Figure 4: Time effects on GPs' earnings and activity

[Insert Figure 5 about here]

Figure 5: Cohort specific effects on earnings

5 Interpreting inequalities between cohorts

5.1 The impact of medical demography at the beginning of practice

GPs belonging to the same cohort have some characteristics in common: they belong to the same generation, with possible specific preferences; they faced the same *numerus clausus* at the beginning of their medical studies; they set up their practices the same year, within the same demographic context.

[15] The estimates of experience, time and cohort effects obtained on net earnings are very similar to the results presented and not reported here. They are available upon request.

In order to examine the link between cohort effects and medical demography, we removed the cohort effects from specification (1) and replaced them by a linear-quadratic function of three variables characterizing the demographic situation at the beginning of each GP's career: value of the *numerus clausus* 9 years before the first year in practice; physician:population ratio during the first year in practice; change in the number of GPs during the first year in practice.

Estimating model (1) with the linear-quadratic function of these three variables instead of the cohort effects leads to the curve displayed in figure 5. Its pattern is very similar to estimated cohort effects. We find a correlation coefficient equal to 0.79: the demographic situation at the beginning of the practice is strongly connected to cohort effects.

The variables used in this new estimation capture mainly the number of new practitioners at the beginning of practice and the difference between new arrivals and retirements. Why is medical demography at the beginning of practice so important? Competition intensity between physicians is already taken into account in model (1) with the GP:population ratio. At the beginning of her career, a GP can buy her practice from a colleague who is retiring. Otherwise, she must find new patients. If many new practitioners try to set up at the same time in the same area, the start up of the careers will be hampered by competition between beginners. Our results suggest that the first years of practice are decisive for a GP. If she fails to attract enough patients at this first stage, she will suffer from permanently lower earnings.

Another way in which the *numerus clausus* might influence GPs' earnings is that it introduces a selection which might induce an increase in the average ability of physicians. Unfortunately, we do not have information about selection rates for cohorts prior to 1987. Therefore it is not possible for us to go further in exploring this supply-side explanation of cohort effects.

5.2 Interactions between cohort and experience

Can a flatter experience profile compensate for being in a disadvantaged cohort? Time, experience and cohort effects are specified as additive in model (1). This comes down to assuming that the experience effect is identical for all cohorts. We tested whether interaction terms between cohort and experience effects were significant on some pairs of cohorts that share a common range of experience. No significant difference appeared between experience profiles of cohorts 1972 and 1977, whose common range of experience is 11-27 years. Conversely, differences between experience profiles were significant for cohorts 1977 and 1985 (range of experience: 6-19 years) and for cohorts 1972 and 1985 (range of experience: 11-19 years).

For these pairs of cohorts the interaction terms are positive, revealing that GPs belonging to cohorts with the lowest earnings compensate for their disadvantage by a flatter experience profile: they reduce their activity after the 12th year to a lesser extent than other cohorts. This can be interpreted as an additional disadvantage: given the difficulties they experienced at the beginning of their careers, these GPs cannot afford to slow their pace of work early in their careers.

When the interaction terms are significant, the estimated cohort effects are stronger. For example, the gap in permanent earnings between cohorts 1977 and 1985 is -22%, instead of -11.8% when estimated without interaction terms. In that case, specification (1) underestimates the cohort effects.

5.3 Earnings distributions by cohort: a stochastic dominance analysis

Can individual heterogeneity compensate for average differences between cohorts? So far, our approach has focused on average differences in GPs' permanent earnings. However, the unobserved heterogeneity affecting GPs' earnings is quite large: model (1) explains only 27.55% of earnings variability (R^2). Yet, it is possible that some doctors belonging to a poor cohort compensate for their disadvantage through individual dynamism or hard work. These earnings determinants are components of unobserved individual heterogeneity. We ran a stochastic dominance analysis to take the whole distribution of earnings into account. Unobserved heterogeneity is no longer considered to be a residual but included in the analysis.

