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Martí Oliva
Misericòrdia Carles

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Universitat Rovira i Virgili
Facultat de Ciències Econòmiques i Empresarials
Avgda. de la Universitat, 1
43204 Reus
Tel.: +34 977 759 811
Fax: +34 977 300 661
Email: sde@urv.cat

CREIP
www.urv.cat/creip
Universitat Rovira i Virgili
Departament d'Economia
Avgda. de la Universitat, 1
43204 Reus
Tel.: +34 977 558 936
Email: creip@urv.cat

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Price policies and Price dispersion in the private healthcare insurance industry: The Catalan case.

M. Oliva and M. Carles*[1]

Abstract

We present an overlapping generations model that explains price dispersion among Catalonian healthcare insurance firms. The model shows that firms with different premium policies can coexist. Furthermore, if interest rates are low, firms that apply equal premium to all insureds can charge higher average prices than insurers that set premiums according to the risk of insured.

Economic theory, health insurance, health economics

1. **Introduction.**

More than a fifth of the Spanish people have double health coverage. These people pay an insurance premium to use private healthcare services, in addition to the taxes they pay to finance the *National Health System* (or "*Sistema Nacional de Salud*"), a public healthcare mechanism that provides universal coverage. They pay a double coverage for the greater number of healthcare providers to choose from, the better hospital accommodations, and the shorter waiting lists offered by private healthcare providers.

The private insurance entities that provide healthcare evolved from early co-operatives of doctors who give people comprehensive healthcare in exchange for a fixed fee (or *iguala*). Today, the sector consists of corporations, which account for more than 85% of all health insurance premiums, on the one hand, and mutual organizations, which keep a market share of the 15% remaining, on the other.

In the last decades, the health insurance industry is affected by the incorporation of numerous insurers already operating in other branches of the insurance business. Since then, the entities present in the industry are divided into two groups, those with experience in hospital and health management and those that have wide knowledge of risk management.

The latter introduced an innovation in pricing in the health insurance industry, which consisted in setting premiums according to risk of the insured, rather than to apply the same premium to all insureds, used by insurers specialised in healthcare management. The risk is distributed primarily on the basis of age, since an older age

[1] *Departament d'Economia. Facultat de Ciències Econòmiques i Empresarials. Universitat Rovira i Virgili. Av. Universitat, s/n, 43204. REUS. martin.oliva@urv.cat, misericordia.carles@urv.cat.

was associated with a higher accident rate. Most traditional insurers in the health sector will progressively adopt this price policy. The premiums established from actuarial criteria divide the population by age groups. Price lists vary between companies, but in general, older aged insured means higher premium, without any benefits for long lasting clients. The price difference between the premium paid by an insured 60 years old and the one charged on another who is 40 years old can reach 170%.

Conversely, with a policy of equal premiums, all insureds pay the same amount, regardless of age. Only if the insured contracts insurance in old age for the first time, the price includes a charge that can be 120% higher. In addition, insurance companies will only accept the new member if it demonstrates that he has no chronic disease.

The policy of equal premium implies intertemporal price discrimination, because although the health cost of old people is higher, all consumers are charged the same price. With this policy, insurer costs are spread over more insured people and the old ones can be charged a lower price. Therefore, insurance firms that apply the same premium regardless of age will have more population at risk than the others insurers. So they will have higher average costs and will charge higher prices. At first sight this reasoning suggests that those insurance firms can not compete with insurers that apply actuarial criteria to set premiums. But this conclusion is not correct. In certain circumstances, particularly in times of economic growth, to set a constant premium, regardless of the insured risk group, is beneficial for the insurance company.

In the health insurance market, consumers face switching costs (Klemperer, 1987) to change insurer. These switching costs that hinder the mobility of clients among insurance companies are of two types. On the one hand, health insurance policies contain clauses or penalties in terms of waiting periods, usually two years, for certain services not covered in certain health risks. Secondly, the insured also suffers switching costs when changes of insurance company if it requires to change also of healthcare provider and forego the benefits of an idiosyncratic relationship. However, this type of switching costs, seems to have a reduced impact on consumers' decisions regarding the hired company, because doctors and hospitals are bound simultaneously by contract with various entities.

In this paper, we analyze the effect of the price policy of the insurance firm healthcare provider on the average premium charged and the welfare advantages of each price policy, premium by age or equal premium to all policyholders, regardless of insured risk[2]. We perform the analysis from an overlapping generations model, which incorporates a competitive insurance sector, that has two kinds of insurers with different price policies. Insurers that apply equal premium to all insureds have more aged policyholders and higher average costs than the ones that set premiums by risk group of insured. As in the standard overlapping generations model (Diamond, 1965), we define two periods in the duration of the contract between the insurance company and the consumer, his youth, which corresponds to the working life of the insured and the old age stage, which corresponds to retirement. For any insured, income is usually higher in the first period than in the second, while health costs evolve in the opposite way.

