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Supplemental Health Insurance and Healthcare Consumption: A Dynamic Approach to Moral Hazard

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Sommaire

Supplemental Health Insurance and Healthcare Consumption: A Dynamic Approach to Moral Hazard

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Abstract: We analyze the existence and persistence of moral hazard over time to test the assumption of pent-up demand. We consider the effects of supplemental health insurance provided by a private insurer when added to compulsory public insurance already supplemented by private insurance. Using panel data from a French mutuelle, we compute error component models with the Chamberlain specification to control for adverse selection. By separating outpatient care consumption into (1) the probability of healthcare use, (2) the number of uses conditional on use and (3) the per-unit cost of care, we provide evidence that supplemental insurance is significantly and positively associated with (1), (2) and (3). However, these effects decrease significantly over time. This pattern supports the existence of pent-up demand, the magnitude of which varies greatly and depends on the dimensions (1), (2) and (3) and the type of care (physician care, prescription drugs, dental care or optical care).

JEL codes: D82, I13.

Keywords: Supplemental health insurance, moral hazard, health care expenditures, longitudinal analysis.

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Surcomplémentaire et consommation de soins : une approche dynamique de l'aléa moral

Carine Franc[1], Marc Perronnin[2] , Aurélie Pierre[2]

Résumé : Selon l'hypothèse d'une pent-up demand, la demande de soins de santé n'est pas constante au cours du temps. Le phénomène d'aléa moral, qui se caractérise par une hausse des dépenses de santé suite à l'augmentation du niveau d'assurance, peut donc être particulièrement élevé juste après une hausse de l'assurance et s'atténuer ensuite au cours du temps. Dans ce papier, nous analysons l'existence et la persistance de l'aléa moral sur une période donnée suite à la souscription d'une surcomplémentaire santé fournie par un assureur français privé, qui complète l'assurance maladie obligatoire et une complémentaire santé dite « de base ». Nous modélisons les dépenses de santé par des modèles de panel à erreurs composées en utilisant l'approche de Chamberlain pour contrôler au mieux de la sélection adverse. En distinguant dans la consommation de soins ambulatoires (1) la probabilité de recours aux soins de santé, (2) le nombre de recours conditionnellement au fait de consommer, (3) le coût par unité de soins, nous montrons que la surcomplémentaire est significativement et positivement associée à (1), (2) et (3) et que ces effets diminuent au fil du temps, confirmant ainsi l'hypothèse d'une pent-up demand mais dont l'ampleur varie fortement selon les 3 dimensions et les postes de soins (soins médicaux, prescription de médicaments, soins dentaires ou optiques).

Codes JEL : D82, I13.

Mots clés : Surcomplémentaire, aléa moral, dépenses de santé, analyse longitudinale.

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1. Introduction

Economic theory predicts that, by reducing the price of healthcare at the point of use, increased health insurance coverage encourages individuals to increase their consumption of care (assuming that healthcare is an ordinary good). This prediction results from changes in the individual tradeoffs that can be illustrated utilizing two classical, conceptual effects highlighted by Slutsky (1915). Both of these effects lead to an increase in consumption even if they have different welfare effects (Pauly, 1968). First, the substitution effect results from a change in relative prices: when a good is less expensive than other goods, individuals face incentives to purchase this good more frequently (given that their income remains unchanged). Second, the income effect, which results from an increase in purchasing power, allows consumers to acquire larger quantities of all types of goods, including the good for which the price has decreased. These two effects are often associated with moral hazard. However, in the healthcare context, increased purchasing-power (for instance, due to a copayment reduction) enables sick individuals to purchase valuable healthcare that they could not afford without health insurance (De Meza, 1983; Nyman, 1999a). Thus, the income effect of improving access to healthcare can positively affect equity.

Numerous empirical studies have estimated the effect of health insurance on inpatient and/or outpatient healthcare consumption. However, endogeneity bias may occur as a result of adverse selection; indeed, individuals who decide to purchase health insurance may also have had higher healthcare expenditures prior enrollment. Estimates obtained from the Rand health insurance experiment (HIE) are widely acknowledged. Newhouse and the Insurance Experiment Group (1993) obtained price elasticity values of approximately -0.2 for inpatient and outpatient care. In addition to this experimental research, different modeling strategies have been used to control for adverse selection. Several studies suggest using instrumental variables (for example, Ettner, 1997; Albouy and Crepon, 2007), whereas others suggest observing the exogenous change in copayments in healthcare plans (Cherkin *et al.*, 1989; Chiappori *et al.*, 1998). Regardless of the strategy used to control for adverse selection, nearly all of the US studies have found negative price elasticities for inpatient and/or outpatient care (Cutler and Zeckhauser, 2000; Zweifel and Manning, 2000). This consensus is not observed in European studies. For example, Schokkaert *et al.* (2010) and Bolhaar *et al.* (2008) analyze the influence of complementary health insurance on hospitalization and outpatient care in Belgium and Ireland, respectively, and do not observe significant effects (except in dental care). In France, Caussat and Glaude (1993) and Albouy and Crepon (2007) demonstrate that coverage by complementary health insurance has no influence on hospital care consumption but has a significant, but weak, influence on the probability of using outpatient care. This result appears to be consistent with the results of previous studies using French data (Genier, 1998; Chiappori *et al.*, 1998; Buchmueller *et al.*, 2004; Raynaud, 2005). However, moral hazard and its expected magnitude depend on both the operationalization of the concept itself and the institutional context of health insurance provision.