Stochastic dominance analysis can be used to order earnings distributions associated with different cohorts . Following the methodology set up by Davidson and Duclos (2000) and used by Lefranc, Pistolesi, Trannoy (2004), we ran non-parametric tests of stochastic dominance between pairs of cohorts.[16]

First, we applied statistical dominance analysis to distributions of raw earnings. Focusing on a few representative cohorts, we found that cohorts of the eighties and the early nineties were dominated at the first-order by the cohorts of the seventies and by cohort 1999. However, a ranking performed on raw earnings in not relevant, since it compares cohorts that are observed for different levels of experience and for different periods. Given the magnitude of experience and time effects, it is more appropriate to compare distributions of earnings that have been homogeneized relative to these factors. In what follows, we combine the stochastic dominance analysis with microsimulations.

In our second step, we constructed an hypothetical earnings distribution for each cohort, corresponding to the amount that physicians would have earned if they had the same characteristics, except cohort and unobserved heterogeneity. The simulated earnings $\widetilde{y}_{ict}$ of physician i, belonging to cohort c in year t is defined as follows:

$$\widetilde{y}_{ict} = \overline{D}\widehat{b} + \overline{Z}\widehat{d} + \widehat{\eta}_{Paris} + \widehat{\alpha}_{10} + \widehat{\delta}_{1995} + \widehat{\gamma}_c + \widehat{\varepsilon}_{ict} \tag{5}$$

where $\overline{D}$ stands for the average GPs:population and specialist:population ratios, $\overline{Z}$ corresponds to a full-time self-employed male physician with no *MEP* specialization and a two-year period after his studies before beginning his practice. All simulated earnings are supposed to be observed in 1995 for physicians with 10 years of experience practicing in Paris area. $\widehat{b}$, $\widehat{d}$, $\widehat{\eta}_{Paris}$, $\widehat{\alpha}_{10}$, $\widehat{\delta}_{1995}$ and $\widehat{\gamma}_c$ are the estimated coefficients of model (1); $\widehat{\varepsilon}_{ict}$ are the estimated residuals.

The results are displayed in table 4. We focus on a few representative cohorts: 1972, 1977, 1985, 1993 and 1999. They can be ordered using the first-order dominance criterion. Earnings distribution of cohort 1972 dominates all other cohorts, except 1999, whereas cohort 1985 is dominated by all cohorts. Cohorts 1972 and 1999 are equal: with identical characteristics, younger cohorts have the

[16] Consider F and G, the cumulative distribution functions of earnings of GPs belonging to cohorts C and C'. Consider a given level of earnings $x \geq 0$. $F(x)$ and $G(x)$ give the proportion of physicians of cohorts C and C' whose earnings are equal or lower than x. Distribution F dominates G at the first-order if, $\forall\ x$, $F(x) \leq G(x)$. We denote $(F\ SD_1\ G)$. This criterion does not make it possible to order two distributions whose cumulative distribution functions intersect. In this case, it is possible to use the second-order dominance criterion.

same distribution of earnings as the better-off older cohorts. This is in line with the improvement observed in the cohorts effects concerning recent cohorts.

The results of the stochastic dominance analysis thus confirmed the findings of the econometric analysis. Belonging to a "poor" cohort has a systematic effect: unobserved heterogeneity does not compensate for average differences in earnings between cohorts.

[Insert Table 4 about here]

Table 4: Stochastic dominance tests for selected cohorts - simulated earnings

6 Conclusion

In France, almost all general practitioners are self-employed and paid through a fee-for-service scheme. Reference fees are fixed by negociations between doctors and the health insurance administration. Given this context, GPs' earnings are closely related to the number of their encounters with patients, and hence on the number of other practicing GPs. In this article,we have examined the relationship between changes in medical demography and earnings inequality among doctors.

