XIII CONFERENZA

STATO O MERCATO?
Intervento pubblico e architettura dei mercati
Pavia, Università, 5 - 6 ottobre 2001

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PUBLIC AND PRIVATE HEALTH INSURANCE UNDER ADVERSE SELECTION: A PUBLIC CHOICE ANALYSIS

pubblicazione internet realizzata con contributo della COMPAGNIA di San Paolo

Società italiana di economia pubblica

Dipartimento di economia pubblica e territoriale – Università di Pavia

Public and Private Health Insurance under Adverse Selection: A Public Choice Analysis.

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10 September 2001

Abstract

Public provision of private goods can be rationalised as the outcome of a voting process, supported by the majority of the population on redistributive grounds. Influential results have been obtained in a perfect market framework, whereas sectors such as health insurance are often affected by informational imperfections and regulatory constraints which limits the possibility to fix premia on actuarially fair basis. We develop a two stage model where households differ in income and ill risk. The amount of public health insurance is initially determined according to majority rule, then households decide whether to purchase supplementary private policies. We assume that private insurers cannot discriminate subscribers according to risk, thus inducing potential nonsingle-peakedness of preferences. We identify conditions that ensure the existence of a majority voting equilibrium and characterise it in terms of average income of the coalitions. The impact of adverse selection on the size of the public sector is finally briefly discussed.

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†Thanks are owed to Francesca Barigozzi, Rinaldo Brau, Matteo Cervellati, Gianluca Fiorentini and Claudio Zoli for helpful discussions and comments on an earlier draft. Usual disclaimers apply.

1 Introduction

Although services such as education and health care exhibit public good features only to a limited extent, they drain a substantial share of public expenditures in developed countries. Extra-welfarist arguments (e.g. paternalism and specific egalitarianism), as long as externalities, information asymmetries and uncertainty have been advocated as causes of public intervention in these sectors (Besley and Gouveia 1994). Nonetheless, their presence does not seem to fully justify the widespread extension of government's role highlighted by empirical observation. A potential alternative explanation is the redistributive impact implicit in the direct public provision of private goods (Besley and Coate 1991). The literature usually considers the case of a pure private good a priori assumed to be the potential target of a public provision program. Despite providing a very general framework, this literature tends to overlook the distinguishing features of the most commonly provided private services.[1]

More specifically, two different approaches have emerged: a normative one which justifies public provision insofar as it represents an effective instrument within an optimally designed redistributive policy, and a positive (or public choice) one where the policy maker decision is the endogenous outcome of a political process. The latter, rather than focusing on efficiency issues, rationalises government intervention through the introduction of a voting procedure. Public provision occurs whenever a majority of the population supports it, because the gain from redistribution exceeds the cost imposed by the tax burden and by the distortion in consumption patterns. Models also differ with respect to the technology of consumption (topping up vs. opting out) and available tax instruments.[2]

In a seminal contribution to the public choice approach, Usher (1977) identifies the incentives favouring and those opposing the collectivisation of a service when the coexistence of government intervention with competing private providers is not allowed. The more heterogeneous tastes are across the population, the more costly is the distortion due to universal provision

[1] See Balestrino (1999) on this point.

[2] In a topping up scheme households consume the publicly provided service and eventually supplement it in the private sector. On the contrary, an opting out scheme imposes to consume the service either in the public or in the private sector. The difference may stem from technological or even institutional reasons. The most common reference for the topping up case is health care, whereas opting out applies more directly to education.

and the less likely is the community to vote for it. At the same time, an asymmetric distribution of income may develop a sufficiently wide coalition of agents that favours public provision because the gain from redistribution exceeds the loss generated by the existence of a quantitative constraint in consumption.[3]

Stiglitz (1974) originally underlined that, in an opting out scheme, nonsingle-peakedness of preferences may occur, thus undermining the existence of a *Majority Voting Equilibrium*. Epple and Romano (1996a) address the issue for the topping up case and show that, with a linear tax system and perfect private markets, the possibility of supplementing is a sufficient condition for single-peakedness to hold.[4] Gouveia (1997) provides a more realistic framework for the health sector and generalises the result by considering a two dimensional heterogeneity of households who differ not only in income but also in ill risk.