We illustrate the analysis with data from Catalonia, a Spanish autonomous region where the private health system is particularly developed, as about 25% of people have double coverage, a percentage higher than the Spanish average. We present some data from insurers in Catalonia for the period 2002-2008 in the next point. The explanatory model is shown in point 3. Point 4 is reserved for conclusions.

[2] In Oliva and Carles (2008) we perform the analysis of private health insurance industry from another approach based on product differentiation.

2. Private Insurance entities which provide Healthcare services in Catalonia.

The health system in Spain is decentralized: The competencies of the government on health are transferred to autonomous regions. So, the Catalonia government (*La Generalitat*) is the governmental body that holds regulation and control on the Catalan healthcare system.

The importance of the private health sector in Catalonia explains that *La Generalitat*, through *La Direcció General de Recursos Sanitaris* (DGRC), develops from 2002 an annual report, "*Entitats d'Assegurança Lliure d'Assistència Sanitària*" ("*Private Insurance entities which provide Healthcare*") which presents, in a systematic way, data for the firms operating in the health insurance industry. Since not all regions of Spain offer the same statistical information, we have limited the study to Catalonia.

Further, we analyze only the relevant category of insurance plans that provide health services, which establish a contractual relationship between healthcare providers, hospitals and doctors, and the insurance company (similar to USA 'managed care'). These contracts account for approximately 90% of all health insurance plans in Catalonia as well as in Spain. Health insurance contracts that provide reimbursement of expenses ('traditional health insurance plans' in the United States) only account the remaining 10%. This way, in year 2000, 5.052.490 Spanish consumers have insurance contracts with provision of health services, while only 778.402 consumers have insurance plans with reimbursement of expenses, according to DGRC (2002-2008).

The serie of annual reports "*Entitats d'Assegurança Lliure d'Assistència Sanitària*" show that the three largest insurance companies control almost a 40% of the health insurance market that provide health services, a 37%, to be precise, in 2008. Two of them, *Sanitas* and *Adeslas*, set premiums with actuarial standards and the other, *Assistència Sanitària Col·legial* (ASC), use the price policy of the same premium for all policyholders, independent of the insured risk characteristics. The data from these three companies in the period 2002-2008 can thus illustrate the effects of different pricing policies.

The higher revenues insurer's is ASC whit a 14% of the market; Sanitas has a share of 12% and Adeslas the remaining 11%. In 2002 ASC controlled the 16% of the market, while the two other insurers, Adeslas and Sanitas, kept a 19%. The share increase of Adeslas and Sanitas dont implies a perceptible decrease in the market share of ASC, but arises mainly due to the loss of market share of small insurance companies.

Between 2002 and 2008, ASC has an increase of 4%, very small, in the number of insured, up to 200,000 people. The average premium calculated as the ratio between revenues and number of insured increases by 25%, from 666 to 831 € and the revenue from premiums growths a 29%, reaching 166 million € in 2008. In annual rate, ASC revenues increased almost 4%. For the set of the other two insurers, the average premium increases in the period 2002-2008 a 27%, from € 476 to € 607, the number of insureds grew by 50% and revenue increased 90%, with an annual revenue growth rate of 10%.

ASC has charged premiums, calculated as revenue divided by the number of insureds, significantly higher than the firms that charge premiums according to actuarial criteria, Adeslas and Sanitas. Notwithstanding ASC increased the number of insured people and don't loss remarkable market share. Adeslas and Sanitas have increased their market share from 19% to 23%, through the better prices they offer to young consumers, who are the bulk of the new insured population. But consumers concerned about high prices when they become older, prefer the policy of the same premium for all, which implies a smooth growth of prices.

Most of the insurance industry set premiums according to the insured risk. For the set of all insurance companies, the average premium increased by 33% in the period 2002-2008, from € 487 to € 648, the number of insured people by 17% and revenue by 56%, with a annual revenue growth rate of 6%. In the same period, the Euribor, the european benchmark interest rate, has fluctuated between 1.2% and 5.2%, with an average of 3.27%, well below insurers annual revenue growth rate.

In times of economic growth the rate of increase of new insureds is higher than the interest rate and a price policy of the same premium for all consumers will be advantageous to insurance firms, because the increase in the number of new insureds can finance more easily than the capital market the expenses of old insureds. The overlapping generations model developed in the next point explains this intuition more clearly.

3. A model of Private Insurance entities that provide Healthcare services.

The Overlapping Generations (OLG) Model (Diamond, 1965) analyzes the interaction in a decentralized market economy, of individuals from different generations[3]. The standard OLG model is very stylized. Each individual lives two periods, youth and old age. Every period there is only a good, which can be consumed or accumulated. This good is manufactured by a set of competitive firms, from capital and labour rented by the consumers, the owners of resources.

