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# Intergenerational Inequalities in GPs' Earnings: Experience, Time and Cohort Effects\*

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## Abstract

This paper analyses the regulation of ambulatory care and its impact on physicians' careers, using a representative panel of 6,016 French self-employed GPs over the years 1983 to 2004. The beginning of their activity is influenced by the regulated number of places in medical schools, named in France *numerus clausus*. We show that the policies aimed at manipulating the *numerus clausus* strongly affect physicians' permanent level of earnings.

Our empirical approach allows us to identify experience, time and cohort effects in GPs' earnings. The estimated cohort effect is very large, revealing that intergenerational inequalities due to fluctuations in the *numerus clausus* are not negligible. GPs beginning during the eighties have the lowest permanent earnings: they faced the consequences of an unlimited number of places in medical schools in the context of a high density due to the baby-boom numerous cohorts. Conversely, the decrease in the *numerus clausus* led to an increase in permanent earnings of GPs who began their practice in the mid nineties. Overall, the estimated gap in earnings between "good" and "bad" cohorts may reach 25%.

We performed a more thorough analysis of the earnings distribution to examine whether individual unobserved heterogeneity could compensate for average differences between cohorts. Our results about stochastic dominance between earnings distributions by cohort show that it is not the case.

## Résumé

Cet article vise à étudier l'impact de la régulation de la démographie médicale sur les carrières des médecins généralistes du secteur 1. A partir d'un panel représentatif des omnipraticiens en exercice sur la période 1983-2004, nous mettons en évidence que les conditions d'installation des médecins, qui sont liées au *numerus clausus*, affectent leurs honoraires de manière durable.

Une analyse économétrique permet d'identifier les effets de la date, de l'ancienneté et de la cohorte sur les honoraires. Les inégalités intergénérationnelles sont considérables. Les cohortes installées dans les années 1980 subissent les impacts conjoints du baby-boom et d'un *numerus clausus* élevé : elles perçoivent les honoraires les plus faibles. En revanche, la diminution progressive du *numerus clausus* a amélioré la situation financière des cohortes installées à partir du milieu des années 1990. L'écart estimé entre les honoraires permanents des différentes cohortes peut atteindre 25%, toutes choses égales par ailleurs. L'utilisation d'une analyse en terme de dominance stochastique montre que les écarts liés aux hétérogénéités individuelles ne permettent pas de compenser les différences considérables repérées en moyenne pour les cohortes.

JEL Classification : C2, D63, I18

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

# 1 Introduction

Physician incomes throughout developed countries are among the highest for any occupational group (McGuire, 2000). However, the literature devoted to physician behaviour traditionally focuses on physicians' payment schemes and the incentives they create for the quantity and quality of care provided. We want to address another worthwhile issue: the level of physician incomes. Indeed, doctors' earnings influences both the attractiveness of the profession and, whether they are paid according to a fee-for-service scheme, the incentive for doctors to induce demand. Moreover, the contentious target-income hypothesis refers to an assessment, from the physician, about the fairness of his or her earnings. The aim of this paper is to study differences in incomes between generations of doctors.

In France, general practitioners (GP) are paid under a fee-for-service scheme; their earnings are therefore closely related to the amount of services they provide. In such a system, the number of physicians is a key determinant of the level of their earnings. Our article examines the link between the regulation of the number of physicians in France and physicians' earnings and careers.

This issue is addressed using longitudinal individual data about French GPs. We estimate GPs earnings functions to identify experience, cohort and time effects in physicians' earnings. Time effects correspond to events that affect all physicians identically in one year. Experience effects refer to the evolution of activity since the beginning of the practice, and cohort effects relate to earnings differences between cohorts of physicians. Then, we perform stochastic dominance tests between distributions of earnings to allow for unobserved individual heterogeneity.

This article is of major interest for three reasons. Firstly, we provide empirical evidence that the regulation of the number of physicians has a lasting impact on physicians' careers. More precisely, we show that physicians' "permanent" earnings are strongly influenced by changes in the *numerus clausus*, *i.e.* the number of places in medical schools. Secondly, we use an original and reliable source of information on self-employed GPs. Our dataset is a representative panel of 6,016 French self-employed GPs observed over the 1983 – 2004 period, which corresponds to 81,691 individual-year observations. This sample is drawn from an exhaustive source of information : the administrative files about self-employed physicians collected by the public health insurance. Reliable data about self-employed workers are not numerous. But the French organization of ambulatory care (GPs are paid by patients who are reimbursed by the public health insurance) leads to administrative data which do not suffer from a lack of reliability. Thirdly, we provide results on the careers of self-employed professionals, which shed light on results relative to salaried workers obtained in the field of labour economics.

Literature about physicians' earnings is not plentiful. As stated above, most studies focus on the impact of payment schemes on care provision (McGuire, 2000). Studies about self-employed profession-

als are very scarce. A pioneering work was performed by Friedman and Kuznets in 1945 to compare physicians to other professionals (lawyers, dentists). Then the issue of careers of self-employed professionals was addressed on cross-sectional data by Lazear and Moore (1984). More recently, Parker (2005) performed on longitudinal data a comparison between earnings of British self-employed professionals and employees. To our knowledge, no paper has so far addressed the issue of physicians' careers on longitudinal data.

This paper is organized as follows. The following section describes the data. Then we briefly show how ambulatory care is regulated in France and perform a descriptive analysis of GPs' careers. The next section is devoted to the identification of time, experience and cohort effects in physicians' earnings. Then, we perform a more thorough analysis of the earnings distributions, using stochastic dominance tests. The final section concludes.

## 2 Data

Our dataset is an extraordinary source of information on physicians' careers in France: it is a 10% random sample of all self-employed GPs practicing between 1983 and 2004. It is drawn from an administrative file about French self-employed GPs collected by the public health insurance (Caisse Nationale d'Assurance Maladie des Travailleurs Salariés, CNAMTS). Given that the public health insurance is mandatory and universal in France, this sample is drawn from the exhaustive source of information about self-employed physicians. The latter account for 84% of physicians operating in ambulatory care; the others are salaried doctors who work in schools or firms.

The panel is unbalanced: each physician  $i$  is observed for a period  $T_i$ , which can begin after 1983 (beginner physician) or end before 2004 (retiring physician). 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 acts), location (with two administrative levels: *département*, with 95 digits and *région*, with 22 digits), practice earnings. We also know whether the GP has a *MEP* specialization, *i.e.* a specific activity such as acupuncture or homeopathy, or not.

In France, self-employed physicians are paid according to a fee-for-service scheme. More than 80% of physicians belong to sector 1, where fees are fixed by an administrative process. Free setting of fees is only authorised for a minority of physicians, those enrolled in sector 2. As the choice between sector 1 and 2 has only been possible between 1982 and 1992, most physicians are paid under a fee-for-service scheme with fixed fees. Their income relies only on their level of activity. In order to keep an homogeneous sample to study the relationship between activity and earnings, we focused on sector 1 doctors. We also selected GPs who began their practice between 1970 and 2001. On the whole, the final sample consists of 6,016 GPs with a total of 81,691 individual-year observations over years 1983

to 2004.

The representativeness of our sample is slightly affected by the fact that some physicians leave the sample. These exits can be transitory or not. About 16 % observations are concerned. It was possible in some cases to find the exit reasons: a moving to another *département*, or a switch to sector 2. In our empirical approach, we shall deal with a potential selection bias.

Table 1 summarizes the structure of the sample. It gives an idea of the richness of the available information: 32 cohorts (defined by the first year in self-employed practice) and 95 to 290 physicians per cohort are observed over years 1983 to 2004. Experience ranges from 1 to 34 years. This database will allow a very flexible specification using dummy variables to identify experience, time and cohort effects in GPs' earnings. Information about cohorts relative to years 1945 to 1969 and 2002 – 2003 is also available. However, for these cohorts, the number of observed GPs was unstable and too small (between 12 and 85) for a relevant econometric analysis: these observations were eliminated.