The present paper focuses on public provision of health insurance and is aimed at extending the analysis to a context where adverse selection is introduced. The study of mixed public/private insurance systems is of particular relevance at an institutional level, since many health care systems' reforms intended to create a more balanced and efficient interaction between private and public coverage (Pauly 1992).

Moreover, it is well known that informational imperfections widely affect health insurance contracts and play an important role in justifying public intervention.[5] Consequently, the assumption of perfect information may result inadequate to describe how this sector works in practice and its relaxation is one of the priorities in the research agenda. More in detail, the information asymmetry considered here arises from the impossibility for private insurers to observe the risk of morbidity at the individual level and to differentiate premia accordingly. The motivation of the assumption is two-fold. First, it allows to test the robustness of existing theoretical results in a more general and realistic framework.[6] Second, the model is consistent with a framework

[3] Along the same line of research, Wilson and Katz (1983), Petersen (1986) and Pauly (1992), develop studies where public provision becomes progressively more flexible and admits the joint presence of public and private suppliers.

[4] Conditions for the existence of a MVE in the opting out case are analysed in Epple and Romano (1996b) and Gloom and Ravikumar (1998).

[5] See, among others, Cutler (1996).

[6] The case considered here can be seen as an interesting starting point for the study of environments where private insurers face severe, although partial, information constraints.

where the absence of risk rating is not due to a limited insurers' monitoring ability, but to explicit public regulation.[7]

A third feature that distinguishes our contribution from standard health insurance models is that the monetary loss due to the ill state is endogenised, and households characterised by the same health status but different incomes can purchase different levels of care.[8]

To our knowledge, only two contributions introduce informational imperfections in a positive model of public provision of private goods. Anderberg (1999) builds up an interesting model applied to the pension system. The main difference with our contribution is that the population differs only in ill risk and not in income, while we consider a two dimensional heterogeneity. Delipalla and O'Donnell (1999) consider a binary instead of a continuous distribution of ill risk and an insurance market characterised by exclusive contracts.

The main implication of adverse selection is that the market price of private insurance is influenced by the level of public provision, because of the strategic behaviour adopted by consumers who benefit of an informational advantage. This feedback effect influences the attitude of consumers/voters towards public provision and results in potential nonsingle-peakedness of preferences. We identify sufficient conditions for a MVE to exist and characterise it in terms of the average income of the coalitions. We also argue that, unless households are very risk averse, the presence of adverse selection does not alter substantially the size of the public sector, despite its relevant redistributive impact in favour of bad risks.

The paper is organised as follows. Section 2 sets up the model. Section 3 investigates consumer's preferences over variables assumed as given in the second stage. Section 4 analyses the voting equilibrium and section 5 concludes.

[7] In the attempt to conjugate flexibility of coverage with protection for bad risks, Italy has recently introduced Private Health Funds targeted at supplementing the uniform NHS public insurance and premium rating according to individual ill risk is banned by law. Even in a market oriented system such as the USA, there are increasing examples of strong regulatory constraints in the underwriting possibilities for private insurers. See Browne and Frees (1999) and Buchmueller and Di Nardo (1999) for empirical evaluations of the impact of such measures.

[8] In this way we relax the restrictive assumption that health treatments are entirely delegated to an external agent, typically the physician.

