Public versus Private Insurance: a Political Economy Argument.

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Abstract: This paper analyzes the political support for a public insurance in the presence of a private insurance alternative. The public insurance is compulsory and offers a uniform insurance policy. The private insurance is voluntary and can offer different insurance policies to different individual risks. We show that adverse selection on the private insurance market can lead a majority of individuals to prefer public insurance over private insurance, even if the median risk is below the average risk (so that the median ends up subsidizing high-risk individuals). We also show that more risk aversion always leads to a greater political support for public insurance and that a mixture of public and private insurance is politically non sustainable. Lastly, we demonstrate how progressively more powerful information technology may help the private insurance market to mitigate the adverse selection problem and reduce the demand for public insurance threatening its political sustainability.

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1 Introduction

This paper is concerned with the political demand for public insurance when there exist private insurance alternatives. We focus attention on the insurance against the risk of incurring a damage, and to keep the argument clear, we abstract from the possible redistributive element in public insurance.[1] To separate redistribution from insurance arguments, we assume that individuals differ only with respect to their risk (or probability of incurring a damage) without distinguishing the nature of the risk. We can therefore interpret the analysis as regarding the provision of health care insurance when individuals differ in their health status, or the provision of pension annuities when individuals differ in their life expectancy, etc....

There is strong evidence that in the OECD countries the public sector plays an important role in the provision of insurance for health care (see OECD, 1994) and that the retired depend largely on state pensions (Miles and Timmermann, 1999). In most European countries, state pensions are typically 50-80 percent of average earnings. The essential distinction we make between private insurance and public insurance is that private insurance is voluntary and can offer different insurance policies (essentially, premia and coverage rates) to different individuals while public insurance is compulsory and offer the same insurance contract to everyone. There are two good reasons why public insurance is compulsory. First, to overcome the adverse selection problem which would leads the good risks to opt out increasing the average cost of those remaining in the pool. Second, to avoid the so-called Samaritan's dilemma problem according to which if individuals anticipate that the government will provide them with insurance whether or not they insure, this will undermine their incentive to buy insurance.

[1] We can motivate this assumption on the basis of recent empirical work by Lynn Coronado and al (2000) showing that social security has negligible distributive effects

Focusing on the pure insurance element, we derive the majority rule equilibrium between private and public insurance. We proceed in two steps. First we derive the political equilibrium outcome when individuals must choose between a public insurance or a private insurance as exclusive to each other. We obtain the result that for a large family of distributions of risks in the population, a majority will prefer public insurance over private insurance, and that the size of this majority is increasing with risk aversion. In that sense no distributive argument is required to justify the provision of public insurance. In a second step, we consider the possibility for individuals to supplement a (basic) public insurance with a private insurance and individuals can vote over the degree of public insurance. The main result we obtain is that for any distribution of risk in the population, mixing public with private insurance is politically non sustainable in the sense that there is always a majority that would like to push this supplementary system towards either an exclusive public insurance or an exclusive private insurance. This impossibility result of mixing public with private insurance may seem to contradict the well-known argument that some public insurance operates a cross-subsidization from low-risk to high-risk individuals which is beneficial to both types in relaxing the incentive compatibility constraint on the private insurance market (see Mas-colell and al., 1995, p.459; or Eckstein and al., 1985). While this result is correct with two risk levels, our result simply shows that it does not extend to a continuum of risks.

This paper belongs to recent theoretical work on the politics of publicly provided private goods (see, among others, Gouveia, 1995, and Epple and Romano, 1996). However the models used are different as well as the results. For instance this literature typically obtains a majority equilibrium involving a mixture of private and public insurance.

The paper is organized as follows. Section 2 deals with voting over exclusive private and public insurance when the private market can only offer a pooling contract. Section 3 introduces the possibility for the private market to offer different contracts to different individuals. Section 4 presents the case where individuals can supplement public insurance with a separating insurance contract and individuals must vote over the degree of public insurance. Section 5 investigates how the demand for public insurance changes when the private insurance companies can use some tests that help them to infer, at least partially, individual risks. Section 6 concludes the paper.

2 Private insurance without screening

We use a simple model from Hindriks and Myles (Chapter 12, forthcoming). We consider that there is a large number of risk neutral insurance companies and that the insurance market is competitive. The insurance premium is based on the level of expected risk (no screening) among those who accept insurance offers (voluntary insurance). Competition ensures that profits are zero in equilibrium through entry and exit. That is, if there is any new insurance contract that can make a positive profit given the contracts already available, then one of the companies will choose to offer it.