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 restrictive policies, implemented from the mid 70s to reduce the number of physicians. The change in the average experience derives also partly from the sample selection process, given that cohorts 1945 to 1969 were eliminated. Computing the same statistics for the whole sample, one finds a still sizeable but less spectacular increase in the average experience, from 11 years in 1983 to 18 years in 2004.

Earnings are defined by the total fees received by the GP during the year. Matching our database with fiscal records, we were able to compute earnings net of charges at the individual level for years 1993 – 2004. In 2004, the average earnings net of charges equal € 62,024. Using the OECD Health Database (2006) and measuring the earnings in US \$ PPP, international comparisons of GPs' earnings levels can be performed. These data show that the earnings of American self-employed GPs are 91% higher than the earnings of their French counterparts. As for Swiss, Canadian and British GPs, their earnings are, respectively, 29%, 26% and 12% higher. To sum up, the earnings of French GPs appear to be rather moderate.

*[Insert Table 1 about here]*

Table 1: Cohorts included in the working sample

*[Insert Table 2 about here]*

Table 2: Basic features of the data

## 3 The French regulation of the ambulatory care

### 3.1 Insurance coverage

In France, about 99% of the population is covered by the mandatory public health insurance, which covers about 70% of individual health care expenses. Each treatment has a reference price fixed by agreement between physicians and the health insurance administration. In addition to the public system, individuals can subscribe to a voluntary private insurance scheme or be covered through occupational group private insurance. These complementary insurance contracts cover the share of expenses (30 %) not covered by the public health insurance. In 2000, a reform (CMU, i.e. *Couverture Maladie Universelle*) was implemented to provide a free complementary coverage to low-income people. Thanks to these different kinds of insurance schemes, 80% of the population get 100% of the reference price reimbursed over the period 1983-2004, and the coverage is even higher from 2000 on. Moreover, patients freely choose the type of practitioners they consult and can visit several GPs for the same illness. A gatekeeping system has been introduced at the end of year 2004. Given the period covered by our data (1983 – 2004), the activity of the observed GPs are not affected by this reform.

### 3.2 The number of practicing physicians

The supply of physicians is mainly defined by the number of students who obtained their diploma in medicine in France. Foreign doctors came only recently. Education to become a GP is provided by faculties of medicine. The medical studies consist of 6 years, common to all medical specialties and 1 more year (until 1988) or 2 or even 3 more years (after 2001) as a junior practitioner. This education ends with a PhD. A common exam has been introduced in 2004 to manage the student's choice between various specialties, General Practice being one of them. This introduced a great change in the choice for General Practice: depending on their ranking, students were given the possibility to choose another specialty.

Places in medical schools have been regulated since 1971 *via* the *numerus clausus*. This is a strong selection at the end of the first year in medical school : only 10% could go on with their medical education after the first year<sup>1</sup>. In France medical education is almost free. On the one hand, this contrasts strongly with the American situation, where tuition is rather expensive and amounts to a sizeable investment for the student. On the other hand, selection is less severe in the United States: there are about two applicants for a spot in medical school (McGuire, 2000).

In France, the regulation of ambulatory care does not experience serious difficulties but recurrent problems. Among OECD countries, France has one of the highest physician:population ratio (Bourgueil

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<sup>1</sup>A recent increase in the *numerus clausus* raised this share to 17% .

et al.,2006). At the geographical level, despite the high level of medical density, the location of doctors is very uneven. This induces inequality in the access to care (distance to the doctor). Moreover, one consequence of the 2004 medical education reform has been the decrease in the number of students choosing to specialize in General Practice (Billaut, 2006). Furthermore, less students are willing to practice as self-employed doctors. They more often choose a salaried practice at the end of their studies (Bourgueil, 2007). Finally, there is an empirical evidence of supply-induced demand as concerns French GPs. This behaviour is more prominent in *départements* where the level of medical density is high, corresponding to more than 110 GPs per 100,000 inhabitants (Delattre and Dormont, 2003).

A relevant regulation of the supply of GPs should follow three main objectives: ensure an equal access to care; restore the attractiveness of the self-employed GP profession and avoid supply-induced demand behaviour. This involves a sufficient number of GPs, a more even location and fair earnings.

### 3.3 The cohort pyramid

Graphs (1) and (2) display "cohort pyramids" drawn from our dataset, each cohort being defined by the first year in self-employed practice. These pyramids have a really chaotic shape, interpretable using information on events that happened years before: i) demographic changes, using the number of births 30 years earlier (as GPs begin their practice at the average age of 30); ii) changes in the *numerus clausus* 9 or 10 years earlier (the average length of medical education).

The small number of physicians belonging to the pre-1970 cohorts is due to retirements : 95% to 100% of those physicians retired during the 1983 – 2004 period. The huge increase in the number of physicians belonging to the 1974 to 1978 cohorts (graph (1)) is explained both by the baby-boom and no regulation of the number of places in medical schools. The impact of the *numerus clausus* appears clearly on graph (2). Before its implementation, the growth in the number of practicing physicians followed the French population growth. This reform introduced a discrepancy between changes in the number of GPs and the general demographic growth, as shown on the right side of graph (1).

*[Insert Figure 1 about here]*

Figure 1: Cohort pyramid (by year of setting) and number of births 30 years before

*[Insert Figure 2 about here]*

Figure 2: Physicians per cohort and numerus clausus 9 and 10 years before the first year in activity

### 3.4 A descriptive analysis of French GPs' careers

Graph (3) gives the average GPs' earnings (in 2004 euros) by cohort and experience. We observe a reversed "U-shaped" profile, which could characterize experience effects. However this graph is built



using raw earnings: cohort, time and experience effects are mixed up. A more relevant approach is to draw average earnings net of time effects, by cohort and experience. Let  $w_{ict}$  denote the earnings in year  $t$  of the  $i^{th}$  physician belonging to the  $c^{th}$  cohort. Graph (4) shows the values of  $w_{.ct} - w_{..t}$  where  $w_{.ct}$  stands for the average earnings of cohort  $c$  in  $t$  and  $w_{..t}$  is the average earnings in year  $t$ . For a better readability, only 7 cohorts are displayed. These cohorts are also labelled on graph (1) to locate them clearly on the cohort pyramid: we will concentrate on these cohorts throughout the analysis. On graph (4), the 1972 cohort has the highest earnings. Then earnings decrease for the 1977 cohort and even more for the 1985 and 1993 cohorts. These results reveal inequalities between cohorts.

*[Insert Figure 3 about here]*

Figure 3: Mean earnings by cohort and experience

*[Insert Figure 4 about here]*

Figure 4: Mean earnings, net of time effects, by cohort and experience

## 4 Estimating the earnings function

The estimation performed in this section allows us to disentangle experience, time and cohort effects in physicians' earnings and examine their relative impact.

### 4.1 The econometric specification

We consider the earnings function first introduced by Mincer (1974) to measure returns on human capital and experience. In this approach, the log of individual earnings is traditionally explained by education and a polynomial function of experience. The meaning of this specification is slightly different when studying GPs' earnings. Indeed, all GPs have the same education level. Moreover, the effect of experience on earnings results more likely from the doctor's patient number than from an increase in her productivity due to human capital accumulation.