Different approaches have been adopted to analyze the relevance and magnitude of moral hazard. Some studies have analyzed the level of expenditure conditional on utilization (for instance in France, Caussat and Glaude, 1993); others consider the probability

of initiating an episode and the frequency of episodes (in France, Genier, 1998). Some studies have analyzed the persistence of a potential increase in healthcare consumption over time (Long *et al.*, 1998; Keeler *et al.*, 1982; Newhouse *et al.*, 1982). However, considering the effects of health insurance from a dynamic perspective is crucial because even if health insurance improves access to care in a sustainable manner, its effects on consumption patterns can change over time. This is the assumption incorporated into the theory of pent-up demand: a strong, immediate and temporary increase in healthcare expenditures occurs just after enrollment, assuming that the effect of health insurance decreases over time. This theory also assumes that newly insured individuals may have either postponed or avoided healthcare consumption prior to obtaining the new plan, which explains the difference in consumption immediately before and after subscription. Empirical studies have failed to give strong evidence to this theory. For instance, Long *et al.* (1998) find little support for this behavior among the newly insured. As early as 1982, Keeler *et al.* find relatively little evidence of pent-up demand after a year, whereas Newhouse *et al.* (1982) find evidence of this pent-up demand for medical care at both the beginning and the end of the three-year Health Insurance Experiment.

In France, a universal public health insurance (PHI) program, which is compulsory and uniform for all individuals living legally in the territory, covers a broad range of medical products. Since the institution of Social Security (1945), re-insurable copayments for any service have been implemented and are computed as percentages of regulated prices. Moreover, several providers are allowed to charge extra fees in addition to the regulated fees (Buchmueller and Couffinhal, 2004). The sum of copayments and extra fees may be high, particularly for dental and optical care. Private complementary health insurance (CHI), offered by *mutuelle*s, provident institutions and private insurance companies, is primarily purchased to cover these costs. Even though CHI is not compulsory, more than 90% of individuals eligible for PHI benefit from CHI. In the French context, most studies have analyzed moral hazard by focusing on the CHI coverage effects while CHI contracts are very heterogeneous in terms of both prices and warranties.

In this paper, we study the existence and persistence of moral hazard over time. We analyze the effects of an extra complementary health insurance (ECHI) contract provided by a French private health insurer (*mutuelle*) in addition to PHI (uniform and compulsory) and to basic complementary health insurance (BCHI) optional and uniform for all insured of this *mutuelle*. To understand the manner in which healthcare expenditures are eventually modified by ECHI, we determine the influence of insurance on all of the determinants of healthcare expenditures: (1) do the ECHI insured have an increased probability of utilizing healthcare; (2) do they increase the number of uses conditional on use; and (3) do they purchase more expensive care? To conduct this study, we use error component models by introducing the Chamberlain specification that enables us to control for adverse selection to the greatest extent possible. This paper is organized as follows: in the second section, we present the data and the context. In an extensive third section, we present the economic model and the different residual assumptions that must be defined to ensure that adverse selection is controlled for as much as possible. The fourth section presents the results. In the final section, we discuss the results and conclude.

2. Data

2.1. Context of dataset

The dataset originates from the administrative records of a non-profit *mutuelle*, which primarily insures civil servants and their relatives. This *mutuelle* manages both PHI and CHI. Until July 2003, this *mutuelle* only offered one uniform and basic complementary health insurance contract (BCHI). Since July 2003, a voluntary extra complementary health insurance (ECHI) contract has been offered in addition to BCHI such that any BCHI enrollee has the opportunity to individually (within a household) purchase ECHI without a specific underwriting process. During the six months preceding the ECHI offer, an informational campaign was launched to spread awareness among the BCHI insured. Table I presents the reimbursements respectively provided by PHI, BCHI and ECHI. The additional coverage provided by ECHI mostly concerns physicians' extra fees and copayments for dental and optical care. The ECHI plan was community rated, and the premium was set at 11€ per individual per month (with no charge for additional children beyond two) and remained unchanged during our observation period. Subscribing to ECHI had no effect on the BCHI contract, including the premium.

Table 1. PHI, Pooling BCHI and ECHI: coverage for different types of healthcare expenses

	PHI	BCHI in addition to PCHI	ECHI in addition to BCHI
Physician care			
Medical practitionners fees (GPs and specialists)	70% RP	+30% RP	+30% RP
Dental care			
Preventive dentistry	70% RP	+30% RP	/
Dental protheses / orthodontia	70% RP	+140% RP	+105% RP
Other fees (surgical acts, radiology procedures)	70% RP	+30% RP	+30% RP
Drugs			
White vignette drugs	65% RP	+35% RP	/
Blue vignette drugs	35% RP	+60% RP	/
Optical			
Eyeglasses	65% RP	+900% RP	+92€ or +31€ (1)
Frame	65% RP	+55	+61€
Contact lenses	0€ or 65€ RP	+115	+115€
Other prescription			
Auxiliary care	60% RP	+40% RP	/
Orthopedia	65%	+130% RP	/
Acoustic prosthetics	65%	+260% RP	/
Hospitalization			
Medical practitionners fees	80% or 100% RP	+20% or +0% RP	+30% RP
Stay costs	80% or 100% RP	+20% or +0% RP	/
Per diem copayment	/	14€*	/
Other types of care			
Medical transportation	65% RP	+35% RP	/
Spa care (2)	65% or 70% RP	btwn +20% and +35% RP	/

*10€ for a psychiatric hospitalization and 14€ otherwise

Note: RP = Regulated price. White / blue vignette: this indicator permits the segmentation of drugs. White vignette represents medical utility drugs, blue one represents moderate medical utility drugs.

PHI reimburses 100% of RP for medical practitionners fees and stay costs when they are linked to surgery acts whose cost exceed 91€.

(1) ECHI reimburse 31€ for unifocal eyeglasses and 92€ for for multifocal eyeglasses.

(2) For Spa care, PHI reimburse 65% or 70% of RP depending of the type of care.Sample and dataset.

2.2. Sample and dataset

We analyze a representative sample of BCHI customers that includes 18,126 individuals. We observe each insured for 10 semesters, from January 2001 to December 2005. By the end of our observation period (5 semesters after ECHI implementation), 20% of all BCHI enrollees subscribed the ECHI plan: 42% enrolled immediately (during the first semester), 23% during the second (first semester of 2004), 13% during the second half of 2004, 11% during the first semester of 2005 and 10% during the last semester of 2005. No subscribers abandoned the ECHI plan during the observation period.