Using longitudinal data, we estimated earnings functions to identify experience, cohort and time effects. The cohort is defined by the first year in practice. We find sizeable cohort effects: *ceteris paribus,* GPs who began to practice in 1985 earn 19.6% less than those who began to practice in 1972. Earnings where higher for GPs who set up their practices from the mid-nineties on: cohort 1999 earns 16.8% more than cohort 1985. These effects come on top of experience effects, time effects, and the impact of competition intensity at the local level: they can be interpreted as permanent differences in earnings associated to the first year of practice. Moreover, stochastic dominance analysis shows that belonging to a "poor" cohort has a systematic effect: unobserved heterogeneity does not compensate for average differences in earnings between cohorts.

Cohort effects are strongly correlated with the number of new practitioners and the difference between the number of new arrivals and the number of retirements at the beginning of practice. We could not test for causal effects, but our results suggest that the first years of practice are decisive for GPs. Baby-boom cohorts faced intense competition at the beginning of their practices and they have the lowest earnings. Subsequent cohorts benefited from the *numerus clausus* on medical students and from early retirement incentives implemented between 1988 and 2003. Our results show that these policies buoyed up permanent physicians' earnings.

Why is medical demography so crucial at the beginning of careers? Our estimated experience effects show that the first stage of a GP's career is characterized by a phase of recruitment of patients. It is possible that difficulties experienced at this stage have a lasting impact on the whole career. Indeed, a small number of patients for a GP who is no longer a beginner can act as a signal that the physician is not competent and thus discourage potential patients. Further investigations are needed to give empirical support to this interpretation.

GPs' career profile are different from the increasing and concave function of experience usually observed for salaried workers. GPs' activity and earnings drop continuously after reaching a peak at 12 years of experience. In contrast with salaried workers, self-employed professionals can freely choose their work hours. Our results indicate that GPs take advantage of this freedom by reducing their level of activity early in their careers. This can be seen as the result of a preference for leisure. It is also possible that GPs overwork at the beginning of their careers in order to recruit a sufficient number of patients, which is crucial for their success later on.

Finally, these results show that returns to medical education differ throughout the cohorts, depending on regulation of medical demography. The low earnings for GPs in cohorts 1980 to 1990 could explain why medical students have recently been reluctant to choose general practice. Policy makers generally consider GPs to be a homogenous group. However, differences in earnings between cohorts help in understanding why GPs set up a specific association in 1984. Composed mainly of GPs belonging to disadvantaged cohorts, this association has very different positions from other physicians' associations, in particular it advocates payment systems other than fee-for-service.

Further investigations are needed for a better understanding of GPs' careers. GPs' often claim that their incomes are insufficient, given the length of their studies. In future work, we will compare GPs' earnings and career profiles with those of salaried workers with a comparable level of education.

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Cohort (First year in activity)	Sample size	Number of observed physicians	Years observed	Range of experience (1)
1970	1,290	97	1983-2004	13-34
1971	1,565	107	1983-2004	12-33
. :	. :	. :	. :	. :
1984	4,095	255	1985-2004	1-20
1985	3,881	250	1986-2004	1-19
1986	3,276	208	1987-2004	1-18
. :	. :	. :	. :	. :
2000	509	138	2001-2004	1-4
2001	264	95	2002-2004	1-3
Total	**81,691**	**6,016**	**1983-2004**	**1-34**

Table 1*:* Structure of the sample

Notes: (1) Experience is the number of years of practice= year of observation - first year of practice - duration of a possible temporary break

	1983	1993	2004
Gender (proportion of female)	0.132 (0.338)	0.187 (0.389)	0.247 (0.431)
Experience	5.779 (3.322)	10.736 (5.956)	17.663 (7.968)
Earnings (€ 2004)	90,144 (42,948)	97,145 (42,020)	119,598 (48,309)
Earnings net of charges (€ 2004)	-	44,160 (22,815)	62,064 (28,724)
Number of observations	2,458	3,761	4,496

Table 2: Basic features of the data

Notes: French GPs, sector 1, period 1983-2004, 81,691 observations, cohorts 1970-2001. Standard errors are in parentheses.