Let  $y_{ict}$  denote the log of earnings (in 2004 euros) in year  $t$  of the  $i^{th}$  physician belonging to the  $c^{th}$  cohort. One has :

$$y_{ict} = a + D_{ict}b + Z'_{ic}d + \alpha_e + \delta_t + \gamma_c + \varepsilon_{ict}, \quad (1)$$

$$i = 1, \dots, N, c = 1 \dots C, t = 1 \dots T \text{ and } e = 1 \dots E$$

where  $D_{ict}$  includes two indicators of the medical density (the number of GPs and the number of specialists per 100,000 inhabitants in the *département* where physician  $i$  works) which vary during the period of observation.  $Z'_{ic}$  includes time-invariant variables such as gender (= 1 for a female), the number of years between PhD and the beginning of practice, region of practice, type of practice (full-time independant GP or not), *MEP* physician or not, location of practice (city center, suburban area, urban sprawl or rural area).

Our data set allows us to consider a more flexible specification of the impact of experience than the traditional polynomial function. We specify experience fixed effects, denoted  $\alpha_e$  ( $e = 1, \dots, 34$ ) and estimated by introducing dummy variables. Experience is defined as the number of years since the first year of practice. Similarly,  $\delta_t$  ( $t = 1983, \dots, 2004$ ) and  $\gamma_c$  ( $c = 1970, \dots, 2001$ ) are time and cohort effects. Cohort is defined as the first year in self-employed practice.

The extensive use of various fixed effects raises identification problems. Our specification is not identifiable without the addition of restrictions on the fixed effects. We used the following constraints:

$$\sum_e \alpha_e = 0, \sum_t \delta_t = 0 \text{ and } \sum_c \gamma_c = 0 \quad (2)$$

$$\sum_c c * \gamma_c = 0 \quad (3)$$

Constraints (2) come down to define a reference category for each of the three effects. The reference category is 7 years for experience and 1983 for time. For cohort effects, we imposed that all effects sum to zero.

Constraint (3) is specified to deal with another colinearity source : for each physician  $i$ , one has  $t = c + e$ . For instance, in year 1990, GPs belonging to cohort 1970 have, by definition, 20 years of experience<sup>2</sup>. Imposing no trend on cohort effects (constraint (3)) is a way to solve this colinearity problem. We could have imposed the same kind of constraint on time rather than on cohort effects (Deaton, 1997). The information displayed on graph (1) suggests there is no trend on cohort effects, but no theoretical background is available to choose the effect on which to put the additional constraint. Our challenge was then to find empirical evidence of a lack of trend for the cohort effects. We estimated (1) using fixed effects relative to group-of-cohorts (5 groups) instead of cohort fixed effects. This approach is another strategy to eliminate the colinearity source. Indeed, one has  $t \neq (\text{groups of } c) + e$ . The results are detailed in appendix A: they show that the estimates of the group-of-cohort effects

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<sup>2</sup>This is not true for all Gps of the sample, given that some of them experience a break in their career. In this case, we correct the experience  $e$  by subtracting the duration of the break. Only 6 % of the observations are concerned:  $t$  is strongly correlated with  $c + e$ .

have no trend, justifying constraint (3).

The Heckman sample selection model is not appropriate to deal with our potential selectivity biases. Indeed, we have seen that there are various reasons for a GP to leave the sample. These reasons cannot be accurately specified by a single participation equation. Following Verbeek and Nijman (1992), we simply added five dummy variables indicating whether the GP has quit the sample, or not, definitely or not, for a sector change, a moving or other reasons. The coefficients of these dummies were significant, revealing a selection bias. We can present the results of the estimates with or without the dummies. This comes down to include or eliminate the outgoing GPs for the estimation. Actually, the estimated profiles of the cohort, experience and time effects we are interested in, do not differ with or without these dummies. We thus present the results obtained without the dummies, thus considering all GPs<sup>3</sup>.

Our model does not control for unobserved heterogeneity among physicians. Considering an error-component model would make it difficult to identify the cohort effects we are interested in. Another failings of our empirical approach is that it cannot allow for the potential non-exogeneity of explanatory variables such as type and location of practice. Indeed, no appropriate instrument is available to explain the doctors' location choices. In addition, we should have a specific sample of beginners to provide a relevant explanation of location choice.

## 4.2 Results

The estimated experience, time and cohort effects are reported on graphs (5) to (7). The estimates of the other parameters are presented in table 5 (Appendix B).

On average, female physicians' earnings are 34% lower than males'. Fees being fixed, this gap is mainly related to differences in the number of hours worked. But the reason why women work less remains unexplained. Unfortunately, we do not have any information on household composition at our disposal. Rizzo and Zeckhauser (2006) consider three possible explanations : differences in productivity, differences in preferences relative to the duration of work or gender discrimination from patients and other practitioners. Rizzo and Zeckhauser show that differences in preferences account for the entire differentials in income: males' "reference income" is higher than females' and males are more likely to spend less time per patient or to focus on more lucrative procedures.

The GPs' and specialists' density indicators can be seen as proxies of the competition intensity and supply shocks faced by the physician in his practice area. On the one hand, our estimates show that the specialists:population ratio is not significant, revealing that GPs' activity does not compete with specialists' activity (pediatricians for example). On the other hand, there is competition between GPs : a rise in the level of the GPs:population ratio (for example from 100 to 110 GPs per 100,000

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<sup>3</sup>The other estimates are available on request.

inhabitants) leads to a 2,4 percentage points drop in the level of earnings. This impact is sizeable as it comes in addition to the regional fixed effects (see estimates in appendix B) which include a part of the medical density effect. The average earnings of physicians living in the south of France, where the level of medical density is very high, are around 8% less than the earnings of those living in the Paris area (the reference). On the contrary, the center and north of France are rather deserted by physicians and we find physicians practicing in those *régions* earn up to 20% more than physicians practicing around Paris. Recently, policies have been implemented to provide financial incentives for physicians to locate in these regions. Our results show that living in those areas already means higher earnings (i.e. more work).

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

### Experience effects

Earnings are a reversed u-shaped function of experience (graph (5)). This pattern is rather different from the increasing and concave function of experience usually observed for salaried workers. Major differences can be pointed out for GPs. Firstly, there is a huge increase at the beginning of the practice. Between the first and the seventh year (reference year), the earnings growth is 37%. This can be considered as the time needed by a GP to build up its practice. Secondly, unlike salaried workers whose earnings remain stable during numerous years, there is no period of stabilisation. For GPs the maximum earnings is reached after 12 years and then decreases rapidly. For comparison with the average earnings after 7 years, GPs earnings are 12% lower after 25 years of practice and 24% lower after 30 years.

There are currently numerous debates among labour economists on the influence of age and experience on the individual productivity. Our results on self-employed doctors shed light on the behaviour of people whose number of hours worked is mostly influenced by individual preferences, contrary to salaried workers whose labour duration is constrained by the demand they face. Our results show that GPs take advantage of the freedom offered by an independant practice to reduce their level of activity much sooner. They concentrate their activity in the first 15 years of practice.

This result differs strongly from the findings of Lazear and Moore (1984) who report a flatter earnings-profile for self-employed workers than for salary workers. Referring to Lazear's theory of an earnings profile implemented by the firm to provide work incentives, they argue that such incentives are not at stake for self-employed workers. However, Lazear and Moore results derive from estimates performed on cross-sectional data with a very parametric specification. It is well-known that longitudinal data as ours are more appropriate to provide relevant estimates of experience effects. Our results show that GP's career is influenced by the need to reimburse large investments made at the beginning of the

practice. The decrease in activity observed after 12 years reveals however some preferences for leisure, once reimbursements have been done.