2 Set up

We consider a population of n agents who differ in income and ill risk, defined by the exogenous parameters y and p, whose support is $[\underline{y},\check{y}]$ and $[\underline{p},\check{p}]$. The joint and marginal p.d.f. are $\phi(y,p)$, $f(y)$ and $s(p)$ respectively and we denote with $\bar{y}$ and $\bar{p}$ the average value of the marginal distributions. Two states of the world may occur: each agent is either sick with probability p, or healthy with probability $(1-p)$.[9] The ex-ante probability of falling ill p is private information whereas the ex-post health state is observable.[10]

There are two private goods in the economy: the numeraire commodity c, and health care q. In addition to it, the government provides health insurance whose amount can be topped up through individual purchases in the private sector. Technology displays constant returns to scale and γ units of the numeraire commodity are required in order to produce one unit of health care. For the consumer's utility function, we adopt a standard set up where utility depends exclusively on the general consumption good when healthy and both on consumption and health care when sick.[11]

The insurance market is competitive and insurers are risk neutral. We consider an insurance contract where reimbursement is conditional on the (observable) ex-post health state.[12] Each consumer pays a premium of αR_r monetary units and obtains an indemnity of R_r in case of illness.[13]

We develop a two stage public choice model where, in the first stage, agents vote on the level of public health insurance uniformly provided to the whole population. In the second stage, each consumer can top up public provision with purchases in the private market.

[9] We define state of the world 0 the case of illness and state of the world 1 the case of good health.

[10] The assumption of perfect observability of health states is consistent with the feature that only two states are considered and health expenditures are positive only in state 0.

[11] For sake of simplicity an additive relation is assumed in the latter case. See for instance Gouveia (1997) and Breyer and Haufler (2000).

[12] A similar way to model reimbursement can be found in Rochet (1991). In this way we abstract from the moral hazard effect that arises when reimbursement depends on the amount of care received. For a comparison among different reimbursement methods see Barigozzi (2000).

[13] Since we develop a single-period analysis, we assume, without loss of generality, that, whereas contracts are subscribed ex-ante, monetary transactions take place only ex-post.

2.1 The consumer's optimisation program

In the second stage, each consumer acts as a price taker and chooses q and R_r in order to maximise the following expected utility function:

$$U(q, R_r; y, p) = (1-p)\left[u\left(c_1\right)\right] + p\left[u\left(c_0\right) + v\left(q\right)\right], \tag{1}$$

subject to:

$$c_0 = y(1-t) + R_u + (1-\alpha)R_r - \gamma q, \tag{2}$$

$$c_1 = y(1-t) - \alpha R_r, \tag{3}$$

$$t\bar{y} = \bar{p}R_u, \tag{4}$$

$$R_r \geq 0. \tag{5}$$

Given the level of publicly provided health insurance (R_u), each agent chooses the optimal amount of health care (q) and supplementary health insurance (R_r). Consumer's budget constraints are given by (2) and (3) for state of the world 0 and 1, while (4) ensures that the public budget is balanced.[14] The inequality constraint (5) precludes the transfer of purchasing power from the ill to the healthy state. Sub-utility functions $u\left(c_h\right)$ and $v\left(q\right)$ are continuous, increasing, twice differentiable and concave.

First order conditions for problem (1-5) are:

$$u_0^{'}\left(\cdot\right) = \frac{1}{\gamma} v_q^{'}\left(\cdot\right), \tag{6}$$

$$u_0^{'}\left(\cdot\right) p\left(1-\alpha\right) \leq u_1^{'}\left(\cdot\right)\left(1-p\right)\alpha, \tag{7}$$

$$R_r\left(\cdot\right)\left\{u_0^{'}\left(\cdot\right) p(1-\alpha) - u_1^{'}\left(\cdot\right)\left(1-p\right)\alpha\right\} = 0. \tag{8}$$

where $v_q^{'}\left(\cdot\right)$ and $u_h^{'}\left(\cdot\right)$ are the marginal utility of health care and consumption in state h. Condition (6) equalises the marginal rate of substitution

[14] We are assuming that the tax system is proportional and public intervention is limited to the provision of health insurance.

between consumption in state 0 and health care to their relative price [15], whereas condition (7) describes how agents distribute consumption between states of the world through the purchase of health insurance. The optimal consumption smoothing depends on the difference between individual ill risk p and the market price of insurance α.