The demand for insurance comes from a large set of risk averse individuals. These can be broken down into a continuum of different types of individuals who differ in their probability of incurring (fixed) damage of (uniform) value $d = 1$.[2] The probability of damage for an individual is given by θ. Different types of individuals have different values of θ lying between 0 and 1. There is no moral hazard since individuals cannot affect their prob-

[2]The current cost escalation in health care can be represented by an increase in d which is easily seen to have no effect on the relative desirability of public and private insurance

ability of accident which is fixed and since the damage is also fixed there is no agency cost related to the fact that for example in health care provision the prescribing agents may have an incentive to prescribe treatment beyond what is necessary for the insured and uninformed patients.[3] However adverse selection is introduced by assuming that each individual knows their own risk (i.e. value of θ) but that it is not observable by the insurance companies. The insurance companies know correctly that risks are distributed in the population over the interval $[0, 1]$ according to the cumulative distribution function $F(\theta)$. So $F(\theta)$ is the fraction of the population with probability of accident less or equal to θ. The *mean* risk is $\overline{\theta} = \int_0^1 \theta dF(\theta)$ and the *median* risk is $\theta_m = F^{-1}(1/2)$. We allow both for positively skewed ($\theta_m < \overline{\theta}$), symmetric ($\theta_m = \overline{\theta}$) and negatively skewed ($\theta_m > \overline{\theta}$) distributions.
Since all of the individuals are risk averse, they are willing to pay an insurance premium in excess of their expected damage to avoid facing the cost of damage. For each type θ the maximal insurance premium that they are willing to pay (reservation premium), $\pi(\theta)$, is given by

$$\pi(\theta) = (1 + \alpha)\theta, \tag{1}$$

where $\alpha > 0$ measures the degree of risk aversion (see the Appendix for the formal derivation of the risk premium from the underlying Von Neumann-Morgenstern expected utility function). So $\pi(\theta)$ represents the value of (complete) insurance against a damage of $d = 1$ for an individual with a probability θ of incurring this damage.

The assumption of competitive insurance market implies that in equilibrium insurance companies must earn zero profits. Now assume that insurance

[3] Moral hazard and agency cost are assumed away because they affect private and public insurance in the same way and so they should not influence the choice between the two systems.

companies just offer a single insurance policy to all customers. (We introduce the possibility of screening through a menu of insurance policies in the next section.) Given the premium π the policy will be purchased by all the individuals whose expected value of damage is greater than or equal to this. That is, an individual will purchase the policy if $\pi(\theta) \geq \pi$ which using (1) is equivalent to $\theta \geq \frac{\pi}{1+\alpha}$. Thus to break even with zero profits, the premium must just equal the expected damage for those who choose to purchase the policy. Formally,

$$\begin{aligned}
\pi &= E(\theta : \pi(\theta) \geq \pi) \\
&= E\left(\theta : \frac{\pi}{1+\alpha} \leq \theta \leq 1\right) \\
&= \frac{1}{1 - F(\frac{\pi}{1+\alpha})} \int_{\frac{\pi}{1+\alpha}}^{1} \theta dF(\theta) \qquad (2)
\end{aligned}$$

Let π^* be the corresponding equilibrium premium. This equilibrium is illustrated in Figure 1 for the uniform distribution of risks.[4] It occurs where the curve $E(\theta : \pi(\theta) \geq \pi)$ crosses the 45° line. The slope of the curve $E(\theta : \pi(\theta) \geq \pi)$ is inversely proportional to the degree of risk aversion and its intercept is a constant equal to 1/2. So increasing risk aversion reduces the equilibrium premium. It can be seen from the figure that insurance is only taken by those with high risks, namely $\theta \geq \frac{1}{1+2\alpha}$. This reflects the process of (partial) market unravelling through which only a fraction of the potential customers are actually served in equilibrium. The level of the premium is too high for the low risks (i.e., $\theta < \frac{1}{1+2\alpha}$) to find it worthwhile to take out the insurance. Since the equilibrium premium is decreasing with risk aversion, the number of those who opt out also decreases with risk aversion. On the

[4]For a uniform distribution of risk, $E\left(\theta : \frac{\pi}{1+\alpha} \leq \theta \leq 1\right) = \frac{1}{2}\left[\frac{\pi}{1+\alpha} + 1\right]$ and the equilibrium premium then satisfies $\pi = \frac{1}{2}\left[\frac{\pi}{1+\alpha} + 1\right]$ which gives $\pi^* = \frac{1+\alpha}{1+2\alpha}$.

other hand the market will completely unravel if individuals are risk neutral since the equilibrium premium is then equal to 1.