### Time effects

The estimates show that there was a large and constant growth in real earnings between 1983 and 2004, with an annual growth rate of 0,9% (graph (6)). Time effects on earnings derive from the estimation of 1 subject to 2 and 3. Time effects on activity derive from the same estimation performed on a model whose dependent variable is activity, *i.e.* the average annual number of encounters between the physician and his patients. Encounters are of different types: office visits, home visits, surgery or radiology acts. As fees are fixed, the gap between the two curves is only due to the rise in fees granted by the government after bargainings with physicians' unions and the public health insurance. The major increases were in 1988, 1995, 1998, 2002 and 2003. As a consequence, even though activity remained constant or increased slightly during these years, earnings did progress a lot. On the contrary, the growth of activity did not lead to much increase in earnings during years without any revalorisation.

### Cohort effects

The estimated cohort effects are very large : the gap in earnings between cohorts may reach 25% (graph (7)). The cohort effect is rather high for cohorts prior to 1978, then deeply decreases for cohorts relative to the eighties and the beginning of the nineties. It gets better for cohorts of the mid-nineties. Cohorts of GPs beginning during the eighties have the lowest permanent earnings. For example, GPs who began their practice in 1985 earn 19.6% less than cohort 1972. Graph (1) shows that they had to deal with the impact of baby-boom numerous cohorts. Furthermore, graph (2) shows that the number of places in medical schools was still high. Given the large number of praticians beginning their activity at the same time, those cohorts were confronted with a high degree of competition.

The decrease in the *numerus clausus* led to an increase in the permanent earnings of GPs who began their practice in the mid nineties. For instance, cohorts who began in 1999 earn 16.8% more than cohort 1985 (but still less than cohort 1972). A measure authorizing praticians to retire at the age of 60, without any loss of earnings, also helped to reduce the number of physicians and favored the beginning of new cohorts' practice.

Other professions are affected by the Baby Boom. The impact of cohort size on earnings has already been documented for salaried workers' careers. For example, Welch (1979) finds a drop in earnings of new entrants in labour markets, coinciding with the arrival of the peak-size cohorts spawned by the baby boom.

As stated above, we have computed earnings net of charges at the individual level for years 1993 to 2004. We do not present the estimates of experience, time and cohort effects on net earnings. Indeed,

they are very similar to the results presented here.

Our results show that the demographic situation that prevails at the beginning of the practice strongly affects GPs' permanent level of earnings. However, the unobserved heterogeneity affecting GPs' earnings is quite large: the earnings variability explained by our model is only 27% ( $R^2$ ). Hence, doctors belonging to a bad cohort could compensate for their disadvantage with individual dynamism, motivation and greater taste for their work. All these earnings determinants are components of the unobserved individual heterogeneity. So far, our approach has been a first-order analysis. In the following, we use a stochastic dominance approach to take the whole distribution of earnings into account. The unobserved heterogeneity is no more considered as a residual but included in the analysis. We examine if our results are maintained or if individual unobserved heterogeneity can compensate for average differences between cohorts.

*[Insert Figure 5 about here]*

Figure 5: Experience specific effects on earnings

*[Insert Figure 6 about here]*

Figure 6: Time specific effects on earnings and activity

*[Insert Figure 7 about here]*

Figure 7: Cohort specific effects on earnings

## 5 Stochastic dominance and inequalities between cohorts

### 5.1 Definitions

Let  $F_C$  and  $F_{C'}$  be the distributions of earnings of two different cohorts. Their cumulative distribution functions (CDF) are  $F_C(x)$  and  $F_{C'}(x)$ , where  $x \geq 0$  is the level of earnings.

**Definition 1**  $F_C \geq_{SD1} F_{C'} \Leftrightarrow \forall x \in \mathbb{R}^+, F_C(x) \leq F_{C'}(x)$ , with one strict inequality.

If  $F_{C'}$  lies nowhere below  $F_C$  and at least somewhere above  $F_C$ , then  $F_C$  displays first-order stochastic dominance over distribution  $F_{C'}$ . Graphically, it means that  $F_C$  is everywhere to the right of  $F_{C'}$ . In terms of welfare economics, it means that for any  $x \geq 0$ , the distribution  $F_C$  is ranked better than  $F_{C'}$  for any welfare function that is both increasing in  $x$  and anonymous.

If the two distributions cross, first-order dominance does not hold anymore. One must rank the distributions using second-order stochastic dominance criterion.

**Definition 2**  $F_C \geq_{SD2} F_{C'} \Leftrightarrow \forall x \in \mathbb{R}^+, \int_0^x F_C(t)dt \leq \int_0^x F_{C'}(t)dt$

If the area under  $F_C$  up to  $x$  is less than the area under  $F_{C'}$  up to  $x$ , then distribution  $F_C$  is said to (strictly) second-order dominate distribution  $F_{C'}$ . It means that, for any  $x \geq 0$ ,  $F_C$  is a better distribution than  $F_{C'}$  for any welfare function with an increasing and concave utility.

**Remark 1**  $F_C \geq_{SD1} F_{C'} \Rightarrow F_C \geq_{SD2} F_{C'}$ . More generally, stochastic dominance of order  $s$  implies stochastic dominance of order  $s + 1$

**Remark 2** From Shorrocks (1983), scaling up the Lorenz curves to form the generalized Lorenz curve will often reveal a dominance relationship. He suggests to prefer a distribution  $F_C$  over a distribution  $F_{C'}$  if its generalized Lorenz curve is nowhere below the generalized Lorenz curve of  $F_{C'}$ . For Thistle (1989), generalized Lorenz dominance is equivalent to second-order stochastic dominance.

Comparing the cumulative distribution functions of different cohorts gives an idea of the relations of dominance between the cohorts. But statistical tests need to be implemented to give more robust results.

## 5.2 Testing for stochastic dominance on raw earnings

We follow the methodology used by Pistolesi (2006) and based on Davidson and Duclos' work to implement non parametric stochastic dominance tests (2000). Dominance ordering is performed by comparing vectors of poverty indices between two cohorts. Dominance of order  $s$  of the cohort  $C$  over the cohort  $C'$  implies that, regardless of the poverty line chosen, the poverty measure  $D_{\frac{z}{2}}^s$  is lower for distribution  $C$  than for distribution  $C'$ . Wald tests, where a set of *inequality* constraints is tested, are used to rank all pairs of cohorts  $C$  and  $C'$ . These tests are more extensively explained in Lefranc, Pistolesi and Trannoy (2004).

Our purpose is to test whether there is *dominance* of a cohort over another one or not. Three kinds of tests are considered:

1. We test the null hypothesis of first-order stochastic dominance of cohort  $C$  over cohort  $C'$  and of cohort  $C'$  over cohort  $C$ . If this test does not give any clear conclusion (*i.e.* if  $C$  dominates  $C'$  and  $C'$  dominates  $C$ ) we perform test 2. Otherwise, as it means that one cohort dominates another one at different points of the earnings distribution, we may conclude that there are intergenerational inequalities between cohorts  $C$  and  $C'$ .
2. We test the null hypothesis of second-order stochastic dominance of cohort  $C$  over cohort  $C'$  and of cohort  $C'$  over cohort  $C$ . Again, without any strong conclusion, we perform test 3. Otherwise, we may conclude again that there are intergenerational inequalities between cohorts  $C$  and  $C'$ .

3. We test the null hypothesis of equality of cohorts  $C$  and  $C'$  earnings distributions. If the null hypothesis is accepted, we may conclude that there are no intergenerational inequalities.

The results are presented in table 3<sup>4</sup>. The 1970s cohorts have the highest permanent earnings and dominate all cohorts. Cohorts of the eighties and beginning of the nineties have the lowest earnings. They are first-order stochastically dominated by nearly all other cohorts. New cohorts (1999) have higher earnings than the 1985 and 1993 cohorts but are still dominated by the 1970s cohorts<sup>5</sup>. Such results would mean that unobserved heterogeneity cannot compensate for average differences between cohorts. Nevertheless, this ranking is performed using raw earnings. Cohorts are compared for different levels of experience and different years. The previous section has shown that these variables account for a great part of earnings differences between physicians. We improve the analysis by combining stochastic dominance tests with microsimulations.