Conditions (6)-(8) implicitly define the individual demand for health care and supplementary insurance for any given level of public coverage:

$$\begin{aligned} q^* &= q\left(y, p; R_u, \alpha, \gamma\right), \\ R_r^* &= R_r\left(y, p; R_u, \alpha, \gamma\right). \end{aligned}$$

For any internal solution to problem (1-5), perfect discrimination of health risks would imply fair pricing of insurance ($p = \alpha$) for each household and, by (7), this would induce complete consumption smoothing [16]. However, since here the price of insurance is community rated, there are agents who face a favourable premium ($p > \alpha$) and purchase a more generous cover than in the fair case, whereas those facing an unfair premium ($p < \alpha$) underinsure themselves. Strict inequality in (7) holds when individuals, typically characterised by low risk, would like to transfer consumption from the ill to the healthy state but constraint (5) prevents this possibility.

Comparative static analysis yields the following lemma:

Lemma 1 $\frac{dR_r}{dp} > 0$ *and* $\frac{dR_r}{dy}$ *undetermined.*

`Proof`: See appendix.

According with intuition, any raise in p has a positive impact on insurance demand since, in expected terms, the marginal benefit of coverage increases with risk. On the contrary, a variation in y produces an ambiguous effect, as the positive income effect must be weighed against the fact that income and indemnity are perfect substitute in state of the world 0.

2.2 The insurance market

As illustrated in the introduction, private health insurance markets are often highly regulated, allowing only for a limited risk segmentation. The purpose

[15] Individual ill risk does not enter the expression because both events occur in the same state of the world.

[16] Since consumption of health care is endogenous, complete smoothing ($c_0 = c_1$) implies a reimbursement equal to the cost of care purchased in equilibrium $R_u + R_r^* = \gamma q^*$.

of our analysis is to deal with the case where the insurance premium is community rated. Therefore we exclude the possibility for private insurers to impose exclusivity clauses on subscribers, which would allow the former to extract part of the informational rent from bad risks through the implementation of a self-selecting convex premium schedule on private policies.[17]

The analysis of the insurance market draws on Anderberg (1999) and is characterised by the presence of N risk neutral firms competing in prices.[18] Each firm k chooses α in order to maximise expected profits:

$$\begin{aligned} \max_{\alpha} \quad \pi^k &= \frac{\int_y \int_p \left[\alpha R_r^* - p R_r^*\right] \phi(y,p) dp dy}{N}, \\ \text{s.t .} \quad \pi^k &\geq 0 \qquad\qquad \forall k = 1.....N. \end{aligned} \tag{9}$$

Competition ensures that in equilibrium α is such that the expected profits for the k-th firm equal zero. From (9) we obtain:

$$\alpha^* = \frac{\int_y \int_p p R_r^* \phi(y,p) dp dy}{\int_y \int_p R_r^* \phi(y,p) dp dy}. \tag{10}$$

Expression (10) can be interpreted as a weighed average of ill risks, where weights are represented by the amount of insurance purchased by each agent. Since the individual demand for public insurance depends on the amount of public coverage made available at the first stage, also the equilibrium price α^*depends on R_u (i.e. $\alpha^* = \alpha(R_u)$).[19]

At this stage it is useful to make the following regularity assumptions:

Assumption 1 :

$E\left[p \mid R_r\left(y,p;R_u,\alpha,\gamma\right) = \widehat{R}\right]$ *is non decreasing in* $\widehat{R}$.

[17]Although the non-exclusivity assumption may result more appropriate for the annuities market, in the literature on health insurance different views are held on this point. Works like Pauly (1974) and Besley (1989) follow the same approach adopted here, whereas other papers like Neudeck and Podzeck (1996) focus on exclusive contracts.