[insert figure 1 about here]

This market unravelling is a consequence of the fact that insurance companies cannot distinguish low-risk from high-risk consumers and when they offer the same premium to all consumers, the high-risk consumers force the premium up and this drives the low-risk out of the market. Of course, changing the distribution of risk will change the shape of $E(\theta : \pi(\theta) \geq \pi)$ and so the equilibrium premium. In fact, it is possible to conceive distribution functions $F(\theta)$ that lead to multiple equilibria in the sense that the curve $E(\theta : \pi(\theta) \geq \pi)$ crosses the $45°$ line several times. At the low intersection point, the premium is low because a large fraction of the population is covered. At the high intersection point, the premium is high because only the small fraction of high-risk consumers take out the insurance. The important point is that whatever the equilibrium and provided that risk aversion is not infinite, the lowest risk individuals will always opt out forcing the equilibrium premium above the average risk in the population. In this situation where adverse selection unravels the market, compulsory insurance based on average risk can make most consumers better off and thus be chosen by majority voting. The benefit of a compulsory insurance is that it can always force the lowest risk to participate lowering the equilibrium premium. In fact the equilibrium premium of a public (compulsory) insurance is $\pi^\circ = \overline{\theta}$. Because of the inevitable partial unravelling of a private (voluntary) insurance policy that offers the same premium to all consumers, we have that $\overline{\theta} < E\left(\theta : \frac{\pi}{1+\alpha} \leq \theta \leq 1\right)$ and thus $\pi^\circ < \pi^*$.[5]

[5] In particular for the uniform distribution, we have $\pi^\circ = \frac{1}{2} < \frac{1+\alpha}{1+2\alpha} = \pi^*$.

We can now compare the payoff individuals get with a private and a public insurance. At the risk of excessive simplification, we identify payoff as the difference between the premium a consumer is willing to pay given her risk (i.e., the value of insurance) less the premium effectively paid (i.e., the cost of insurance). Formally, the payoff of an individual with type θ and a private insurance policy with equilibrium premium π^* is

$$V(\pi^*;\theta) = Max\{0,(1+\alpha)\theta - \pi^*\} \tag{3}$$

The payoff of an individual with type θ and a public insurance policy with equilibrium premium $\pi^\circ = \overline{\theta}$ is

$$\begin{aligned} V(\pi^\circ;\theta) &= (1+\alpha)\theta - \pi^\circ \\ &= (1+\alpha)\theta - \overline{\theta} \end{aligned}$$

where $\pi^\circ = \overline{\theta} < \pi^*$. It can be seen from these payoff functions that all those individuals with $\theta \geq \frac{\overline{\theta}}{1+\alpha}$ prefer public insurance while all the low-risk individuals with $\theta < \frac{\overline{\theta}}{1+\alpha}$ prefer private insurance. Hence we get the following result.

Proposition 1: *(No screening) Suppose that (risk neutral and competitive) private companies offer the same insurance policy to all consumers, and that each individual degree of risk aversion is $0 < \alpha < \infty$, then a majority of individuals prefer public (compulsory) to private (voluntary) insurance if and only if $\theta_m \geq \frac{\overline{\theta}}{1+\alpha}$.*

Notice that this result holds true even for some positively skewed distributions of risk ($\theta_m < \overline{\theta}$) leading the median to subsidise the high risk in the public insurance. Notice also that the political support for the public insurance increases with risk aversion. The reason is simple. All those participating in the private insurance market prefer a public insurance to benefit from a lower premium. Only those who opt out are worse off with a public insurance. More risk aversion induces more consumers to participate on the private insurance market and fewer to opt out, leading to a greater support for public insurance.

This finding is of course a consequence of the partial unravelling resulting from a voluntary participation in the private insurance market when insurance companies offer the same policy to all consumers. We know introduce the possibility for the insurance companies to offer different insurance policies to different consumers.