The dataset includes many individual socio-demographic characteristics known to influence health insurance demand, such as age, gender, labor market status, residence, insured status and a proxy for income[1]. These characteristics are known for December 2005, and we assume that they did not change from January 2001. The datas*et al*so provides detailed information for individual outpatient healthcare expenses from 2001 to 2005 for specific expenses: the date of utilization; the type of care (physician care, dental care, prescription drugs and optical care)[2]; and the entire cost of care that was partly reimbursed by PHI, BCHI and eventually ECHI. Tables IIa and IIb present the main characteristics of our sample. We analyze the effect of ECHI for each type of care by successively considering (1) the increase in the probability of using healthcare, (2) the number of uses conditional on use and (3) the cost per use.

Table 2a. Sample demographic characteristics in 2005

	Full sample	Covered by the ECHI	Not covered by the ECHI
Age	**49.5**	**56.3**	**47.7**
Gender			
Man	62.6%	59.4%	63.4%
Woman	37.4%	40.6%	36.6%
Wage index brackets (in points)			
<= 1350€	6.1%	7.5%	5.7%
From 1350€ to 1790€	57.8%	51.9%	59.3%
From 1790€ to 2240€	20.5%	22.6%	19.9%
From 2240€ to 3110€	10.2%	11.6%	9.8%
> 3110€	5.5%	6.5%	5.2%
Administrative situation			
Active	40.1%	43.7%	39.1%
Retired	31.2%	38.5%	29.3%
Student	1.5%	0.9%	1.6%
No professional activity	27.3%	16.9%	29.9%
Family situation			
CHI policyholder	65.6%	76.0%	63.0%
Spouse	14.8%	16.7%	14.3%
Child	19.6%	7.3%	22.8%

To be continued

1 Policyholder Income is approximated using the national grid of wage indices for civil servants. Multiplied by the value at that point (53.9€ in December 2005), we computed the values to obtain a monthly gross wage.

2 We focus on outpatient care and exclude hospital care data that may be incomplete (several services provided during hospitalization are not reported in the mutuelle patient file).

Table 2a. Sample demographic characteristics in 2005 (continued)

	Full sample	Covered by the ECHI	Not covered by the ECHI
Residential location (grouping of regions)			
Ile de France (IdF = Paris region)	7.8%	10.4%	7.1%
Parisian basin regions (excluded IdF)	16.8%	15.1%	17.3%
Northern regions	4.4%	4.5%	4.4%
Eastern regions: Alsace Lorraine	6.0%	9.2%	5.2%
Eastern regions: Franche Comté	2.6%	2.6%	2.6%
Western regions	16.9%	12.7%	18.0%
South-Western regions	15.4%	15.6%	15.3%
Center-Eastern regions	11.7%	12.8%	11.5%
Mediterranean regions	14.3%	13.1%	14.6%
Number of observations	**18,126**	**8,668**	**9,458**
Number of pool CHI policies	**12,173**	**6,780**	**5,393**
Average number of beneficiaries per pool CHI policy	1.52	1.42	1.56

Table 2b. Healthcare utilization in 2005

	Full sample		Covered by the ECHI		Not covered by the ECHI	
	Before July 2003	After	Before July 2003	After	Before July 2003	After
Average expenditure per semester (in euros)						
Outpatient care	554.6	659.5	673.2	860.5	524.1	607.7
Physician care	81.5	87.8	100.1	109.6	76.7	82.1
Dental care	63.8	72.4	76.1	123.2	60.6	59.3
Drugs	201.2	242.4	255.3	308.8	187.2	225.2
Optical care	31.7	39.9	40.5	63.1	29.4	33.9
Probability of using conditional on use per semester						
Outpatient care	0.881	0.900	0.887	0.930	0.880	0.892
Physician care	0.813	0.819	0.834	0.866	0.808	0.807
Dental care	0.244	0.248	0.270	0.290	0.237	0.235
Drugs	0.800	0.811	0.827	0.861	0.793	0.798
Optical care	0.109	0.117	0.125	0.158	0.105	0.106
Number of uses conditional on use per semester						
Outpatient care	19.6	26.1	23.0	29.0	18.8	25.3
Physician care	4.8	5.0	5.4	5.7	4.6	4.9
Dental care	2.0	2.5	2.1	2.8	2.0	2.3
Drugs	8.7	9.3	10.4	11.2	8.2	8.8
Optical care	2.2	2.9	2.2	2.9	2.2	2.8
Average cost use conditional on use per semester (in euros)						
Outpatient care	34.5	33.8	35.1	37.2	34.3	32.8
Physician care	21.2	21.6	22.0	22.4	21.0	21.4
Dental care	127.6	121.4	122.2	142.3	129.2	114.5
Drugs	24.1	26.3	26.2	27.7	23.6	25.9
Optical care	142.5	119.5	159.2	136.9	137.4	112.9
Number of observations	**18,126**		**8,668**		**9,458**	