[18]The only requirement in order not to have trivial solutions is $N > 1$ and finite.

[19]At $\alpha = \alpha^*$ each firm attains zero profits ex-ante but not necessarily ex-post. Since insurers are risk neutral, this does not jeopardise the stability of the equilibrium and, if the number of consumers is sufficiently large, deviations from the break even condition tend to disappear also ex-post. On the contrary, in aggregate, profits are zero both ex-ante and ex-post.

Assumption 2 :

$\frac{d\alpha^*}{dR_u} \geq 0.$

Assumption 1 states that households with a larger demand for private insurance are on average characterised by a higher risk of morbidity, thus implying that the positive relation between p and R_r holds also in the bivariate dimension.[20] By (10) and assumption 1, it follows that the price of private policies lies always above the average risk $\bar{p}$, because bad risks disproportionately insure themselves with respect to good risks.

Assumption 2 imposes some structure on the impact of marginal variations in public cover on the private market. The change in α^* depends on the differential crowding out rate between different risk groups. In general, large amounts of public provision determine a high level of α^*, since only bad risks tend to stay active in the private market, given that they get larger expected benefits from insurance. Conversely, α^* reaches its lower bound at $R_u = 0$, when a relatively larger share of good risks chooses a positive level of supplementation. Assumption 2 requires α to raise monotonically, which is attained if good risks are crowded out more intensively along the entire range of variation of R_u. [21]

In general, problem (9) may have more than one equilibrium. Nonetheless, it is possible to establish the following lemma.

Lemma 2 *Sufficient condition for the equilibrium to be unique is that the weighted average elasticity of demand with respect to the loading factor* $(\alpha - p)$ *is lower than one.*

`Proof`: Omitted (available on request).

The intuition behind Lemma 2 is straightforward. An increase in the loading factor $(\alpha - p)$ has two effects on expected profits. On the one side, they increase because of the price effect, on the other side, agents reduce their demand for insurance, with a negative impact on profits. The sufficient condition requires that on average the change in demand does not outweigh the price effect.

[20] Empirical evidence suggests that income and health risk are usually negatively correlated. Assumption 1 allows such correlation but introduces a lower bound to it.

[21] Anderberg (1999) shows that homotetic preferences with respect to consumption in the two states of the world is a sufficient condition for monotonicity to hold.

3 The structure of individual preferences

The purpose of this section is to study consumer's preferences over α and R_u, the variables assumed as given in the second stage.

We introduce two definitions:

Definition 1 *Government Only (GO) is the regime of exclusive public provision, Market Only (MO) the regime with a null amount of public provision and Government Market (GM) the mixed regime.*[22]

Definition 2 *Group 1 (G^1) includes (low income) agents whose tax price of public insurance $\frac{\overline{p}y}{\overline{y}}$ is smaller than, or equal to, α^{*MO}, which represents the equilibrium market price of insurance in regime MO. Group 2 (G^2) (high income) collects the remaining part of the population.*

The follow-up of the section shows that preferences with respect to public coverage differ substantially between groups and thus the two cases need to be separately investigated.

For any given level of α and R_u, the indirect utility is given by:

$$V(\alpha, R_u; p, y) \equiv \max_{q, R_r \geq 0} U(q, R_r) = (1-p)\left[u\left(c_1^*\right)\right] + p\left[u\left(c_0^*\right) + v\left(q^*\right)\right]. \quad (11)$$

We consider the indifference locus in space (α, R_u). By substituting constraints (2)-(4) into (11) and taking into account that the choice variables are fixed at their optimum values, the slope of the constant utility level curves is:

$$M(R_u, \alpha; y, p) = \frac{\partial \alpha}{\partial R_u}\mid_{V(\cdot)=\overline{V}} = -\frac{u_1^{'}(\cdot)(1-p)\left(-\frac{\overline{p}y}{\overline{y}}\right) + u_0^{'}(\cdot)\,p\left(1-\frac{\overline{p}y}{\overline{y}}\right)}{-R_r^*\left[u_1^{'}(\cdot)(1-p) + u_0^{'}(\cdot)\,p\right]}. \quad (12)$$