Variable	Coefficient	Standard Error
Female	-0.3429 (***)	0.0041
Mep specialization	-0.0650 (***)	0.0069
Years between PhD and 1rst year of practice	-0.0224 (***)	0.0007
Part-time independent practice	-0.0524 (***)	0.0045
Part-time Hospital Practice	0.0019	0.0024
Suburbs	0.0903 (***)	0.0041
Urban sprawl	0.1121 (***)	0.0079
Rural area	0.1452 (***)	0.0044
GPs :population ratio	-0.0025 (***)	0.0002
Specialists :population ratio	-7.78*10-6	0.00009
Regional effects (ref :Ile de France (Paris area))		
Rhône-Alpes	-0.1113 (***)	0.0077
Picardie	0.2091 (***)	0.0105
Auvergne	-0.0050	0.0126
PACA (Côte d'Azur)	-0.0775 (***)	0.0106
Champagne-Ardenne	0.1459 (***)	0.0124
Midi-Pyrénées	0.0274 (***)	0.0107
Languedoc Roussillon	0.0131	0.0128
Basse Normandie	0.0673 (***)	0.0124
Poitou Charente	0.0607 (***)	0.0118
Centre	0.0464 (***)	0.0099
Limousin	0.0172	0.0149
Corse	-0.2328 (***)	0.0243
Bourgogne	0.0466 (***)	0.0111
Bretagne	-0.0394 (***)	0.0095
Aquitaine	0.0519 (***)	0.0103
Franche Comté	-0.0335 (***)	0.0129
Haute Normandie	0.1655 (***)	0.0105
Pays de la Loire	0.0726 (***)	0.0092
Lorraine	0.0973 (***)	0.0097
Nord	0.2143 (***)	0.0093
Alsace	0.0091	0.0102
R^2	0.2755	
Fisher	269.56 (p <0.0001)	
Sample Size	81,691	

Table 3: Estimates of the earnings function

Notes: Dependent variable: logarithm of earnings.

Method: OLS under constraints (2) and (3).

The estimated experience, time and cohort effects are displayed on figures (4) to (6)

*** Statistically significant at the 1% level; ** Statistically significant at the 5% level; * Statistically significant at the 10% level

	1972	1977	1985	1993	1999
1972	-	$\succ$(SD1)	$\succ$(SD1)	$\succ$(SD1)	=
1977	-	-	$\succ$(SD1)	$\succ$(SD1)	$\prec$(SD1)
1985	-	-	-	$\prec$(SD1)	$\prec$(SD1)
1993	-	-	-	-	$\prec$(SD1)

Table 4: Stochastic dominance tests for selected cohorts - simulated earnings

Notes : $\succ (SD_1)$: the row dominates the column for first-order stochastic dominance

$\prec (SD_1)$: the column dominates the row for first-order stochastic dominance;

=: the distributions are equal

The tests are performed with a 5% significance level. Statistic values and confidence intervals are not reported on. They are available upon request.