3 Private insurance with screening

We continue to assume a continuum of risk θ distributed over the interval $[0,1]$ according to the distribution function $F(\theta)$. The insurance companies offer a menu of insurance policies $\{\delta(\theta),\pi(\theta)\}_{\theta\in[0,1]}$, where $\delta(\theta)\in[0,1]$ is the coverage rate and $\pi(\theta)$ is the premium intended for a consumer with risk θ. In a fully separating equilibrium, each type $\theta\in[0,1]$ selects the policy intended for her and the premium is actuarially fair $\pi(\theta)=\delta(\theta)\theta$. This requires to satisfy the following set of incentive compatibility (self-selection) constraints: For all $\theta\in[0,1]$ and for all $\hat{\theta}\in[0,1]$ with $\hat{\theta}\neq\theta$,

$$V(\delta(\theta),\pi(\theta);\theta)=(1+\alpha)\delta(\theta)\theta-\pi(\theta)\geq$$

$$V(\delta(\hat{\theta}),\pi(\hat{\theta});\theta)=(1+\alpha)\delta(\hat{\theta})\theta-\pi(\hat{\theta})$$

or given the actuarially fair premia,

$$V(\delta(\theta), \pi(\theta); \theta) = (1+\alpha)\delta(\theta)\theta - \delta(\theta)\theta \geq$$

$$V(\delta(\hat{\theta}), \pi(\hat{\theta}); \theta) = (1+\alpha)\delta(\hat{\theta})\theta - \delta(\hat{\theta})\hat{\theta}$$

To see whether there exists a separating equilibrium in the model, we follow the incentive compatibility approach of Mailath (1987). A necessary condition for a separating equilibrium is that the following local incentive compatibility conditions hold: for all $\theta \in [0, 1]$

$$\begin{aligned} \left[\frac{\partial V(\delta(\hat{\theta}), \pi(\hat{\theta}); \theta)}{\partial \hat{\theta}}\right]_{\hat{\theta}\to\theta} &= (1+\alpha)\delta'(\theta)\theta - \delta'(\theta)\theta - \delta(\theta) = 0 \\ &= \alpha\theta\delta'(\theta) - \delta(\theta) = 0 \end{aligned}$$

.

In other words, any separating equilibrium requires that no type be able to obtain a strictly higher payoff by announcing another arbitrary close type. From Mailath (1987), we also see that the payoff functions are such that these local necessay conditions are also sufficient. Hence the equilibrium coverage rate function $\delta(\theta)$ is the solution to the following homogeneous first-order differential equation,

$$\delta'(\theta) = \frac{\delta(\theta)}{\alpha\theta}$$

Solving this equation we get,

$$\begin{aligned}\delta(\theta) &= Ce^{\int \frac{1}{\alpha\theta} d\theta} \\ &= Ce^{\frac{\log\theta}{\alpha}} \\ &= C\theta^{1/\alpha}\end{aligned}$$

where C is a constant of integration. Using the terminal condition $\delta(1) = 1$ we get $C = 1$ and the equilibrium coverage function is,

$$\delta^*(\theta) = \theta^{1/\alpha}$$

with the corresponding equilibrium premium function,

$$\pi^*(\theta) = \delta^*(\theta)\theta = \theta^{(1+\alpha)/\alpha}$$

Hence the policy menu $\{\delta^*(\theta), \pi^*(\theta)\}_{\theta\in[0,1]}$ characterizes the unique separating equilibrium in this continuous-type insurance model. Substituting the equilibrium insurance policies into the payoff functions we get

$$\begin{aligned}V(\delta^*(\theta), \pi^*(\theta); \theta) &= (1+\alpha)\delta^*(\theta)\theta - \pi^*(\theta) \\ &= \alpha\theta^{(1+\alpha)/\alpha} \qquad (4)\end{aligned}$$