3. Economic model and methods

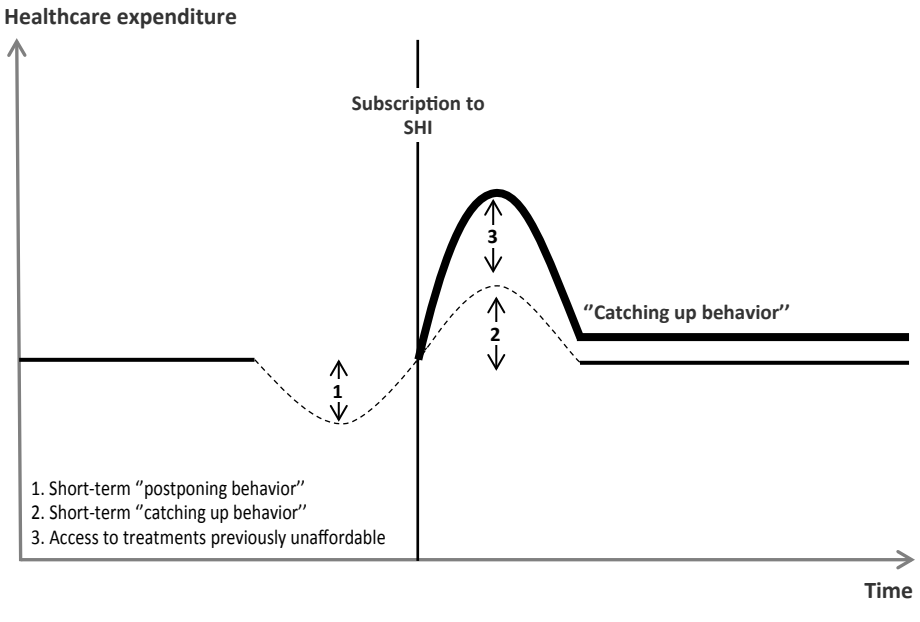
3.1. The assumptions of pent-up demand

The pent-up demand theory assumes that the effect of health insurance on health expenditures does not remain constant over time. Long *et al.* (1998) argued that an increase in insurance coverage may have two types of consequences: a "postponing behavior" prior to enrollment and a "catching up behavior" immediately after. "Catching up behavior" results in a sharp increase in health expenditure just after the rise of the insurance coverage that decreases over time (Figure 1). "Postponing behavior" before subscribing to health insurance results from an economic tradeoff: individuals transitory postpone non-urgent treatments to benefit from higher reimbursements (Chen *et al.*, 2004) (dotted thin line). This short term "postponing behavior" reflects an inter-temporal substitution of healthcare consumption in order to take profit of lower prices and leads to a short term catching up effect (dotted thin line). This effect has to be added to the expenses associated to access to treatments previously unaffordable to constitute the overall "catching up behavior" (solid thick line). Indeed individuals may have foregone to unaffordable treatments before the increase of insurance coverage.

This concept can be brought closer to moral hazard as one does not completely exclude it in the overall "catching up effect" (solid thick line). However, validating the pent-up demand assumption means that even if there is moral hazard, it does not last over time and does not reflect a permanent change in the consumption pattern.

In this paper, we test the pent-up demand assumption by considering the existence of the "catching-up" effect and its evolution over time.

Figure 1. Variation of health care consumption according to the pent-up demand theory



3.2. Healthcare expenditures

An increase in healthcare consumption caused by an increase of insurance coverage has to be divided into three dimensions: the probability of using care, the number of uses of care conditional on use and the cost of care per use.

$$E(exp) = E(cost/unit) \times E(nbuse \mid use = 1) \times p(use = 1) \qquad \text{(Eq.1)}$$

- The probability of using care reflects access to healthcare or to a type of care.
- The number of uses conditional on use reflects the frequency of healthcare consumption when individuals have access to healthcare or to a type of healthcare.
- The cost per use reflects the average expense per use. This price per use is the ratio of the total cost and the number of uses that both vary over time. An increase in the cost per use may reflect several factors (for example, an increase in the cost and/or a decrease in the number of uses). If the number of uses increases, the cost increases more sharply illustrating a change in the consumption pattern (expecting a higher level of quality; Feldstein, 1971) or a change in the supply side (providers charge higher fees in response to the higher level of coverage; Delattre and Dormont, 1999).

3.3. Empirical models

3.3.1. Notation

According to the equation of healthcare consumption (Eq. 1), we test pent-up demand for outpatient care and each type of care by studying the effects of ECHI through three models:

- (1) the probability of using care: $p(use_{is}=1)$,
- (2) the conditional number of uses of care: $E(nbuse_{is} \mid use_{is}=1)$,
- (3) the cost per use: $E(ucost_{is})$,

where i (i=1,…,N) is the individual index and s (s=*1*,…,10) corresponds to a semester from January 2001 to December 2005.

For each ECHI subscriber, we define five dichotomous variables ($LI_{is}^{1}…LI_{is}^{5}$) corresponding to the length of enrollment (into ECHI) at any semester s (s>*6*, ECHI was implemented in July 2003 s=6); for instance, an individual who subscribed at semester seven (s=7), the length of enrollment at the end of the period will be four semesters such that LI_{is}^{4}=1.

In each model, we introduce covariates linked to both health insurance demand and healthcare consumption: X_{is} represents a vector of age and age squared (for individual i at semester s) and Z_i represents a vector of individual fixed variables (gender, number of individuals covered by BCHI within the household, wages of the subscribers of BCHI, labor market status, family situation and location).

3.3.2. Random effect models with Chamberlain specification

For (1), (2) and (3), we use random effects models that consider two levels of unobservable heterogeneity; the first level refers only to individuals and the second level allows heterogeneity between individuals and semesters.

$$y^{1,2,3} = f(X_{is}, Z_i, LI_{is}, sem_s, vi_{is}^{1,2,3}, \varepsilon_{is}^{1,2,3})$$

$vi_{is}^{1,2,3}$ represents the unobserved heterogeneity parameters that are fixed in time and $\varepsilon_{is}^{1,2,3}$ is the unobserved heterogeneity parameters that vary over time.

Without the Chamberlain specification, random effect models are based on the assumption that the residuals, whether fixed or variable over time, are not correlated with the explanatory variables. This strict exogeneity assumption is rather strong because individual health status and risk aversion are both unobservable. As a result, even if the panel structure of the data enables us to account for a significant part of adverse selection, unobservable factors can result in biased estimators. For instance, a risk-adverse (or ill) individual may decide to subscribe to a supplemental health insurance contract and consume more because of risk aversion (or health status).