We add to the standard OLG model that any individual has the possibility of becoming sick and can get insurance to cope with the loss that illness entails[4]. The probability of getting sick is higher if the individual is old than if he is young. That is, in the paper, the risk group is defined exclusively from age. The insurance sector is competitive, with two kinds of insurers that apply different price policies, equal premium to all, regardless of policyholdeer risk, or premiums by risk group of insured. The model enables us to analyze under what circumstances can coexist in equilibrium both types of insurance firms. In the rest of this section we present first the assumptions of the model in detail and later we solve it.

To simplify, we take the most common functional forms in OLG models for consumer preferences (logarithmic utility function) and for the aggregate production function (Cobb-Douglas production function).

2.1. Assumptions

Fundamentals of the overlapping generations economy.

It is a model of decentralised economy. There is only good in the economy, which can be consumed or accumulated. Time is discrete, t=0, 1,... N_t individuals are born at t. The rate of population growth is n: $N_{t+1} = (1+n)N_t$.

Individuals.

Each individual lives two periods. In each period it has one age: age 1, when the individual is young, and age 2, when it is old. N_{t-1} old individuals and N_t young individuals are living in period t. Therefore, the total population at t will be

$$P_t = N_{t-1} + N_t = N_t\left(1+\frac{1}{1+n}\right).$$

[3] Artus and Legros (1999) provide a detailed analysis of overlapping generations models.

[4] There are applications of overlapping generations models to long term healh care insurance. See, for exemple, Meier (1999) or Johansson (2000). However, unlike these models, we considerer rental factor prices as endogenous.

Individuals work only when they are young, each offering inelastically a unit of work in exchange for a real wage. The wage of one born in t is w_t. The individual spends part of that income when young and saves the rest, s_t, to finance the expenditures of older age. In the OLG economy there is a financial market that allows individuals to transfer income between periods to smooth their consumption stream. The interest rate that generates the savings of a young consumer at t, recovered with interests in t+1, is i_{t+1}. To obtain this yield on savings, when individuals are old rent it as capital to the firms.

When the individual is old, in the second stage of his life, has a positive probability of falling sick, $\theta > 0$. This event has a cost for him of x_{t+1}, which is proportional to the income over his life, and has an expected value of $E_\theta x_{t+1}=\theta x_{t+1}$. In particular, we assume that the cost of illness is proportional to the wage earned when the individual is young and to the yield on savings, $x_{t+1}=\gamma w_t(1+i_{t+1})$, with $w_t>x_{t+1}>0$, because higher wages imply higher expenses in the health services sector (the health provider also earns more) and higher interest rates imply higher credit costs. As γ is the ratio cost of getting sick over the individual's working life-capitalised earnings, we assume that its value is near 0. When the consumer is young, the chance of disease is zero. The assumption that young people don't face risk of loss is for simplifying purposes and it should be understood as a limiting case.

Individual's consumption will have two subscripts, age and period. An individual born at t consumes c_{1t} in period t, when it is young, and c_{2t+1} in period $t+1$, when it is old and gets a utility on his life:

$$U_t = u(c_{1t}) + \varphi u(c_{2t+1}), \quad 0 < \varphi = (1+\rho)^{-1} < 1, \quad u' > 0, u'' < 0$$

The parameter φ is the factor of time preference and ρ is the associated rate. We will assume that the felicity function $u(c)$ is isoelastic and, in particular, logarithmic, $u(c) = \ln c$. When the consumer is old, the function $u(c)$ also expresses preferences over states of the world, so that it works as a von Neumann - Morgenstern and Bernoulli utility function. Because the function $u(c)$ is strictly concave, the typical consumer is risk averse.

Firms.

A large number, M, of identical competitive firms produce at t = 0, 1, ... the only output of the economy, Y_t. To carry out the production at t, the old consumers rent them capital, K_t, at price r_t and the young ones rent work, with price w_t. That is, the saving of young people at $t–1$, $S_{t-1} \equiv s_{t-1}N_{t-1}$, where s_{t-1} is individual savings at t–1, becomes the capital stock at t, K_t, used by firms, in combination with the work of N_t young at t, to produce output, Y_t. To simplify notation, we assume no capital depreciation, δ=0. Then, the profits of any firm are:

$$\pi = \Pi/M = [F(K, N) - rK - wN]/M$$

The aggregate production function of the economy $Y_t.=F(K_t, N_t)$ is increasing and concave in both inputs and displays constant returns to scale with respect to the variables K_t and N_t, so it can be represented in intensive or per worker form, $y_t= Y_t/N_t$:

$$y_t = F(k_t, 1) = f(k_t)$$

From the properties of marginal products, the intensive production function satisfies:

$$\frac{\partial F}{\partial K} = f'(k) > 0 \qquad \frac{\partial F}{\partial N} = f(k) - f'(k)k > 0 \qquad f''(k) < 0$$

We assume, in particular, a Cobb-Douglas technology, $Y=AK^{\alpha}N^{1-\alpha}$, or in per worker terms, $y=Ak^{\alpha}$.