We assume that the public insurance policy takes the following form,

$$\{\delta^\circ = 1, \pi^\circ = \overline{\theta}\}.$$

The public insurance policy charges a uniform premium based on average risk and imposes full coverage. So the payoff functions for the public insurance are exactly the same as in the previous section. We can now derive the marginal type $\theta = \theta^\circ$ who is indifferent between the public and the private insurance policies. Obviously all low-risk consumers with $\theta < \theta^\circ$ will prefer the private separating insurance policy and all high-risk consumers with $\theta \geq \theta^\circ$ will prefer the public pooling insurance policy. Given (4), $\theta = \theta^\circ$ solves

$$\alpha\theta^{(1+\alpha)/\alpha} = (1+\alpha)\theta - \overline{\theta}$$

or

$$\alpha\theta(1-\theta^{1/\alpha}) = \overline{\theta} - \theta$$

Since the LHS is always positive, the marginal type θ° must be less than the average $\overline{\theta}$. Unfortunately it is not possible to obtain an explicit solution for θ° as a function of risk aversion (α) and average risk. Numerical solutions for θ° are given in Table 1 for various levels of risk aversion and average risk. Table 1 reveals that given the average risk, the marginal type is decreasing with risk aversion and thus that the political support for public insurance over private separating insurance increases with risk aversion (as in the previous section). Moreover Table 1 shows that the marginal type is significantly below the average type so that even for many positively skewed distributions of risk, a majority will support public insurance over private separating insurance.

[insert Table 1 about here]

The following proposition summarizes our result with separating private insurance policies.

Proposition 2: *(Screening) Suppose that (risk neutral and competitive) private companies offer fully separating insurance policies in equilibrium to all consumers, and that the public insurance contract is the same for all consumers, then there exists a critical risk level* $0 < \theta^\circ(\alpha, \overline{\theta}) < \overline{\theta}$ *such that a majority of consumers prefer the public insurance if and only if* $\theta_m \geq \theta^\circ(\alpha, \overline{\theta})$*. Moreover* $\theta^\circ(\alpha, \overline{\theta})$ *is decreasing with the degree of risk aversion,* α*.*

We emphasize that this Proposition is general and does not depend on the distribution of risk in the population. More risk aversion increases the political support for public insurance because the adverse selection problem induces the private insurance companies to provide only partial coverage to the low risk individuals. So a greater risk aversion reduces the attractiveness of private insurance and leads more individuals to favour public insurance with full coverage (although at a higher price for the low risk).

4 Impossibility of a policy mix

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In this section we introduce the possibility of combining public and private insurance, and demonstrate that such a policy mix is never politically sustainable. This constrasts sharply with Eckstein et al (1985) who show in a two-class of risk model that mixing private and public insurance can make everyone better off (because the partial public insurance would operate a cross-subsidy from the low-risk to the high risk and thereby relax the incentive constraint on the private insurance market). Our analysis reveals that this result is indeed an artifact of their two-class of risk model which disappears once we introduce a continuum of risk.

Let $\delta \in [0,1]$ and $\pi = \delta\overline{\theta}$ be the public insurance policy. Individuals can freely complement this public insurance with a private insurance leading to a total coverage for type θ equal to $\delta(\theta)$ where the extra private coverage $\delta(\theta) - \delta$ is purchased at a fair price $(\delta(\theta) - \delta)\theta$ and satisfies the incentive constraints. The corresponding payoff functions are,

$$V(\delta, \delta(\theta), \pi(\theta); \theta) \quad = \quad (1+\alpha)\delta\theta - \delta\overline{\theta} + (1+\alpha)(\delta(\theta) - \delta)\theta - (\delta(\theta) - \delta)\theta$$

$$= \delta(\theta - \overline{\theta}) + \alpha\delta(\theta)\theta$$

In any separating equilibrium, the following necessary local incentive compatibility condition must hold: for all $\theta \in [0, 1]$

$$\begin{aligned} \left[\frac{\partial V(\delta, \delta(\hat{\theta}), \pi(\hat{\theta}); \theta)}{\partial \hat{\theta}}\right]_{\hat{\theta}\to\theta} &= (1+\alpha)\delta'(\theta)\theta - \delta'(\theta)\theta - (\delta(\theta) - \delta) = 0 \\ &= \alpha\theta\delta'(\theta) - (\delta(\theta) - \delta) = 0 \end{aligned}$$

.