[Insert Table 3 about here]

Table 3: Stochastic dominance tests for selected cohorts - raw earnings

### 5.3 Testing for stochastic dominance on simulated earnings

We construct an hypothetical earnings distribution for each cohort. We simulate earnings that physicians would have if they had the same characteristics, except their cohort and unobserved heterogeneity<sup>6</sup>.

Let  $\widetilde{y}_{ict}$  denote the simulated earnings of physician  $i$ , at year  $t$ , belonging to the  $c^{th}$  cohort. One has :

$$\widetilde{y}_{ict} = \overline{D}\widehat{b} + \overline{Z}\widehat{d} + \widehat{\alpha}_{10} + \widehat{\delta}_{1995} + \widehat{\gamma}_c + \widehat{\varepsilon}_{ict} \quad (4)$$

where  $\overline{D}$  stands for the average GPs:population ratio and the average specialits:population ratio calculated over the 1983 – 2004 period,  $\overline{Z}$  stands for male physicians, practicing in Paris as full-independent workers with no *MEP* specialization and a two-year period before beginning their practice. They are observed in 1995 and all have 10 years of experience<sup>7</sup>.  $\widehat{b}$ ,  $\widehat{d}$ ,  $\widehat{\alpha}_{10}$ ,  $\widehat{\delta}_{1995}$  and  $\widehat{\gamma}_c$  are the estimated coefficients from equation (1) and  $\widehat{\varepsilon}_{ict}$  are the estimated residuals.

The results are displayed on graph (8) and table 4. Compared to the previous analysis, there are three major differences. Firstly, nearly all cohorts can be ranked using the first-order stochastic dominance

<sup>4</sup>We concentrate on the 5 cohorts displayed on graph (1) for consistency with the results of the previous section. The analysis was also performed using all cohorts, but we find that the earning distributions of these 5 cohorts are representative of the distributions observed for all cohorts belonging to the same decade.

<sup>5</sup>The test is performed with a 5% significance level. Statistic values and confidence intervals for first and second order stochastic dominance are not reported on this graph for a better readability. They are available on request.

<sup>6</sup>Such a micro-simulation analysis has been developed by Bourguignon and *ali*. (2002) and used by Dormont and Milcent (2006)

<sup>7</sup>Our results do not depend on the year of reference or on the level of experience chosen.



criterion. Indeed, differences between cohorts are more pronounced. Again, unobserved heterogeneity does not compensate for average differences between cohorts. Secondly, earnings distributions of cohorts 1972 and 1999 are now equal : with identical characteristics, young cohorts have the same level of earnings as the better-off old cohorts. Thirdly, the 1985 cohort is now first-order stochastically dominated by all cohorts, and more particularly by the 1993 one. On raw earnings, the experience level of doctors belonging to these cohorts was partly compensating the bad 1985 cohort effect.

*[Insert Figure 8 about here]*

Figure 8: Simulated earnings distributions by cohorts

*[Insert Table 4 about here]*

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

## 6 Conclusion

Our results show that GPs' earnings are affected by very large cohort effects. Intergenerational inequalities due to fluctuations in the *numerus clausus* are far from negligible. The demographic situation that prevails at the beginning of the practice affects GPs' permanent level of earnings. Our stochastic dominance approach shows that earnings differences between cohorts do not disappear when we take the whole distribution of earnings into account. The unobserved individual heterogeneity does not compensate for average differences between cohorts. Given these results, one can wonder whether the rise in the *numerus clausus* decided in France from 2002 on is really appropriate. As a rise in the *numerus clausus* has a negative impact on physicians' earnings, such a policy may reduce the attractiveness of the profession.

Our study on longitudinal data also provides original results on the careers of self-employed professionals. Our estimates are not affected by confusion between cohort and experience effects that arise when cross sectional data are used. In addition, we specify a very flexible form for experience effects and find that the curvature of the reversed u-shaped experience profile is much more pronounced for GPs than what is usually estimated for salaried workers. They concentrate their activity in the first 15 years and then reduce it strongly. Such a result deserves further investigations in order to assess if this result can be the revelation of a pronounced preference for leisure, which would not be observable for salaried workers whose labour duration is more constrained.

## 7 Appendix A: Identifying constraints

As stated in the section devoted to the econometric specification, the identification of model (1) involves the addition of a linear constraint to constraints (2). Otherwise, one has  $t = c + e$  for each physician  $i$ . We have to choose between two constraints: no trend on cohort effects ( $\sum_c c * \gamma_c = 0$  (3)) or no trend on time effects:

$$\sum_t t * \delta_t = 0 \tag{5}$$

No theoretical background is available to choose the effect on which to put the additional constraint. We provide in this appendix our rationale for choosing constraint (3). To find empirical evidence of a lack of trend for the cohort effects, we use an alternative strategy to eliminate the colinearity source. Considering an aggregation of cohorts, we can directly estimate group-of-cohort fixed effects: indeed,  $t \neq (\text{groups of } c) + e$ .

Graph 9 displays the experience effects estimated by applying three alternative identifying strategies: constraint "no trend on cohort effects" (3), constraint "no trend on time effects"(5) and the "group-of-cohort" specification. We first notice that the choice between constraint (3) and (5) has a very strong impact on the estimates. The mechanical effect of the constraints can easily be understood: if we impose no trend on time effects, the general agreements that progressively raised medical fees over time are captured by the experience effect. The resulting curve (denoted "constraint on time") is increasing with experience because the share of doctors with a high experience level is increasing over time in the medical population as well as in our sample (more precisely, doctors with an experience greater than 20 years represent 7.5 % of the sample in 1993; they are 25 % in 1998 and 41 % in 2004).

Why should we consider constraint (3) instead of (5) ? The curves in graph 10 represent the cohort effects estimated with constraint (3) and with the specification in terms of group-of-cohort. The estimates obtained on the latter give a strong empirical support to the idea that there is no trend on the cohort effects. Moreover, the pattern of the two curves are very similar.

Turning back to the estimated experience effects in graph 9, we notice that the effects estimated with constraint (3) are not significantly different from the ones estimated with the group-of-cohort specification (95% confidence intervals are displayed in the graph).

On the whole, this empirical analysis leads to the conclusion that there is no trend on the cohort effects. This result is consistent with our historical knowledge of the considered period: (i) fees have been steadily raised by general agreements between 1983 and 2004, which disqualify the idea of no trend on the time effect; (ii) the baby-boom and the introduction of the *numerus clausus* led to large fluctuations in the medical demography, which is consistent with no trend on the cohort effect.