Insurance Firms.

There is a competitive health insurance sector in the overlapping generations economy. The assumption of competitiveness seems reasonable. Insurance firms tipically engage in price competition that is more agressive that quantity competition, and leads to more competitive outcomes, i.e., to lower prices and higher quantities.

Each period coexist two sets of competitive insurance firms that differ in the pricing policy used. Group *a* insurers use the policy *a* and group *b* insurers the policy *b*. All the companies in each group are identical, so they use the same policy. The pricing policies reflect that the consumer can pay the health insurance cost only in the age in which he faces risk, or, conversely, can spread the cost over his life.

The individual, when it is young has the option of hiring one of two insurance policies that will maintain when it is old. We suppose there are switching costs that prevent the consumer to change of insurance contract when he becomes old.

- Policy *a*: To prevent the loss x, each consumer pays in each age an insurance premium that depends on the risk in that age. That is, the premium paid is higher when the insured is old that when he is young, $p_{a2}> p_{a1}\geq 0$. Insurance companies that fix premiums according to actuarial approaches apply this price policy. The old consumers have more risk of illness and pay more. We will call it as policy of *premium according to risc* or *premium based on actuarial criteria* or *premium by age*.

- Policy *b*: All consumers, young and old, pay the same premium p_b to the insurance companies. The insurance companies in this group set premiums that are independent of the age of the insured. Therefore, young people with less risk of disease in general finances to the old whom have a higher chance of falling ill. This will be the policy of *equal premium for all* or *the same premium for all*.

At present, most insurance firms set premiums according to the insured risk, i.e., use the policy *a*. And the premium of most insurance policies depends on the insured risk of getting sick. We use the parameter λ, which is close to 1, to denote both, the proportion of insurance firms that apply this policy and the proportion of consumers who have signed contracts with these companies.

Among insurers that operate in the Spanish healthcare market, the insured payment in per capita terms, i.e., the insured payment of only an annual premium, presents a continuous decline. It is usual that, besides the annual premium, the policyholder pays for medical act, but this quantity is, in general, purely symbolic, very small in relation the policy price. For simplicity, we ignore the payment for medical act.

Also for simplicity, assume that insurers operative unit costs are zero. That is, unit costs of insurance firms are due only to pay the coverage when the insured suffers the loss.

In the real world because of financial constraints, lack of liquidity or myopia of consumers, insurance firms applying the policy of *the same premium for all*, regardless of policyholder risk, have a larger proportion of aged insureds that firms who establish *premium according to the client risk*. To capture this fact, we assume in the model that insurers that apply *equal premiums for all* have higher average costs than the ones that use *premiums by age*. To simplify, we assume also that the difference between the average cost of an insurer *b* and the one of an insurer *a* is worth $mw_t(1+i_{t+1})$, with the constant *m* verifying $2m>\gamma\theta>m>0$. Further, we have assumed very small values for the parameters $(1-\lambda)$ and $\xi=\theta\gamma+m$, in the sense that they take values near 0. Furthermore α is less than 1. Then, we synthetize this set of suppositions about parameters, assuming that the product $(1-\lambda)\xi\,\alpha$ is roughly zero, $(1-\lambda)\xi\,\alpha\cong 0$.

2.2. Solution to the overlapping generations model with insurers

Firms

In the profit equation of a competitive firm, *M* is a constant and does not affect profit maximization. A typical firm profit maximization amounts to maximize the representative firm profit:

$$\Pi = F(K_t, N_t) - r_t K_t - w_t N_t$$

The representative firm hires capital and labor each period, considering constant the factors of production rental prices. So the first order conditions of profit maximization, expressed by means of the intensive production function, are:

$$\frac{\partial F}{\partial K} = f'(k_t) = r_t \qquad \frac{\partial F}{\partial N} = f(k_t) - f'(k_t)k_t = w_t$$

Competitive insurers

Given a competitive insurance market, the premium from either, policy *a* or *b*, depends on the expected value of the loss.

With policy *a* each consumer pays in each age an insurance premium that depends on his age. As the insurance market is competitive, insurers *a* representative insurance firm expected value of profits for each insurance contract will be zero. Then for a young consumer, whithout risk of loss, the contract verifies:

$$\pi_{a1}=p_{a1}-0=0$$

And for an old individual, which faces a estrictly positive probabilty of falling sick:

$$E_\theta\pi_{a2}=p_{a2}-E_\theta x=0$$

When the insured is young, he signs the insurance contract, but the premium only is positive when he becomes old, $p_{a2}=p_a>p_{a1}=0$, because if he is young the risk of loss is zero. Therefore,

$$p_a=\gamma\theta w_t(1+i_{t+1})$$

The premium is actuarially fair, so that the risk-averse individual will insure fully.