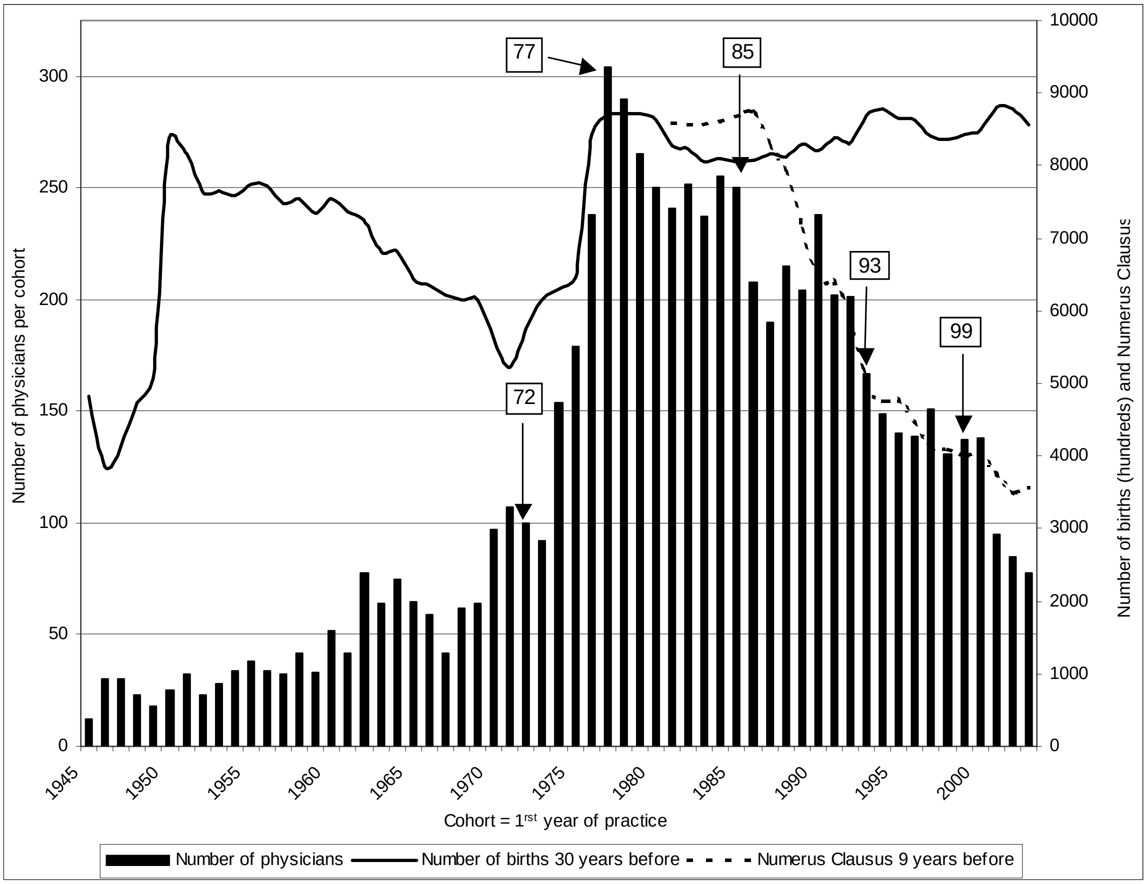

Figure 1: Cohort pyramid, number of births 30 years before and value of *numerus clausus*

Notes: A cohort is defined by the first year of practice.

The number of births (continuous line) is given 30 years before the first year of practice.

The *numerus clausus* is the number of students allowed to go on with their studies after the first year. In the figure is displayed the *numerus clausus* (dotted line) 9 years before the first year of practice