The Chamberlain specification (Chamberlain, 1984) takes into account for the correlation between unobserved constant individual characteristics (such as risk aversion and/or the constant part of an individual's health status) and the decision to subscribe to an ECHI plan and the length of enrollment in the ECHI. This specification decomposes the fixed residuals (v_i^1, v_i^2, v_i^3) into two components: the first one corresponds to the correlation with the length of enrollment in ECHI (LI) and the second component corresponds to exogenous factors.

$$v_i^1 = \sum_{t=1}^{10} \Psi_{i\tau}^{\ 1} \, . \, LI_{i\tau} + w_i^1, \qquad v_i^2 = \sum_{t=1}^{10} \Psi_{i\tau}^{\ 2} \, . \, LI_{i\tau} + w_i^2, \qquad v_i^3 = \sum_{t=1}^{10} \Psi_{i\tau}^{\ 3} \, . \, LI_{i\tau} + w_i^3.$$

Under these specifications, the three economic models are as follows:

- ***Model (1), the probability of using care***

$$use_{is}^{*} = a_1 + \gamma_1 . X_{is} + \beta_1 . Z_i + \delta_1 . LI_{is} + \sum_{t=1}^{10} \Psi_{i\tau}^{1} . LI_{i\tau} + \eta_1 . sem_s + w_i^1 + \varepsilon_{is}^{1}$$

$$use_{is} = 1 \text{ if } use_{is}^{*} \geq 0$$

$$use_{is} = 0 \text{ if } use_{is}^{*} < 0.$$

- ***Model (2), the number of uses conditional on use***

$$nbuse_{is} = f(a_2 + \gamma_2 . X_{is} + \beta_2 . Z_1 + \delta_2 . LI_{is} + \sum_{t=1}^{10} \Psi_{i\tau}^{\ 2} . LI_{i\tau} + \eta_2 . sem_s + w_i^2 + \varepsilon_{is}^{\ 2}).$$

- ***Model (3), the cost per use***

$$ucost_{is} = exp(a_3 + \gamma_3 . X_{is} + \beta_3 . Z_i + \delta_3 . LI_{is} + \sum_{t=1}^{10} \Psi_{i\tau}^{\ 3} . LI_{i\tau} + \eta_3 . sem_s + w_i^3 + \varepsilon_{is}^{\ 3}).$$

Following the Chamberlain specification, we assume that the vectors of residuals (v_i^1, $\varepsilon_{is}^{\ 1}$), (v_i^2, $\varepsilon_{is}^{\ 2}$) and (v_i^3, $\varepsilon_{is}^{\ 3}$) are independent in pairs. For instance, the decision to use care and the expenditure for a specific use are assumed to be independent. Thus, the equations can be estimated separately in a three-part model[3].

[3] Without this assumption, we would have used sample selection models that were adapted to the panel data (Wooldridge, 1995) and identified independent variables to explain each equation separately.

3.3.3. The method of generalized estimating equations (GEE)

Two different methods are available to estimate three-part models, depending on the assumptions made about the residuals. First, the GEE method is a semi-parametric method and requires minimal assumptions regarding residuals. This method is an extension of generalized linear models (Liang and Zeger, 1986) that consists of minimizing the square of the generalized residuals[4] that are normalized by the matrix of their variance. The variance of the generalized residuals is written as a function of an unknown working matrix that describes the time correlation and must also be estimated. All estimations are obtained in a step-by-step approach by estimating the coefficients and determining the generalized residuals to provide the required matrix. This process continues until all of the parameters converge. For (1) (the probability of using care), we assume that $v_i^1+\varepsilon_{i,t}^1$ is normally distributed; for (2) and (3), we assume that f is exponential without making assumptions about v_i^2 and $\varepsilon_{i,t}^2$, v_i^3 and $\varepsilon_{i,t}^3$. The GEE method provides more robust estimations, but the estimators are less efficient than those of parametric methods.

Second, a maximum-likelihood random effect model (RE-MLE) may be applied to determine the estimators. For (1), we assume that v_i^1 and $\varepsilon_{i,t}^1$ are normally distributed. For (2), v_i^2 is normally distributed, and $\varepsilon_{i,t}^2$ has a truncated negative binomial law. Finally, for (3), v_i^3 and $\varepsilon_{i,t}^3$ are normally distributed.

The GEE and RE-MLE methods provide similar estimators and standard errors. However, the RE-MLE method does not converge for all types of care in model (2). In the following section, we present and discuss the results obtained using the GEE method[5] .

4. Results

4.1. Effects of ECHI

The effects of ECHI on the dimensions of healthcare consumption (1), (2) and (3) according to the length of enrollment are presented in Table III.

4.1.1. (1) The probability of using care

ECHI has significant effects on the probability of using at least one type of outpatient care. This effect appears to decrease significantly with the length of enrollment but remains highly significant throughout the five semesters: from +4.3 points during the first semester of enrollment to +2.6 points during the fourth semester and +1.6 points during the fifth semester.

A similar trend is observed for nearly all types of care (except for prescription drugs). For instance, ECHI offers important additional reimbursements for dental and optical care, and the effect is significantly high during the first semester of enrollment: +7.4 points (dental care) and +5.9 points (optical care) (*cf.* Table 3). The probability of pur-

[4] These residuals correspond to the difference between the explained variables and its expectancy conditional on the explanatory variables.

[5] The results obtained using the maximum likelihood method are available upon request.

Table 3. The effect of supplemental health insurance on healthcare consumption according to the length of enrollment (GEE estimates)