With policy *b* every insured, old or young, pays the premium p_b to the insurer, so that revenue of insurers *b* representative insurance firm in period t is:

$$I_{b,t}=p_bN_t+p_bN_{t-1}=p_bN_t+p_b\frac{N_t}{1+n}$$

In competitive equilibrium, the expected profits of type *b* representative insurance firm are zero:

$$E_\theta\pi_b=p_bN_t\left(1+\frac{1}{1+n}\right)-\frac{\xi w_t(1+i_{t+1})N_t}{1+n}=0 \qquad \text{where} \qquad \xi=\gamma\theta+m.$$

Therefore, insurers *b* charge a premium worth:

$$p_b=\frac{\xi w_t(1+i_{t+1})}{2+n}$$

The expected value of the loss of each old individual, $\xi w_t(1+i_{t+1})$, is financed from the premium charged to the own individual, p_B, and from the premiums payed for $1+n$ young, $p_B(1+n)$. Assume, momentarily, that the individual get fully insured.

Consumers

The consumption-saving problem of the agent born a t is:

$$\underset{c_{1t},c_{2t}}{Max}U_t \text{ s.t. } c_{1t}+\frac{1}{1+i_{t+1}}c_{2t+1}=z_t$$

where z_t is the individual labor wage when he is young, w_t, minus the actual value of the premiums the insured pays over his life, which depends of the insurance policy that the individual has chosen.

That is, if the consumer selects the policy a:

$$z_t \equiv w_t - \frac{p_a}{1+i_{t+1}}$$

and if his choice is policy b:

$$z_t \equiv w_t - p_b - \frac{p_b}{1+i_{t+1}}$$

The solution of the consumer optimization problem, (c_{1t}^*, c_{2t+1}^*), verifies the first-order conditions:

$$\frac{u'(c_{1t}^*)}{\varphi u'(c_{2t+1}^*)}=1+i_{t+1} \qquad c_{1t}^*+\frac{1}{1+i_{t+1}}c_{2t+1}^*=z_t$$

Solving these first-order conditions for the logarithmic utility function:

$$c_{1t}^*=\frac{z_t}{1+\varphi} \qquad c_{2t+1}^*=\frac{\varphi z_t(1+i_{t+1})}{1+\varphi}$$

So, the saving of a young individual at t is worth $s_t^*=z_t-c_{1t}^*=\dfrac{\varphi z_t}{1+\varphi}$

If z_t depends on the interest rate, so does individual savings. The optimal consumptions according to the insurance policy selected are:

- If the consumer subscribes the insurance policy a:

$$c_{1t}^*=\frac{1}{1+\varphi}z_t=\frac{w_t}{1+\varphi}-\frac{p_a}{(1+\varphi)(1+i_{t+1})} \qquad c_{2,t+1}^*=\frac{\varphi(1+i_{t+1})w_t}{1+\varphi}-\frac{\varphi p_a}{(1+\varphi)}$$

i.e.,

$$c_{1t}^*=\frac{w_t(1-\theta\gamma)}{(1+\varphi)} \qquad c_{2,t+1}^*=\frac{\varphi w_t(1+i_{t+1})(1-\theta\gamma)}{1+\varphi} \tag{1}$$

and the individual saving at t is:

$$s_t^*=\frac{\varphi w_t(1-\theta\gamma)}{(1+\varphi)}$$

- If the consumer chooses policy b his optimal consumptions are:

$$c_{1t}^*=\frac{w_t}{1+\varphi}-\frac{p_b}{1+\varphi}-\frac{p_b}{(1+\varphi)(1+i_{t+1})} \qquad c_{2,t+1}^*=\frac{\varphi(1+i_{t+1})w_t}{1+\varphi}-\frac{\varphi p_b}{1+\varphi}-\frac{\varphi(1+i_{t+1})p_b}{(1+\varphi)}$$

Then:

$$c_{1t}^* = \frac{w_t[(2+n)-\xi(2+i_{t+1})]}{(1+\varphi)(2+n)} \qquad c_{2,t+1}^* = \frac{\varphi w_t(1+i_{t+1})[(2+n)-\xi(2+i_{t+1})]}{(1+\varphi)(2+n)} \tag{2}$$

and the young consumer savings are:

$$s_t^* = \frac{\varphi w_t[(2+n)-\xi(2+i_{t+1})]}{(1+\varphi)(2+n)}$$

Equilibrium

The equilibrium at any period t, requires that the savings of the young consumers at $\forall t$, $\sigma_t N_t$,, which are the supply of capital of the old individuals at t+1, equals the firms demand for capital at t+1, $N_t s_t^* = K_{t+1}$. As a proportion λ of consumers choose the option a and the remainders choose option b, being s_{tj}^* the optimal savings of a consumer who chooses policy j for $j = a, b$, the equilibrium condition becomes:

$$N_t[\lambda s_{ta}^* + (1-\lambda)s_{tb}^*] = K_{t+1} \qquad \lambda \in [0, 1]$$