*[Insert Figure 9 about here]*

Figure 9: Experience fixed effects estimated with three alternative specifications

[Insert Figure 10 about here]

Figure 10: Cohort fixed effects estimated with two alternative specifications

## 8 Appendix B : Estimates of the earnings function

[Insert Table 5 about here]

Table 5: Estimates of the earnings function

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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
1972	1,656	100	1983-2004	11-32
1973	1,549	92	1983-2004	10-31
1974	2,539	154	1983-2004	9-30
1975	3,014	179	1983-2004	8-29
1976	3,961	238	1983-2004	7-28
1977	5,154	304	1983-2004	6-27
1978	5,129	290	1983-2004	5-26
1979	4,609	265	1983-2004	4-25
1980	4,011	250	1983-2004	3-24
1981	4,256	241	1983-2004	2-23
1982	4,107	252	1983-2004	1-22
1983	3,837	237	1984-2004	1-21
1984	4,095	255	1985-2004	1-20
1985	3,881	250	1986-2004	1-19
1986	3,276	208	1987-2004	1-18
1987	2,764	190	1988-2004	1-17
1988	2,972	215	1989-2004	1-16
1989	2,658	204	1990-2004	1-15
1990	2,929	238	1991-2004	1-14
1991	2,306	202	1992-2004	1-13
1992	2,183	201	1993-2004	1-12
1993	1,561	167	1994-2004	1-11
1994	1,246	149	1995-2004	1-10
1995	1,113	150	1996-2004	1-9
1996	1,001	139	1997-2004	1-8
1997	906	151	1998-2004	1-7
1998	730	131	1999-2004	1-6
1999	620	137	2000-2004	1-5
2000	509	138	2001-2004	1-4
2001	264	95	2002-2004	1-3
1945 to 1969	The number of observed physicians per cohort lies between 12 and 85, which is not enough for relevant statistical inference at the vintage level			
2002-2003				
Total	81,691	6,016	1983-2004	1-34

(1) Experience is defined as the year of observation – first year of activity

Table 1

	1983	1993	2004
gender (proportion of female)	0.132 (0.338)	0.187 (0.389)	0.247 (0.431)
seniority	5.779 (3.322)	10.736 (5.956)	17.663 (7.968)
seniority (cohorts 1945-2003)	11.106 (9.429)	12.847 (7.905)	18.037 (8.507)
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

Notes: Working sample : French GPs, sector 1, period 1983-2004, 81691 observations, cohorts 1970-2001. Standard errors are in parentheses

	1972	1977	1985	1993	1999
1972	-	$\succ (DS2)$	$\succ (DS1)$	$\succ (DS1)$	$\succ (DS1)$
1977	-	-	$\succ (DS1)$	$\succ (DS1)$	$\succ (DS1)$
1985	-	-	-	=	$\prec (DS1)$
1993	-	-	-	-	$\prec (DS1)$

Table 3

Notes:

$\succ (DS_s)$ : the column dominates the row for s order stochastic dominance (s=1 or 2);

$\prec (DS_s)$ : the row dominates the column for s order stochastic dominance (s=1 or 2);

=: the distributions are equal

	1972	1977	1985	1993	1999
1972	-	$\succ (DS1)$	$\succ (DS1)$	$\succ (DS1)$	=
1977	-	-	$\succ (DS1)$	$\succ (DS1)$	$\prec (DS1)$
1985	-	-	-	$\prec (DS1)$	$\prec (DS1)$
1993	-	-	-	-	$\prec (DS1)$

Table 4

Notes:

$\succ (DS_s)$ : the column dominates the row for s order stochastic dominance (s=1 or 2);

$\prec (DS_s)$ : the row dominates the column for s order stochastic dominance (s=1 or 2);

=: the distributions are equal

Variable	Coefficient	Standard Error
Gender	-0.34296 (***)	0.00413
Mep specialisation	-0.06501 (***)	0.00695
Years between PhD and 1rst year of practice	-0.02243 (***)	0.00070052
Part-time independent practice	-0.05236 (***)	0.00452
Part-time Hospital Practice	0.00196 (NS)	0.00245
Suburban area	0.09029 (***)	0.00413
Urban sprawl	0.11207 (***)	0.00786
Rural area	0.14524 (***)	0.00437
GPs :population ratio	-0.00245 (***)	0.00025279
Specialists :population ratio	0.0000041 (NS)	0.00008969
<b>Regional effects (ref :Ile de France)</b>		
Rhône-Alpes	-0.11129 (***)	0.00777
Picardie	0.20911 (***)	0.01050
Auvergne	-0.00499 (NS)	0.01264
PACA	-0.07752 (***)	0.01059
Champagne-Ardenne	0.14595 (***)	0.01238
Midi-Pyrénées	0.02739 (***)	0.01074
Languedoc Roussillon	0.01314 (NS)	0.01285
Basse Normandie	0.06732 (***)	0.01244
Poitou Charente	0.06073 (***)	0.01186
Centre	0.04638 (***)	0.00994
Limousin	0.01725 (NS)	0.01498
Corse	-0.23278 (***)	0.02435
Bourgogne	0.04663 (***)	0.01109
Bretagne	-0.03938 (***)	0.00953
Aquitaine	0.05191 (***)	0.01035
Franche Comté	-0.03352 (***)	0.01290
Haute Normandie	0.16552 (***)	0.01051
Pays de la Loire	0.07260 (***)	0.00918
Lorraine	0.09727 (***)	0.00970
Nord	0.21432 (***)	0.00929
Alsace	0.00907 (NS)	0.01023
R <sup>2</sup>	0.2755	
Fisher	269.56	
<b>Sample Size</b>	<b>81,691</b>	

\*\*\* Statistically significant at the 1% level; \*\* Statistically significant at the 5% level; \* Statistically significant at the 10% level; NS Non significant

Table 5

Notes: Method : OLS under constraints (2) and (3). Estimated cohort, experience and time fixed effects are given by graph 5 to 7 in the text