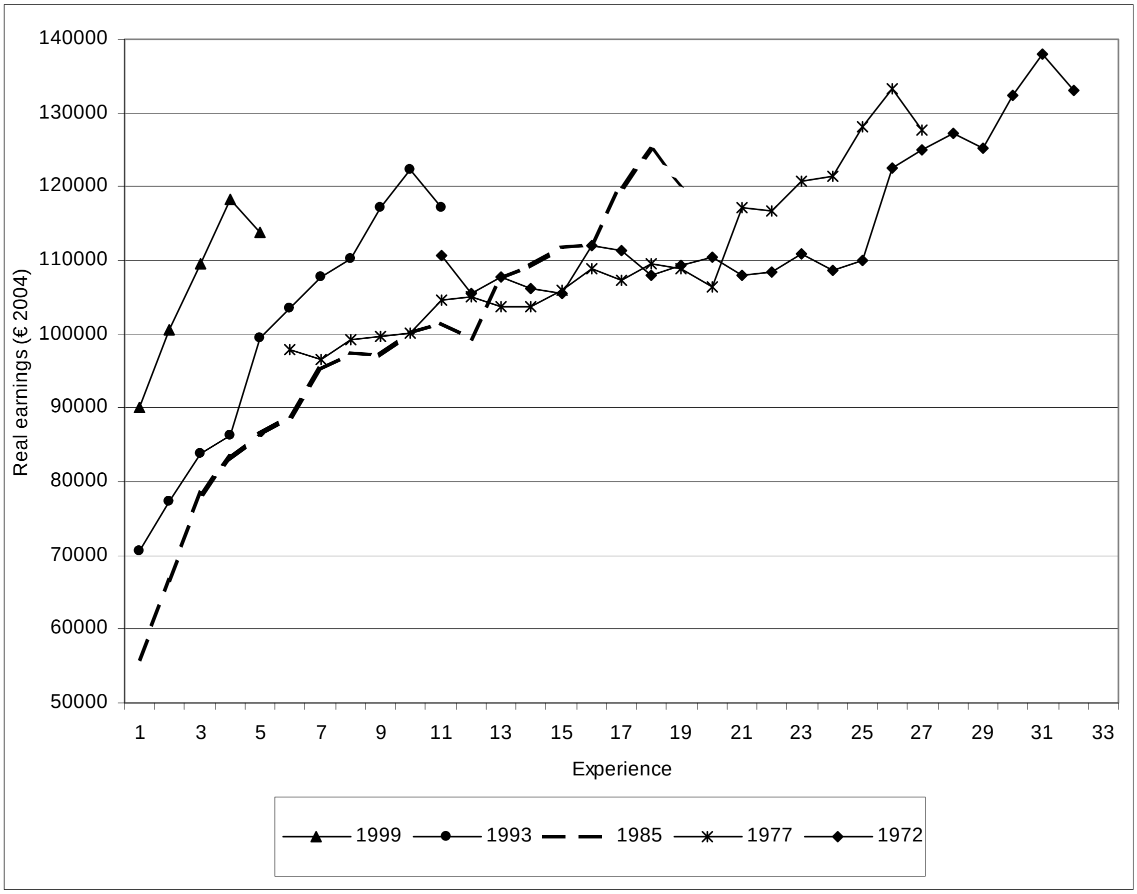

Figure 2: Average earnings by cohort as a function of experience

Notes: Experience is defined as the number of years of practice

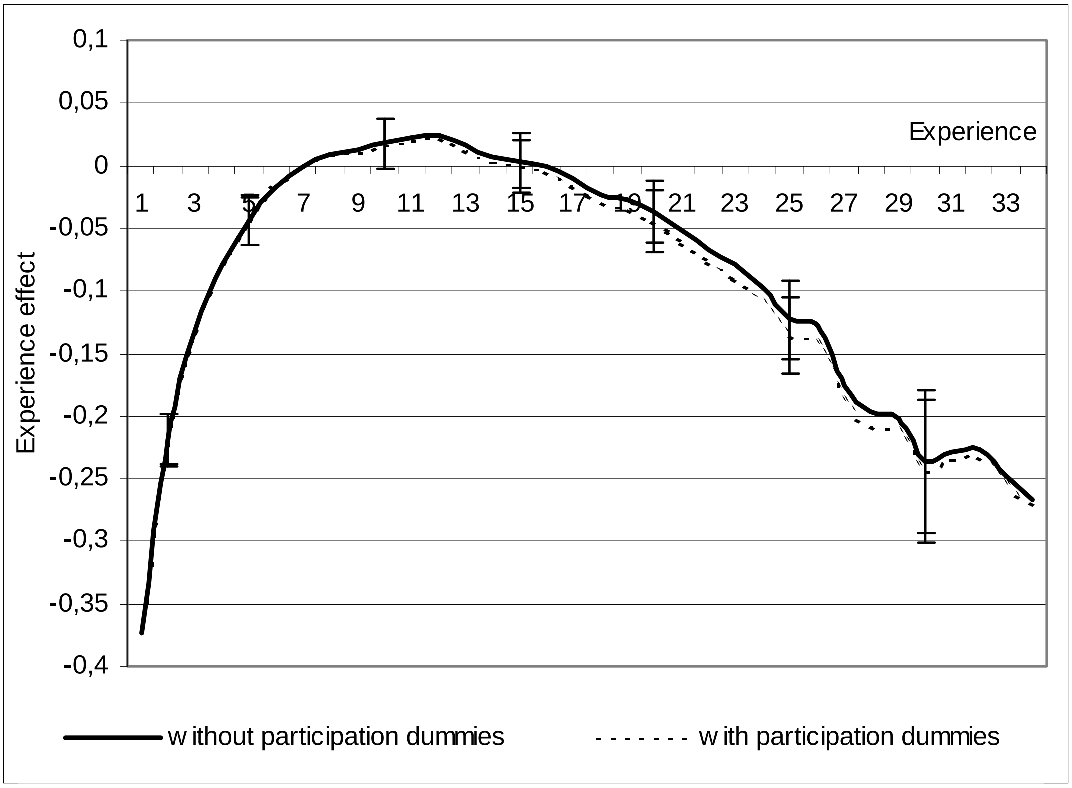

Figure 3: Experience effects on GPs' earnings

Notes: Experience effects obtained by the estimation of specification (1);