The interest rate equals the savings of young individuals at t with the demand for capital by firms at t+1; directly, because with policy b the individual savings depends on the interest rate; and indirectly, because the premiums of both types of insurers depend on interest rates. Expressing the equilibrium condition in per worker terms, dividing by $N_{t+1} = (1+n)N_t$, replacing the consumer optimal savings under the contract of insurance selected and simplifiing, we obtain:

$$w_t[2(1-\xi) + n + \lambda(2m - n\theta\gamma) - (1-\lambda)\xi i_{t+1}] = k_{t+1}(1+n)(2+n)(2+\rho)$$

Keeping in mind firms profit maximization condition, the result in a commodity economy which is numerari good, that $i_{t+1} = r_{t+1} - \delta$, and the assumptions δ=0, and a Cobb-Douglas technology, $f(k)=Ak^{\alpha}$, we get the dynamic equation of the OLG economy, which implicitly defines k_{t+1} as a function of k_t:

$$2(1-\xi) + n + \lambda(2m - n\theta\gamma) - (1-\lambda)\xi A\alpha k_{t+1}^{\alpha-1} = \frac{k_{t+1}(1+n)(2+n)(2+\rho)}{A(1-\alpha)k_t^{\alpha}}$$

As we have assumed that the product of parameters $(1-\lambda)\xi\alpha$ is approximately zero, the dynamic equation of the OLG economy can be approximated by the expression:

$$k_{t+1} \cong Bk_t^{\alpha}$$

where $B = \frac{A(1-\alpha)[2(1-\xi) + n + \lambda(2m - n\theta\gamma)]}{(1+n)(2+n)(2+\rho)}$ is a constant and the function $k_{t+1} = Bk_t^{\alpha}$ is estrictly increasing and estrictly concave, $\frac{dk_{t+1}}{dk_t} > 0$, $\frac{d^2k_{t+1}}{dk_t^{\,2}} < 0$. Therefore, the model has similar characteristics to the classic Diamond overlapping generations model with logarithmic preferences and Cobb-Douglas production function.

A steady state is a long-term equilibrium solution where all variables grow at constant rates. Starting from any initial capital, capital per worker converges in the long run to a stationary equilibrium globally stable $k^*=k_t=k_{t+1}$, which is worth

$$k^* = B^{\frac{1}{1-\alpha}}$$

From the previous expressions and from assumptions about the parameters values, it follows also that if λ increases, so do the equilibrium values of B and k. That is, in the stable steady state, capital per capita increases with the proportion of a type insurance firms. Furthermore, if λ=1 the steady state capital per capita is the highest possible and the value of B satisfyies:

$$B = \frac{(1-\theta\gamma)(1-\alpha)A}{(1+n)(2+\rho)}$$

This expression shows that the loss due to illness reduces the equilibrium capital per capita compared to the typical overlapping generations model.

As in steady state capital per capita is constant, so will the production and consumption per capita, wages, interest rates and the premiums that insurers charge. For simplicity, we do not have considered the existence of economic growth in the steady state of the economy. Then, growth rates of per worker variables are zero, $\frac{\Delta k^*}{k^*} = \frac{\Delta y^*}{y^*} = \frac{\Delta c^*}{c^*} = 0$, and aggregate variables grow at the rate of population growth, $\frac{\Delta K^*}{K^*} = \frac{\Delta Y^*}{Y^*} = \frac{\Delta C^*}{C^*} = n$.

Lemma 1. The OLG model with competitive insurers has a stable stationary equilibrium, in which capital, production and consumption per capita, wages, interest rates and premiums charged for insurance firms are constant, with values, respectively, $k^*, y^*, c^*, w^*, r^*, p_a^*, p_b^*$.

<u>Effects on consumption policies.</u>

The results of this paper arise from the consumption differences that both insurance policies provide to a typical consumer in steady state. These differences are, from (1) and (2):

$$c_{1b}^* - c_{1a}^* = \frac{w^*[\theta\gamma(n-r^*) - m(2+r^*)]}{(1+\varphi)(2+n)} \qquad c_{2b}^* - c_{2a}^* = \frac{\varphi w^*(1+r^*)[\theta\gamma(n-r^*) - m(2+r^*)]}{(1+\varphi)(2+n)} \quad (3)$$

Given the typical consumer preferences and whatever the insurance policy selected, in equilibrium, consumption when he is old equals consumption when he is young capitalized at the real interest rate adjusted by the factor of time preference, $(1+r^*)\varphi$. Therefore, differences in consumption generated by the two insurance options, will keep proportionality. We establish formally this result.