From Mailath(1987), it is easily seen that the payoff functions are such that the local incentive compatibility condition is also sufficient, implying that the solution to the equation above charaterizes the separating equilibrium for the continuum-type case. Hence the separating equilibrium coverage rate function $\delta(\theta)$ solves the following non-homogeneous linear first-order differential equation,

$$\delta'(\theta) = \frac{\delta(\theta)}{\alpha\theta} - \frac{\delta}{\alpha\theta}$$

The general solution is,

$$\begin{aligned} \delta(\theta) &= e^{\int \frac{1}{\alpha\theta} d\theta} \left(C(\delta) - \int \frac{\delta e^{-\int \frac{1}{\alpha\theta} d\theta}}{\alpha\theta} d\theta \right) \\ &= C(\delta)\theta^{1/\alpha} - \theta^{1/\alpha} \int \frac{\delta\theta^{-1/\alpha}}{\alpha\theta} d\theta \\ &= C(\delta)\theta^{1/\alpha} - \frac{\delta\theta^{1/\alpha}}{\alpha} \int \theta^{-(1+\alpha)/\alpha} d\theta \\ &= C(\delta)\theta^{1/\alpha} + \delta \end{aligned}$$

where $C(\delta)$ is the constant of integration given the public coverage rate. Setting $\delta(1) = 1$ for a Pareto optimal equilibrium, we get $C(\delta) = 1 - \delta$. Therefore, the unique separating equilibrium is,

$$\delta^*(\theta) = (1-\delta)\theta^{1/\alpha} + \delta$$

where $\theta^{1/\alpha} < 1$ represents the inherent partial coverage resulting from the adverse selection problem on the private insurance market. In particular, setting $\delta = 0$ we get the same expression for $\delta^*(\theta)$ as in the previous section. Notice that in equilibrium, for all types total coverage is increasing with the public coverage rate δ since $\theta^{1/\alpha} < 1$.

Plugging this equilibrium policy into the payoff function we get

$$\begin{aligned} V(\delta, \delta^*(\theta), \pi^*(\theta); \theta) &= \delta(\theta - \overline{\theta}) + \alpha\delta^*(\theta)\theta \\ &= \delta(\theta - \overline{\theta}) + \alpha\left[(1-\delta)\theta^{1/\alpha} + \delta\right]\theta \end{aligned}$$

We are now in a position to determine the equilibrium level of public coverage $\delta \in [0, 1]$. Differentiating the above payoff functions with respect to δ we get,

$$\frac{\partial V(.)}{\partial \delta} = (\theta - \overline{\theta}) + \alpha\theta\left[1 - \theta^{1/\alpha}\right]$$

Interestingly, this expression is independent of δ. Moreover it is easily seen that there exists a marginal type $\theta^\circ(\alpha, \overline{\theta}) < \overline{\theta}$ who is indifferent to a change in the public coverage rate δ. Notice that this marginal type is the same as in the previous section where public coverage was set equal to one. [6]

[6]Therefore, the value of the marginal type as a function of α and $\overline{\theta}$ is the same as indicated in Table 1.

This is because the preference for public coverage is independent of the level of public coverage. Finally, notice that all those with risk $\theta < \theta^{\circ}(\alpha, \overline{\theta})$ prefer zero public coverage and all those with risk $\theta \geq \theta^{\circ}(\alpha, \overline{\theta})$ prefer full public coverage. Therefore either the median risk is below $\theta^{\circ}(\alpha, \overline{\theta})$ and the political equilibrium involves no public insurance at all, or alternatively the median risk is above $\theta^{\circ}(\alpha, \overline{\theta})$ and the political equilibrium involves full (or exclusive) public insurance. It follows that a mix of public and private insurance is never politically sustainable. We summarize our results in the following proposition.

Proposition 3: *(Policy mix) Suppose that (risk neutral and competitive) private companies offer fully separating insurance policies in equilibrium to all consumers to complement a public insurance contract which is the same for all consumers, then there exists a critical risk level* $0 < \theta^{\circ}(\alpha, \overline{\theta}) < \overline{\theta}$ *such that a majority of consumers prefer a full (or exclusive) public insurance if and only if* $\theta_m \geq \theta^{\circ}(\alpha, \overline{\theta})$ *and no public insurance at all otherwise. A mixture of public and private insurance is never politically sustainable. Moreover since* $\theta^{\circ}(\alpha, \overline{\theta})$ *is decreasing with the degree of risk aversion* (α)*, the political support for a full (or exclusive) public insurance increases with risk aversion.*