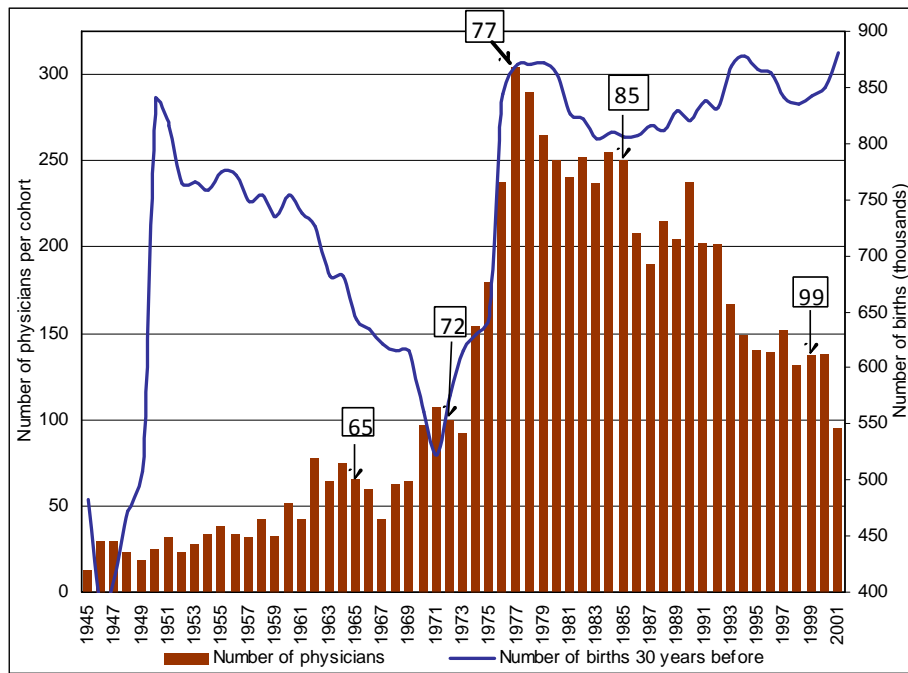


Figure 1

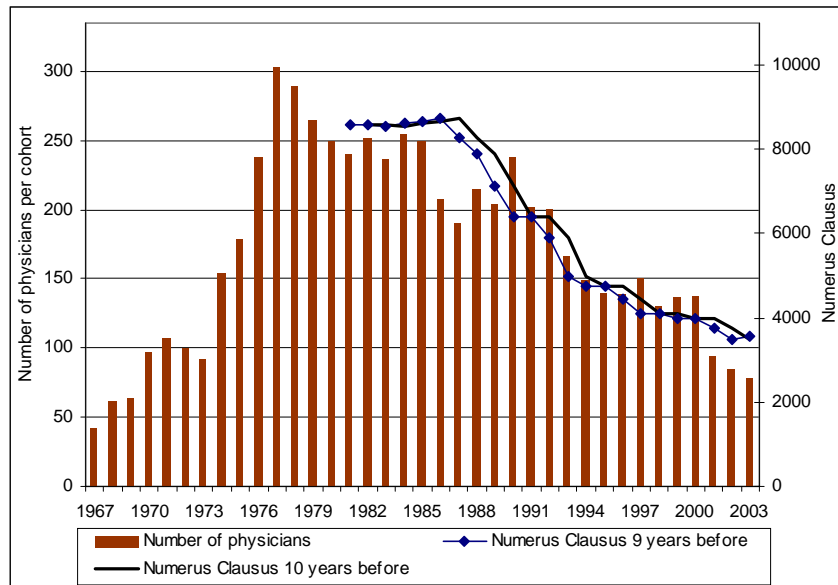


Figure 2



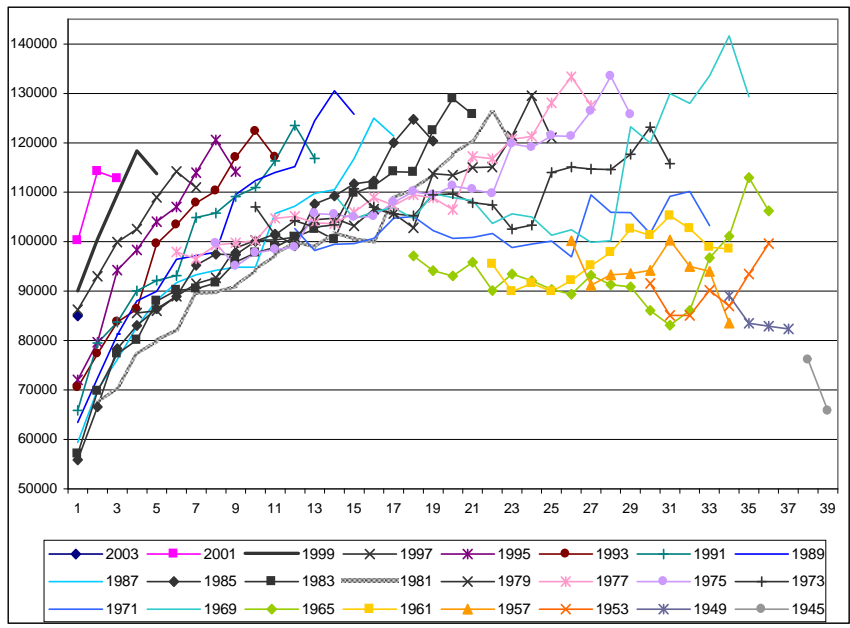


Figure 3

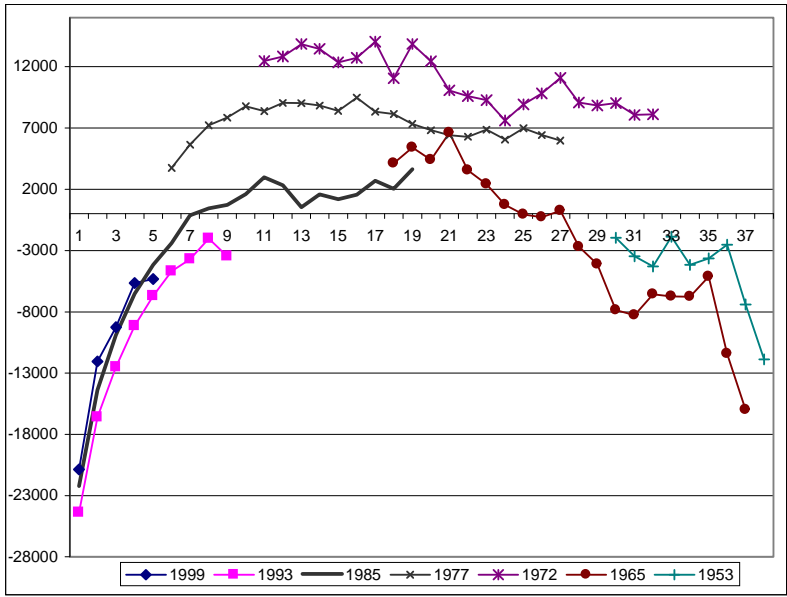


Figure 4

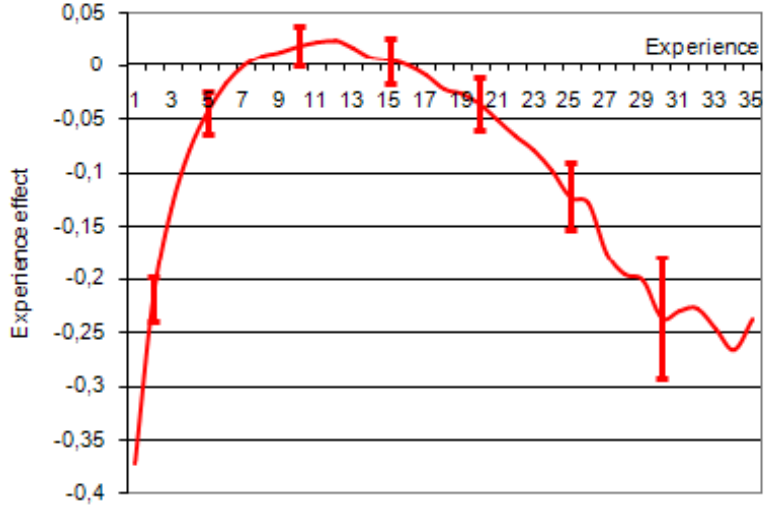


Figure 5