		a) Probability of utilization			b) Number of uses conditional on use			c) Cost per use		
		ME (points)	Pr. (ME=0)	Pr. (ΔME=0)	ME (%)	Pr. (ME=0)	Pr. (ΔME=0)	ME (%)	Pr. (ME=0)	Pr. (ΔME=0)
Outpatient care	1st semester	4.3	***		7.6	***		12	***	
	2nd semester	3.9	***	ns	3.4	**	**	11.5	***	ns
	3rd semester	3.4	***	*	4.3	**	*	7	***	***
	4th semester	2.6	***	***	1.8	ns	***	6.7	***	***
	5th semester	1.6	*	***	2.7	ns	**	3	ns	***
	Ref. Without ECHI (predicted value)	**90.4 pts**			**22.9 uses**			**34.1 euros**		
Physician care	1st semester	4.3	***		3.5	***		0.7	*	
	2nd semester	4.1	***	ns	1.3	ns	ns	0.1	ns	ns
	3rd semester	3.4	***	ns	0.9	ns	ns	0	ns	ns
	4th semester	2.6	***	**	-0.1	ns	*	-0.4	ns	*
	5th semester	1.8	*	***	0.8	ns	ns	-1.0	ns	**
	Ref. Without ECHI (predicted value)	**81.6 pts**			**4.9 uses**			**21.4 euros**		
Dental care	1st semester	7.4	***		20.0	***		21.3	***	
	2nd semester	4.7	***	--	8.8	***	***	34.6	***	**
	3rd semester	3.7	***	---	7.3	***	***	12.1	***	*
	4th semester	2.8	***	---	6.2	***	***	21.5	***	ns
	5th semester	1.0	ns	---	7.7	***	***	13.7	**	ns
	Ref. Without ECHI (predicted value)	**24.6 pts**			**2.2 uses**			**124.5 euros**		
Prescription drugs	1st semester	3.4	***		1.6	***		-1.5	ns	
	2nd semester	3.7	***	ns	2.2	ns	ns	-0.7	ns	ns
	3rd semester	3.2	***	ns	4.1	ns	*	0	ns	ns
	4th semester	2.3	***	ns	1.2	ns	ns	-1.4	ns	ns
	5th semester	1.2	Ns	--	4.8	**	*	-1.5	ns	ns
	Ref. Without ECHI (predicted value)	**80.5 pts**			**9.0 uses**			**25.2 euros**		
Optical care	1st semester	5.9	***		6.3	***		10.1	***	
	2nd semester	3.8	***	**	6.3	***	ns	12.3	***	ns
	3rd semester	3.5	***	**	3.4	Ns	ns	7.4	**	ns
	4th semester	2.5	***	***	1.4	Ns	*	6.3	*	ns
	5th semester	2.3	***	***	3.7	Ns	Ns	7.4	*	ns
	Ref. Without ECHI (predicted value)	**11.3 pts**			**2.5 uses**			**130.6 euros**		

ME: marginal effect (in points or as a percentage).
Pr.: probability that the marginal effect is equal to 0; p<0.01: ***; 0.01<=p<0.1: **; 0.1<=p<=0.5:*; ns : p>0.5 Pr. (ΔME = 0): Probability that the ME of the first semester of enrollment is equal to the ME of semesters.

chasing prescription drugs is also significantly higher for the ECHI insured (and does not significantly decrease over time, except during the fifth semester) despite the fact that ECHI does not directly increase the insurance coverage for drugs.

4.1.2. (2) The number of uses conditional on use

ECHI appears to have a significant influence on the number of times a subscriber uses outpatient care. This effect is strong and significant only during the first three semesters of enrollment; the number of uses increases by nearly 8% during the first semester after enrollment. This effect decreases over time and is non-significant after the fourth semester of enrollment.

Interestingly, the decreasing marginal effect is sharp for physician and optical care as ECHI effects are only significant during the first semester of enrollment (respectively +3.5% and +6.3%). For prescription drugs, no trend is clearly observed (the effects range from +1.2% to +4.8%). For dental care, ECHI effect is significantly large (+20.0%) during the first semester of enrollment and remains significant during the fifth semester (+7.7%) although this effect decreases over time.

4.1.3. (3) The cost per use conditional on use

ECHI significantly affects the cost of outpatient care particularly during the first year (+12%) and remains significant during the first two years of enrollment.

The effect of ECHI on the cost of care is primarily driven by its effects on dental and optical care. For dental care, ECHI significantly increases the cost per unit (+21.3% for the first semester of enrollment and +34.6% for the second semester). The increase between the two first semesters of enrollment is significant and may result from constraints such as delays in obtaining dental appointments and treatments duration. During the following semesters, the effect of ECHI becomes smaller but remains significant (between 12% and 21%). For optical care, the effect is significant and rather high during the two first semesters of enrollment (+10% and +12%, respectively), then becomes smaller but remains significant during subsequent periods.

4.2. Effects of other covariates

The effects of the main covariates are presented in Table 4.

4.2.1. Effect of age and gender

For outpatient care, squared age has a positive effect on the probability of using at least one type of outpatient care: the probability of use increases sharply with age. However, the effect of age differs by type of care.

For physician care, the probability of use and the number of uses follow a U-shaped trend (with the minimum at 29 years and 35 years, respectively), whereas the cost per use conditional on use varies according to an inverse U shape (maximum at 42 years). For prescription drugs, we observe a similar pattern in the probability of use and the number of uses of these drugs, whereas age has a linear positive effect on the cost per use. For optical and dental care, both the probability of use and the cost per use vary