Reference category: 7 years

I: 95% confidence intervals are provided for some of the estimated fixed effects

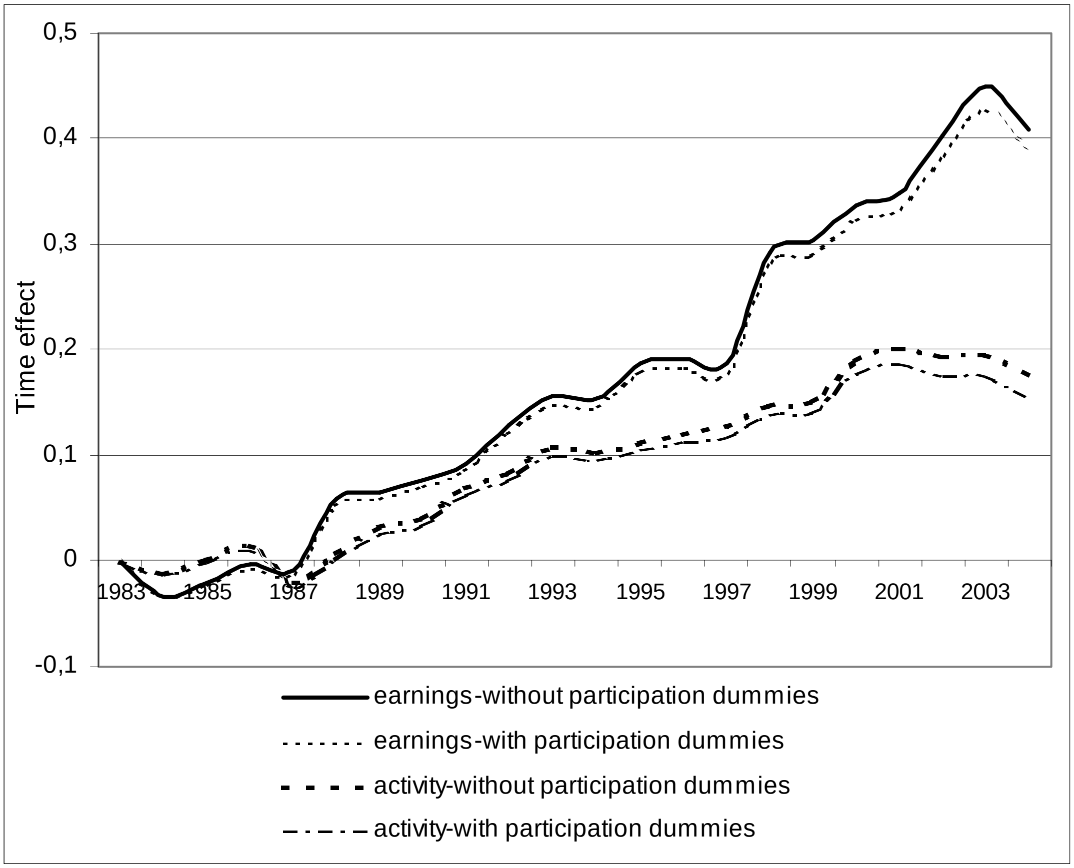

Figure 4: Time effects on GPs' earnings and activity

Notes: Time effects obtained by the estimation of specification (1);