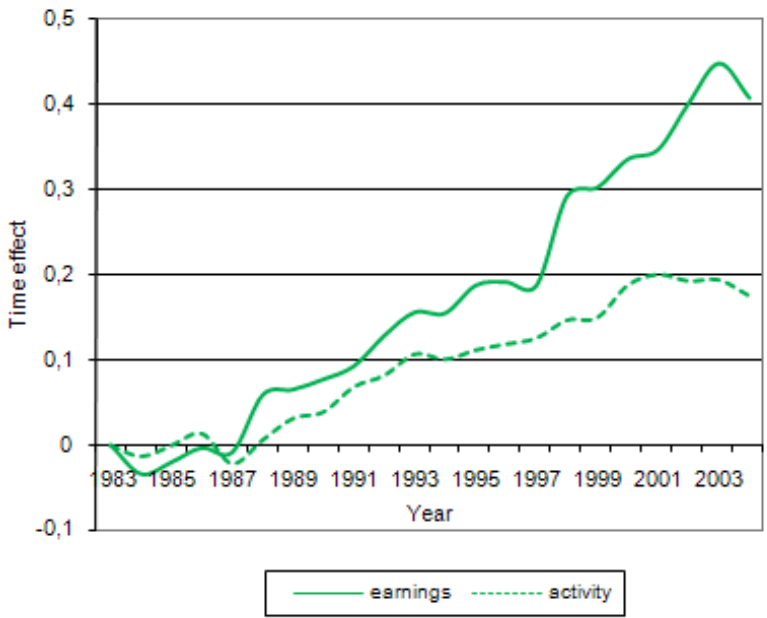


Figure 6

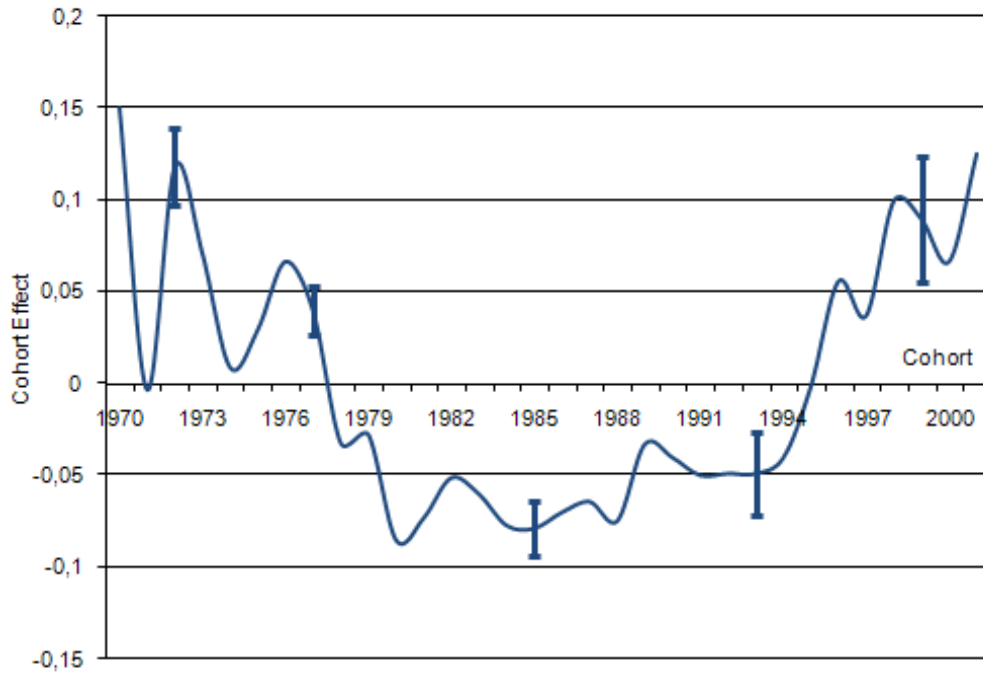


Figure 7

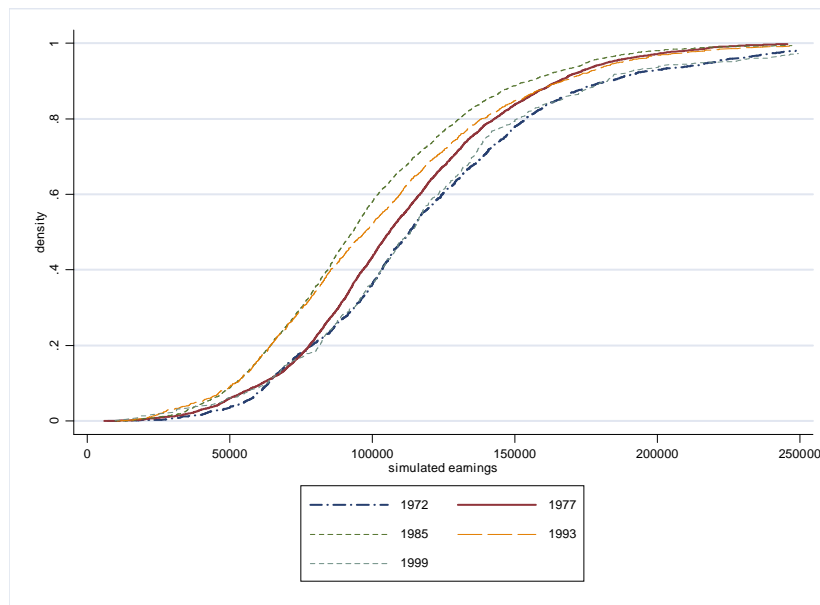


Figure 8

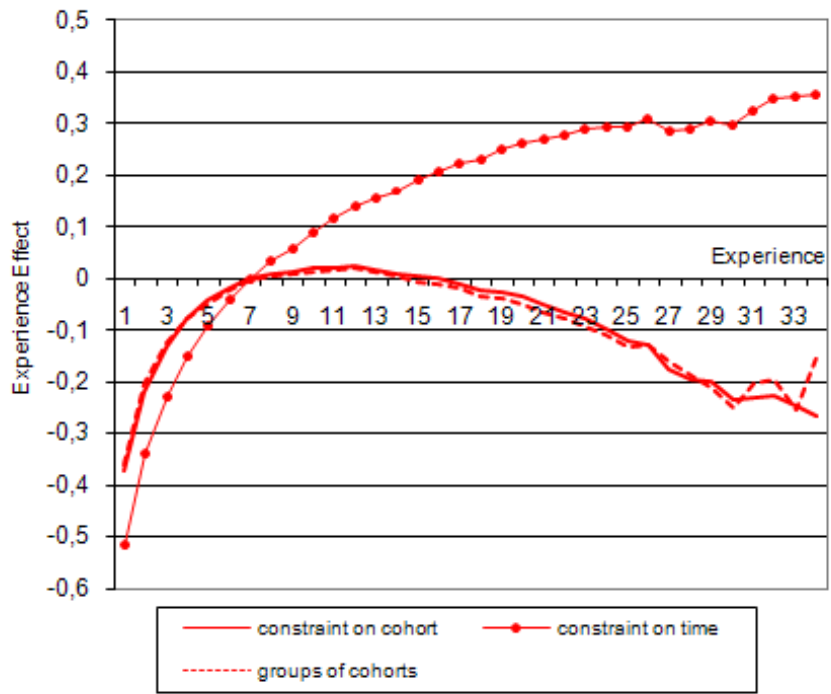


Figure 9

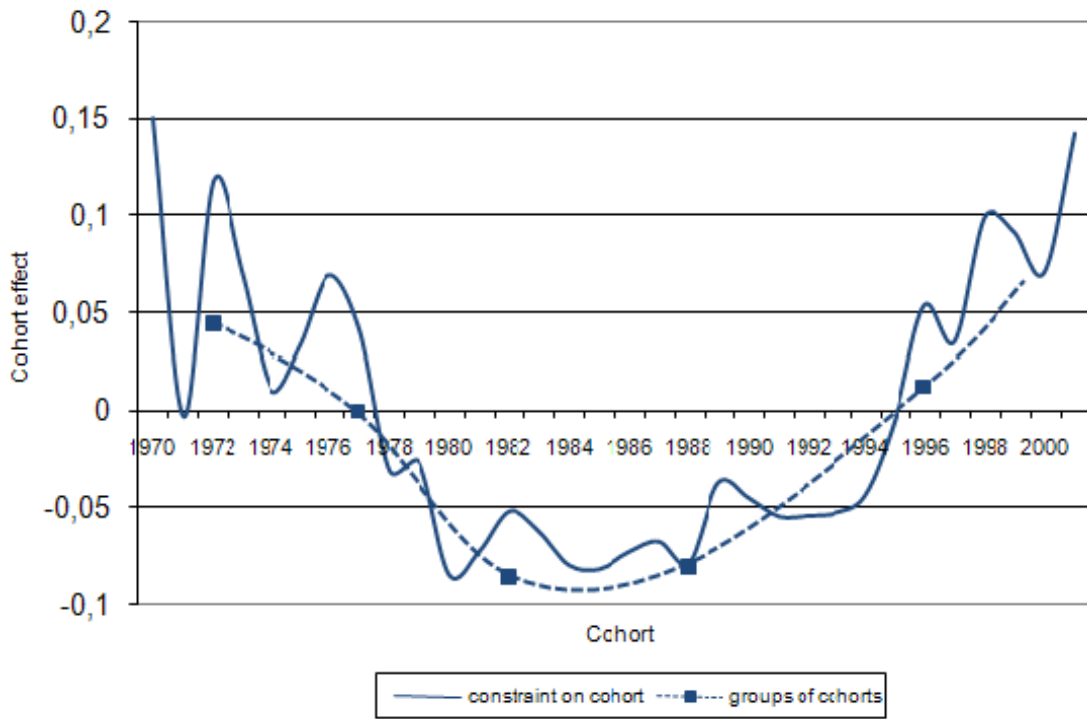


Figure 10