5 Testing for risk and the demand for public insurance

In this section we show how the recent progress in the information technology that improves the capacity of private insurance companies to infer individual risks will affect the demand for public insurance (for a survey on the effetcs of genetic screening, see Barr, forthcoming). Suppose that private companies have access to some genetic tests that reveal the true risk of any individual with probability $s \in [0, 1]$ and reveal nothing at all with probability $1-s$. So s is a measure of the quality of the information available to private companies in using this technology. We assume that if the test is successfull private companies offer a contract with actuarially fair premium and full coverage giving a payoff $(1+\alpha)-\theta$ to an individual with risk θ, otherwise they offer an incentive compatible contract such as described in Section 3 giving a payoff as in (4). So the expected payoff for an individual with risk θ resulting from this private insurance policy contingent on a test of quality s is[7]

$$EV(\delta^*(\theta), \pi^*(\theta); \theta, s) = s[\alpha\theta] + (1-s)[\alpha\theta^{(1+\alpha)/\alpha}] \tag{5}$$

The payoff resulting from the public insurance policy is unchanged by the introduction of this test. Comparing both payoff we can derive the individual with risk $\theta = \theta^\circ(\alpha, \overline{\theta}, s)$ who is indifferent between both systems. This is given by the solution to

$$\alpha\theta[1 - (s + (1-s)\theta^{1/\alpha})] = \overline{\theta} - \theta$$

It is easily seen that the solution of this equation, $\theta^\circ(\alpha, \overline{\theta}, s)$, is increasing in the quality of the test s and converges to $\overline{\theta}$ when s approaches $s = 1$. Since all those with risk $\theta \geq \theta^\circ(\alpha, \overline{\theta}, s)$ prefer public insurance, it turns out that the demand for public insurance decreases as the quality of the test improves. We state this result in the next proposition.

Proposition 4: *(testing) Suppose that (risk neutral and competitive) private companies offer fully separating insurance policies in equilibrium to*

[7] To be more precise this expected payoff should be deflated by a risk premium to reflect the risk associated to the imperfection of the test. However this will complicate the analysis without bringing more insights and we prefer to ignore it

every consumer whose risk has not been revealed by the test (with probability $(1-s)$*), and a full coverage at actuarially fair price to every consumer whose risk has been revealed by the test (with probability* s*). If the public insurance contract is the same for all consumers, then there exists a critical risk level* $0 < \theta^{\circ}(\alpha, \overline{\theta}, s) \leq \overline{\theta}$ *such that a majority of consumers prefer the public insurance if and only if* $\theta_m \geq \theta^{\circ}(\alpha, \overline{\theta}, s)$*. Moreover* $\theta^{\circ}(\alpha, \overline{\theta}, s)$ *is decreasing with the degree of risk aversion,* α *and increasing with the quality of the test* s*.*

The main implication of Proposition 4 is that the demand for public insurance decreases with the increasing capacity of private companies in assessing individual risks up to a point where public insurance may no longer be politically sustainable.

6 Conclusion

In this paper we have derived circumstances under which a majority prefers public insurance over private insurance in the presence of adverse selection problem. The main result is that a mixing of private and public insurance is politically non sustainable. This seems to be consistent with aspects observed in the real world. For example health care is mostly provided by government in many countries. We have also shown that the demand for public insurance increases with risk aversion and decreases with the quality of the tests used by private companies to assess individual risks.

The results are of course illustrative and not conclusive, but still they are instructive. The limitations of our analysis need to be emphasized. First we have not considered the moral hazard problem. Second we have ignored the important agency problem. This agency problem is specially acute in health care where the insured and uninformed patient cannot monitor the prescribing agent who does not bear the cost of prescribtion but on the contrary may benefit from over-prescibtion. The nature of the moral hazard and agency problem is the same for a private insurer as for a public insurer. To do justice to these crucial problems would deserve a separate paper, but would probably not affect our results about the relative preference for public and private insurance. The third and perhaps most important limitation of our analysis is the absence of distributive argument for public insurance. The reason was to isolate the insurance motive for public insurance and show that public insurance can be supported by a majority without resorting to distributive motive. However we agree that most systems of health care and state pensions in the European Union currently include a potential amount of income redistribution by the mere fact that contributions are income-related. We want to take up this issue in a future work where individuals would differ not only in their risk but also in their income. This will lead us to adopt a model similar to Rochet (1991) or Cremer and Pestieau (1996) but with the important difference that the choice between private and public insurance would be made by voting instead of a benevolent decision maker. The key point would be of course how the the degree of redistribution of public insurance and the correlation between income and risk affect the political equilibrium outcome.