Lemma 2. The difference in consumption associated with the two insurance policies when the consumer is old, is proportional to the difference in consumption generated by the two insurance options when he is young, being the constant of proportionality equal to the capitalization factor divided by the discount factor:

$$c_{2b}^* - c_{2a}^* = \frac{1+r^*}{1+\rho}[c_{1b}^* - c_{1a}^*]$$

Proposition 1. The condition $\theta\gamma(n-r^*) \geq m + m(1+r^*)$ is sufficient so that any individual prefers to be fully insured with policy *b* that not being insured.

Proof. If condition $\theta\gamma(n-r^*) \geq m + m(1+r^*)$ is satisfied, from (3) it follows that both consumptions are higher with policy *b*, consumption when the consumer is young and when he is old, so that price policy *b* is preferable to price policy *a*. As the latter is better that not being insured, full insurance with policy *b* is preferable that don't have any insurance.

Corollary 1. In the particular case that m=0 the condition $n>r^*$ is sufficient so that any individual prefers to be fully insured with policy *b*.

Proof. If m=0 and the rate of population growth exceeds the interest rate, consumption in both periods with price policy *b* exceeds consumptions from policy *a*.

This result is an application of the proposition that states that the stationary equilibrium of the decentralized Diamond OLG model is dynamically inefficient if the rate of population growth exceeds the real interest rate.

<u>Coexistence of insurance companies.</u>

In steady state both groups opf insurers will coexist if they provide the same welfare to consumers.

Proposition 2. In steady state the two types of insurers will coexist if and only if the population growth rate minus the real interest rate weighted by the expected cost of the loss, equals the capitalized additional average cost of using policy *b*:

$$\theta\gamma(n-r^*) = m + m(1+r^*)$$

Proof. If this condition is satisfied, consumptions of any consumer in the two stages of his life are the same using either of the two policies as follows (3). The condition is also necessary, because (3) shows that if consumptions coincide with the two pricing policies in any of the two periods, this implies $\theta\gamma(n-r^*) = m + m(1+r^*)$.

To explain this result, we notice that with policy *b* the consumer pays, both when he is young and when he is old, the premium $p_b = \dfrac{\xi w^*(1+r^*)}{2+n}$, where $\xi = \theta\gamma + m$. Discounting the payments to period 1, when the insured is young, we get $p_b + \dfrac{p_b}{1+r^*} = \dfrac{\theta\gamma w^*(2+r^*)}{2+n} + \dfrac{mw^*(2+r^*)}{2+n}$. With policy *a* the consumer pays a positive premium only when he is old. Discounting the payment to his youth, period 1, we get $\dfrac{p_a}{1+r^*} = \theta\gamma w^*$. The difference is worth $\dfrac{p_a^*}{1+r^*} - p_b^* - \dfrac{p_b^*}{1+r^*} = w^*\left[\dfrac{\theta\gamma(n-r^*)}{2+n} - \dfrac{m(2+r^*)}{2+n}\right]$, which is zero only if $\theta\gamma(n-r^*) = m + m(1+r^*)$, and requires $n \geq r^*$, because $m \geq 0$. Then, the expenses from both policies coincide. The individual wealth is the same if the consumer chooses insurance policy *a* or *b*, and he would be indifferent between the two, because the capital market is perfect. Then, the consumer will adjust consumptions over his life according to their time preference factor φ.

Although the average premium calculated as total revenue divided by number of policyholders, that charge insurers *b* is higher than the one charged for insurers *a*, the different pricing policy enables that both insurance firms coexist in equilibrium. The average income of an insurer *b* are superior to those of an insurer *a*, because the first have been assumed more inefficient, with higher unit costs, and the profits of all of them are zero. Thus, if in period *t*, in steady state, the number of insured for all the *a* insurance firms is $N_{t,a} = \lambda_t N_t$, the sum of *a* firms revenues is worth:

$$N_{t-1,a}\theta\gamma w^*(1+r^*) + N_{t,a}0 = N_{t,a}\frac{\gamma\theta w^*(1+r^*)}{1+n}$$

Therefore, the average premium, calculated as income divided by the number of policyholders, young and old, charged for type *a* insurers is:

$$\frac{N_{t,a}\gamma\theta w^*(1+r^*)}{N_{t,a}+N_{t,a}(1+n)}=\frac{\gamma\theta w^*(1+r^*)}{2+n}$$

The premium charged by type *b* insurers to any insured, young as well as old, is the same. Therefore this premium is also the average premium or the revenue by consumer for any type *b* insurance firm, and it is worth in steady state:

$$p_b=\frac{(\gamma\theta+m)w^*(1+r^*)}{2+n}$$

The difference in income or expenses by insured is worth $\frac{mw^*(1+r^*)}{2+n}$, which is the average additional cost for insurance companies of type b. Average revenues are higher for insurers *b*, to meet the average costs, also higher. But, given an insured population growth higher than the interest rate, the discounted value of the premiums paid by a consumer over his life is the same under both policies. Therefore, for any consumer, policy *b* is indiferent to policy *a* and both type of insurance firms, *a* and *b* will coexist in equilibrium.