Table 4. The effect of the main explanatory variables

		Probability of utilization		Number of uses conditional to use		Cost per use conditional on use	
		"ME (points)"	"Pr. (ME=0)"	"ME (%)"	"Pr. (ME=0)"	"ME (%)"	"Pr. (ME=0)"
Outpatient care	Age	-0.0843	ns	-2.4620	***	+3.8589	***
	Age2	+0.0037	***	+0.0420	***	-0.0293	***
	Women (ref: men)	+5.22	***	+34.05	***	-2.63	***
	income (ref: <1350€ per month)						
	From 1350€ to 1790€	+3.73	***	+8.75	**	-0.63	ns
	From 1790€ to 2240€	+3.61	***	+5.53	ns	+1.34	ns
	From 2240€ to 3110€	+1.78	*	+1,26	ns	+5.61	**
	> 3110€	+0.86	ns	-8.40	*	+8.84	***
	Ref. Without ECHI (predicted value)	**90.4 pts**		**22.9 uses**		**34.1 €**	
Physician care	Age	-0.4167	***	-2.2972	***	+0.3798	***
	Age2	+0.0073	***	+0.0326	***	-0.0045	***
	Women (ref: men)	+7.85	***	+26.63	***	+3.84	***
	income (ref: <1350€ per month)						
	From 1350€ to 1790€	+6.66	***	+0.33	ns	+3.12	***
	From 1790€ to 2240€	+6.12	***	-3.78	ns	+5.72	***
	From 2240€ to 3110€	+3.70	***	-6.33	*	+7.85	***
	> 3110€	+2.47	*	-13.71	***	+15.52	***
	Ref. Without ECHI (predicted value)	**81.6 pts**		**4.9 uses**		**21.4 €**	
Dental care	Age	+1.2689	***	-0.2172	ns	+6.1230	***
	Age2	-0.0115	***	+0.0010	ns	-0.0447	***
	Women (ref: men)	+4.67	***	-2.45	*	+0.61	Ns
	income (ref: <1350€ per month)						
	From 1350€ to 1790€	+2.78	***	-0.87	ns	-4.02	Ns
	From 1790€ to 2240€	+5.61	***	-1.46	ns	-3.29	Ns
	From 2240€ to 3110€	+5.90	***	-4.32	ns	-6.91	Ns
	> 3110€	+11.05	***	-3.03	ns	-3.87	Ns
	Ref. Without ECHI (predicted value)	**24.6 pts**		**2.2 uses**		**124.5 €**	
Drugs	Age	-0.6324	***	-1.7494	***	+1.3459	***
	Age2	+0.0106	***	+0.0346	***	+0.0020	Ns
	Women (ref: men)	+8.37	***	+29.89	***	-7.84	***
	income (ref: <1350€ per month)						
	From 1350€ to 1790€	+5.40	***	+7.80	**	-1.40	Ns
	From 1790€ to 2240€	+4.40	***	+4.85	ns	-6.60	**
	From 2240€ to 3110€	+1.38	ns	+0.35	ns	-6.18	*
	> 3110€	-1.01	ns	-10.74	**	-14.80	***
	Ref. Without ECHI (predicted value)	**80.5 pts**		**9.0 uses**		**25.2 €**	
Optical care	Age	**+0.6120**	***	**-0.1497**	**ns**	**+4.3711**	***
	Age2	**-0.0051**	***	**-0.0015**	**ns**	**-0.0297**	***
	Women (ref: men)	**+4.00**	***	**-0.62**	**ns**	**+12.05**	***
	income (ref: <1350€ per month)						
	From 1350€ to 1790€	**+1.29**	**	**-0.46**	**ns**	**+0.24**	**Ns**
	From 1790€ to 2240€	**+2.83**	***	**+1.25**	**ns**	**+4.02**	**Ns**
	From 2240€ to 3110€	**+4.09**	***	**+0.63**	**ns**	**+14.68**	***
	> 3110€	**+3.33**	***	**-0.99**	**ns**	**+22.76**	***
	Ref. Without ECHI (predicted value)	**11.3 pts**		**2.5 uses**		**130.6 €**	

The effects of ECHI are expressed in percentage points for the probability of use and as a percentage for the number of uses conditional on use and the cost per use. For the probability of use, the number of uses conditional on use and the cost per use, the first column presents the effect of ECHI, and the second column indicates the significance of the effet as follows: *** significant à the 0.1% level;** significant at the 1% level; and *: significant at the 5% level.

following an inverse U pattern, whereas age has no effect on the number of uses conditional on use.

Being a woman significantly increases the probability of using care, regardless of the types of care. However, the gender effect on the number of uses and the cost per use varies according to the type of care; women use physician care and prescription drugs more frequently but use dental care significantly less, and there is no significant difference for optical care. Women have significantly higher cost per use for physician and optical care and lower costs for drugs.

4.2.2. Effect of income

The probability of using at least one type of outpatient care varies with income following an inverse U shape: compared to the poorest individuals in our population (<1350€ per month), the probability of using care is significantly higher of +3.7 points for those in the second income bracket (between 1350€ and 1790€ per month) and of +1.8 points for those in the fourth income bracket (between 2240€ and 3110€ per month). For the highest income bracket, the income effect is no longer significant.

A similar pattern is observed for the probability of using physician care and drugs. Indeed, the largest effect is observed for the second income bracket (+6.7 points for physician care and +5.4 points for prescription drugs) and differences observed between the wealthiest and the poorest individuals are weak or insignificant. For optical and dental care, the probability of using care always increases with income.

An inverse U shape is also observed for the number of uses of outpatient care, including prescription drugs; individuals from the second income bracket have, ceteris paribus, the highest number of uses. In contrast, individuals who earn more than 3110€ per month have the lowest number of uses, and the difference is significantly lower than that for the poorest individuals. For physician care, the number of uses decreases with income, whereas income has no significant effect on dental and optical care number of uses conditionally to use.

Finally, the cost per use of physician and optical care increases with income, and for prescription drugs, the cost per use decreases.

5. Discussion

In this paper, we estimate the marginal effect of additional health insurance coverage on healthcare consumption, and more interestingly, we examine the persistence of this effect over time separating healthcare consumption into three dimensions: the probability of using care, the number of uses conditional on use and the cost per use. This study, the first utilizing French data, is also interesting due to both the length of our observation period (more than two years for the first subscribers) and the design of our study; we consider the marginal effects of supplementary health insurance coverage (Blomqvist, 2001), while previous research such as Nyman (1999b) compared the insured and uninsured. This difference is particularly relevant in France, where more than 90% of individuals have purchased CHI in a market where contracts are highly heterogeneous.

Our paper presents several findings: first, we highlight that ECHI has an immediate and positive effect on the three dimensions of healthcare consumption and that the relevance and the magnitude of this effect vary depending on the type of care. Second, our analyses indicate that this positive effect on outpatient consumption significantly decreases over time, supporting the pent-up demand assumption.

5.1. The effect of ECHI according to the type of care

For physician care, little to no effect is observed on the number of uses and the cost per use conditional on use, whereas the probability of using physician care increases significantly. As the average cost per use for physician care (maximum +0.7%) increased less rapidly than the number of uses (maximum +3.5%), we conclude that the increase in insurance coverage has not led subscribers to choose more expensive doctors but has increased access to physicians.

While the contract does not offer additional coverage for prescription drugs, it is interesting to note the significance of ECHI its effect on drugs expenses. This effect likely results indirectly following the increase in physician care: in France, the ratio of visits resulting in the prescription of drugs is higher than in any other European country: 90% of consultations produce a prescription, compared to 83.1% in Spain, 72.3% in Germany and 43.2% in the Netherlands (HCAAM, 2006).