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7 Appendix

For an individual with income w facing a damage $d = 1$ with probability $\theta \in [0,1]$, the risk premium π is derived from the following indifference condition

$$\theta u(w-d) + (1-\theta)u(w) = u(w-\pi)$$

Using a first-order approximation of $u(w-\pi)$ and since d is larger than π using a second order approximation of $u(w-d)$ give

$$\theta\left[u(w) - du'(w) + \frac{d^2}{2}u''(w)\right] + (1-\theta)u(w) = u(w) - \pi u'(w)$$

Dividing the left-hand side and the right-hand side by u'(w), setting $d = 1$ and rearranging we get,

$$\begin{aligned}\pi &= \left[1 - \frac{1}{2}\frac{u''(w)}{u'(w)}\right]\theta \\ &= \left[1 + \frac{R_a(w)}{2}\right]\theta\end{aligned}$$

where $R_a(w) = -u''(w)/u'(w)$ is the Arrow-Pratt coefficient of absolute risk aversion.

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Figure 1 Partial market unravelling with uniform distribution of risk

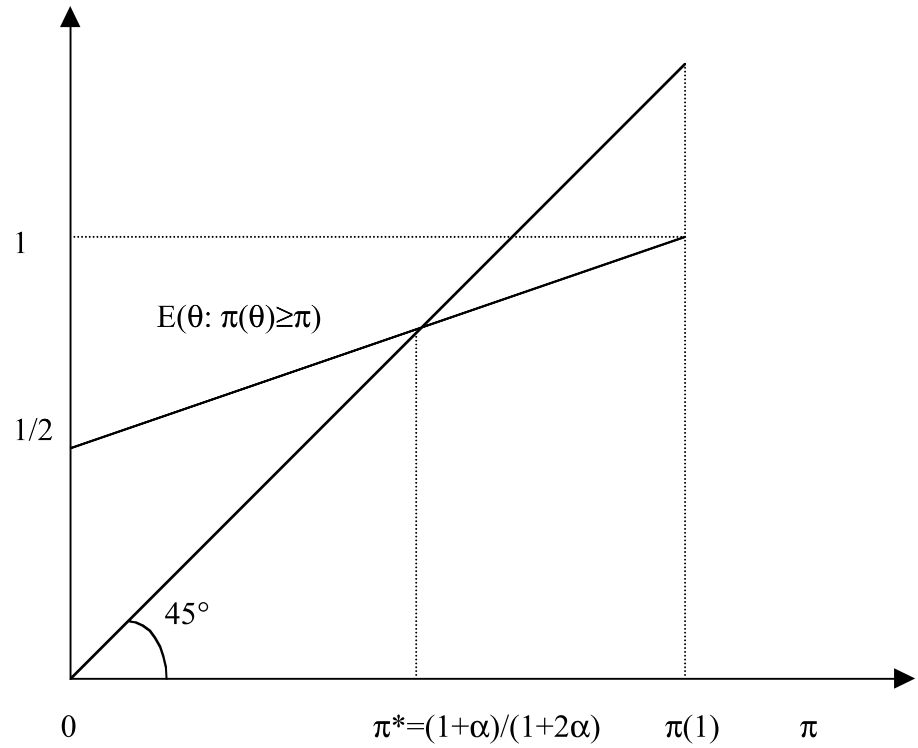

Table 1. Marginal risk level (θ°) as a function of risk aversion (α) and average risk.

α	Average risk				
	0.25	0.33	0.5	0.66	0.75
0.25	0.2	0.27	0.4	0.54	0.62
0.33	0.19	0.25	0.38	0.52	0.6
0.5	0.17	0.23	0.35	0.48	0.56
0.66	0.15	0.21	0.32	0.46	0.53
0.75	0.14	0.2	0.31	0.45	0.52
1	0.13	0.18	0.29	0.42	0.5
1.33	0.12	0.17	0.27	0.4	0.48
1.5	0.11	0.16	0.27	0.39	0.47
1.66	0.11	0.16	0.26	0.39	0.46
1.75	0.11	0.15	0.26	0.38	0.46
2	0.1	0.15	0.25	0.37	0.45
3	0.09	0.14	0.23	0.36	0.43
4	0.09	0.13	0.22	0.34	0.42
5	0.08	0.12	0.21	0.33	0.41