Alternatively, in the particular case where $m = 0$, the two policies involve the same average unit costs and the average premium, calculated as the ratio of revenues of premiums divided by the number of insured is the same. But for every consumer policy *a* implies a higher discounted cost of insurance. Then, the two groups of insurance firms can not coexist, because policy *a* is less beneficial to consumers that policy *b*.

In policy *b,* as all clients pay the same premium p_b, young insureds finance old insureds, because the youngs pay a positive premium and don't have any risk. This financing drop the present value of premiums paid over the insured life when the rate of population growth exceeds the interest rate. Then, the assured population's growth contributes to finance the system.

4. **Conclusions.**

In this paper, we present an overlapping generations model where the old consumers face a positive probability of getting sick, while the probability of falling ill for young consumers is zero. To meet the illness costs, consumers have a competitive insurance sector, in which there are two types of insurance firms, insurers that apply *the same premium to all* people insured, and insurers that charge *premiums according to the insured risk*.The model explains the relative advantages of both price policies.

With *premiums according to actuarial criteria*, the consumers change in economic conditions or their lack of foresight imply that some of them possibly can not cope with the sharp increase of premium at old age. Then, some consumers will only be insured at time of youth. Arriving on the stage of old age, they will stop to pay for double coverage and will choose the option of only public health. Or, they will try to join insurance firms that apply the price policy of *the same premium for all*, paying a premium higher than the standard, in the event of a favorable medical record. This observation justifies that insurance firms that apply the policy of *equal premium for all* have a higher proportion of elderly, i.e., of people with risk, and, therefore, face higher average costs, than insurers that employ the price policy of *premium according to insured risk*.

With the policy of *equal premiums for all* insureds, young consumers, who don’t face risk of illness, finance old insureds that pay the same premium and have a positive probability of getting a costly disease. That is, the policy presents analogies to a *pay-as-you-go* social security system. In the policy of premium according to risk of insured, only the old pay a positive premium and it is analogous to a fully funded social security system, because consumers have to adjust their savings, depending on interest rates, to face old age and the likely costs of disease.

We show that if the growth rate of insured people exceeds the interest rate, the policy of *equal premium for all* entails a discounted value of the expenses for the insured lower than the policy of *premium according to risk*. This is because the entry of a large number of new policyholders that do not face risk enables smaller premiums for elderly. Then, under these conditions, the policy of *the same premium for all*, allows to charge, without losing market share, a premium (calculated as insurer total revenue divided by the number of insureds) higher than the average premium charged by insurers that set premiums in basis of insured’s risk.

In other words, in times of economic growth and increases in the number of insureds, the insurers that apply a policy of *the same premium for all* can set a premium higher than the average premium charged for insurers that use actuarial criteria, and maintain its market share, because the discounted value of spending is the same under both policies. In the Catalan health insurance market, this fact explains the persistence of ASC in maintaining a pricing policy less aggressive than its two direct competitors.

Alternatively, if the growth rate of insured people decreases and becomes lower than the interest rate, insurers that apply the policy of *the same premium for all* only will keep its markewt share, by lowing the premium charged, i.e., reducing the cost of care, which can result in reduced quality of service. The reduction in the entry of young people prevents they finance efficiently the health of old. In this case, the individual savings through the capital market, allows a smaller discounted value of premiums when they are based on actuarial criteria.

Bibliography.

Artus, P. and F. Legros. (1999). *Le Choix du système de retraite*. Economica.

Diamond, P. A. (1965) “National Debt in a Neoclassical Growth Model”. *American Economic Review*, 55, 5 (Dec), pp.1126-1150.

Direcció General de Recursos Sanitaris (DGRC). Departament de Sanitat i Seguretat Social. Generalitat de Catalunya. (2002-2008). “Entitats d’assegurança lliure d’assistència sanitària” *Memòries.*

Johansson, P-O. (2000). “Properties of actuarially fair and pay-as-you-go health insurance schemes for the elderly. An OLG model approach”. *Journal of Health Economics*. Vol. 19, pp. 477-498.

Klemperer, P. (1987). “Markets with consumer switching costs”. *Quarterly Journal of Economics*, Vol. 15, 3, pp. 485-504.

Meier, V. (1999). “Why the young do not buy long-term care insurance”. *Journal of Risk and Uncertainty*, Vol. 8, pp. 83-98.

Oliva M. and M. Carles (2008). “Price dispersion in the Spanish private health insurance industry”. *Working Paper. Department of Economics. Universitat Rovira i Virgili*. pp. 1-21.