Reference category: 1983

I: 95% confidence intervals are provided for some of the estimated fixed effects

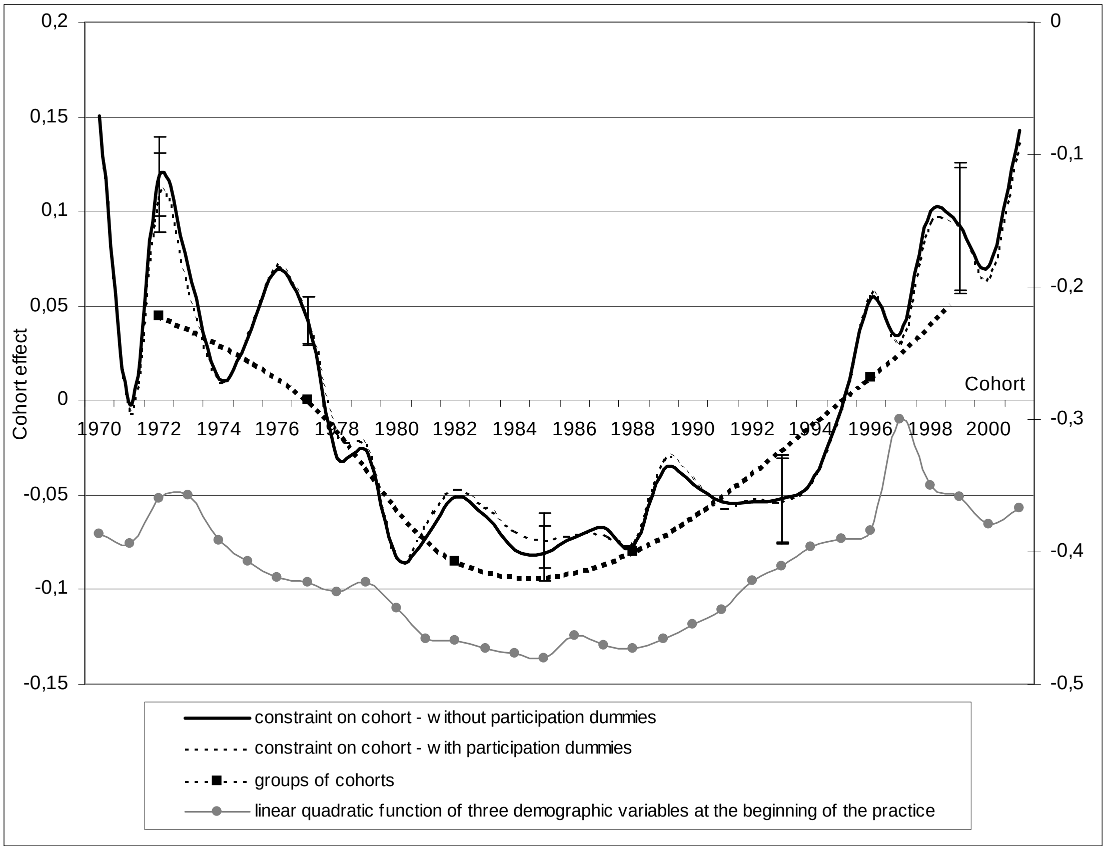

Figure 5: Cohort specific effects on earnings

Notes : Cohorts effects obtained by the estimation of specification (1);

There is no reference category: fixed effects are interpreted as differences between pairs of cohorts.

I: 95% confidence intervals are provided for some of the estimated fixed effects