For dental and optical care, ECHI strongly and positively influences the consumption regardless of the dimension (1), (2), and (3) considered. These effects reflect high copayments remaining after the reimbursements of both PHI and BCHI for dental and optical care. ECHI reduces these copayments and facilitates access to care in different ways. First, one can consider the short term "postponing behavior" and/or the access to treatments previously unaffordable. Second, one can also consider individuals already using optical and/or dental care prior to the ECHI subscription and who decide to buy more expensive care either to improve quality (assuming that the price per unit is a proxy of the quality for dental prostheses, for instance) or to opt for more expensive goods (optical frames).

5.2. The pent-up demand assumption

Another important result of the paper is the study of moral hazard over time. Our results emphasize that after an initial increase in healthcare consumption, the effect of health insurance significantly decreases over time, illustrating the catching up phenomenon (Long *et al.*, 1998). The pent-up demand effect is particularly relevant for the probability of using care (1), whatever the type of care but especially for dental and optical care. The pent-up demand effect is also relevant to the number of uses conditional on use (2), and is arguable for the cost per use conditional on use (3).

The overall effect of ECHI on the probability to use outpatient care corresponds to an increase in access to care mainly driven by an improvement in access to physician care but also by a high increase in access for dental and optical care. For these types of care, high extra fees are the most common, and individuals probably exhaust their

healthcare needs that they could not afford prior to enrollment. It is also possible that the announcement of the ECHI may have resulted in a short term "postponing effect" even if we did not actually distinguish these effects.

Another important result is that there is still a significant and positive effect of ECHI at the end of our observation period. Indeed, the increase in insurance coverage has persistent effects on the probability to use care (1), the number of dental care uses conditional on use (2) and the dental and optical costs per use conditional on use (3). These results can reflect three types of behaviors: first, the increase in insurance coverage may permit sustainable access to previously unaffordable healthcare; this could be especially true for the access of optical and dental care. For instance, vision problems, such as some chronic diseases, lead to regular predictable (to some extent) and rather high expenses which could discourage the initiation of care prior to subscribing to ECHI and this may explain why no ECHI subscribers gave up the contract (during the observation period). In other words, the increase in the coverage did not lead to an opportunistic behavior which would correspond to wait until becoming acutely ill to purchase insurance, use it for the duration of the illness and then drop it. Second, the remaining significant effect of ECHI over time may also reflect moral hazard due to an effective reduction in the price of care. Concerning the optical care per unit cost, the permanent effect may reflect a preference for expensive goods like optical frames revealed by the price effect. Third, but less likely, the length of our observation period may be too short to observe convergence of ECHI healthcare consumption to the level of those who have not subscribed.

Despite these interesting results, our research remains limited in some respects. Even if the robust econometric model with the Chamberlain specification used on panel data allowed us to control for a large part of adverse selection bias, it did not allow us to control for the additional potential bias resulting from the insurance decision and unobserved heterogeneity that varies over time. Consequently, the effect of ECHI on healthcare consumption may be overestimated. This could be the case if a health shock occurred during our observation period leading to both the enrollment in ECHI and an increase of healthcare consumption. Another limitation of our study concerns the observed population (i.e., civil servants and their relatives), which is not perfectly representative of the general population. However, this specificity is not likely to significantly affect the trends in the results if the observed population does not have a specific change in healthcare consumption from ECHI enrollment.

Finally, we observe the effect over time of a shift from one specific health insurance plan to another and show that an increase in health insurance coverage has transitory positive and significant effect for the access to some type of care like physician care and drugs while the effect appeared to be more persistent in terms of access and per unit cost for dental or optical care. To go further, future research could analyze the effect of a shift from any level of coverage to any other to estimate the price elasticities per type of care.

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Table des illustrations

Figure

Tables

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  Irdes, *Questions d'économie de la santé* n° 190, septembre 2013.

Supplemental health insurance and healthcare consumption: A dynamic approach to moral hazard

Surcomplémentaire et consommation de soins : une approche dynamique de l'aléa moral

Carine Franc, Marc Perronnin, Aurélie Pierre

We analyze the existence and persistence of moral hazard over time to test the assumption of pent-up demand. We consider the effects of supplemental health insurance provided by a private insurer when added to compulsory public insurance already supplemented by private insurance. Using panel data from a French mutuelle, we compute error component models with the Chamberlain specification to control for adverse selection. By separating outpatient care consumption into (1) the probability of healthcare use, (2) the number of uses conditional on use and (3) the per-unit cost of care, we provide evidence that supplemental insurance is significantly and positively associated with (1), (2) and (3). However, these effects decrease significantly over time. This pattern supports the existence of pent-up demand, the magnitude of which varies greatly and depends on the dimensions (1), (2) and (3) and the type of care (physician care, prescription drugs, dental care or optical care).

* * *

Selon l'hypothèse d'une pent-up demand, la demande de soins de santé n'est pas constante au cours du temps. Le phénomène d'aléa moral, qui se caractérise par une hausse des dépenses de santé suite à l'augmentation du niveau d'assurance, peut donc être particulièrement élevé juste après une hausse de l'assurance et s'atténuer ensuite au cours du temps. Dans ce papier, nous analysons l'existence et la persistance de l'aléa moral sur une période donnée suite à la souscription d'une surcomplémentaire santé fournie par un assureur français privé, qui complète l'assurance maladie obligatoire et une complémentaire santé dite « de base ». Nous modélisons les dépenses de santé par des modèles de panel à erreurs composées en utilisant l'approche de Chamberlain pour contrôler au mieux de la sélection adverse. En distinguant dans la consommation de soins ambulatoires (1) la probabilité de recours aux soins de santé, (2) le nombre de recours conditionnellement au fait de consommer, (3) le coût par unité de soins, nous montrons que la surcomplémentaire est significativement et positivement associée à (1), (2) et (3) et que ces effets diminuent au fil du temps, confirmant ainsi l'hypothèse d'une pent-up demand mais dont l'ampleur varie fortement selon les 3 dimensions et les postes de soins (soins médicaux, prescription de médicaments, soins dentaires ou optiques).

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