The denominator in (12) is always negative and represents the reduction in utility deriving from an increase in the price of private insurance. On the contrary, the sign of the numerator is ambiguous. The first term is negative being the reduction in utility of a raise in the tax levy in state 1 that follows a marginal increase in R_u. The second term is positive and represents the

[22] This terminology was originally introduced by Epple and Romano (1996a).

marginal benefit of an increase in R_u in case of illness. It originates from the transfer of purchasing power in favour of the ill state produced by public intervention. Both effects are weighed by the respective probabilities.

By (12) and making use of (7), we get the following condition for R_r strictly positive:

$$M(R_u, \alpha; y, p) \gtrless 0 \Longleftrightarrow \frac{\overline{p}y}{\overline{y}} \lessgtr \alpha. \tag{13}$$

The isoutility locus in space (α, R_u) for G^1 and G^2 are depicted in figure 1 and 2 respectively.

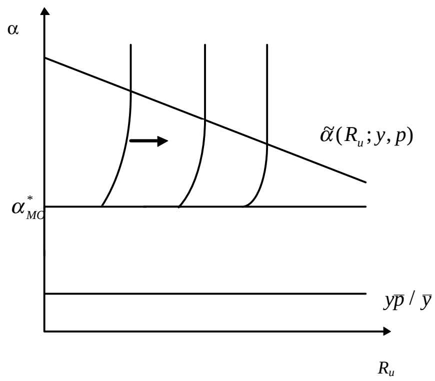

Figure 1 (Group 1)

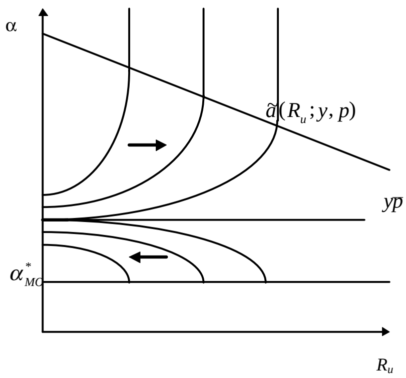

Figure 2 (Group 2)

In both groups, when $\alpha \geq \tilde{\alpha}(R_u; y, p)$, the consumer is in corner solution (i.e. $R_r^* = 0$) and the level curves are vertical. In this case, the consumer does not purchase supplementary coverage and, consequently, marginal variations in α do not affect utility.[23] The lower bound for the market price is set at α^*_{MO}. Any lower level cannot be sustained as an equilibrium since it yields negative profits in expected terms.

In figure 1, the market price always exceeds the tax price. Hence, for any positive supplementation amount, curves are upward sloping. Taxpayers prefer to receive coverage from the government and public provision acts as a subsidy because of the low tax price. Consequently, R_u must increase to compensate the decrease in utility which follows any raise in α.

In figure 2, the individual tax price locus $\alpha = \frac{y\overline{p}}{\overline{y}}$ identifies two separate areas. In the upper portion of the figure, the level curves display a similar behaviour to fig. 1 and asymptotically converge from above to the threshold $\alpha = \frac{y\overline{p}}{\overline{y}}$.[24]

In the lower portion of fig. 2, the agent faces a tax price above the market price and isoutility curves are downward sloping. In fact, a raise in R_u negatively affects utility and the higher cost of private insurance must be compensated by a reduction in R_u, which allows to rebalance coverage composition through an extension of the cheaper private share .[25]

Proposition 1 summarises the discussion.

Proposition 1 *At any α such that $\alpha^{*MO} < \alpha < \tilde{\alpha}(R_u, \alpha; y, p)$, it holds that $\frac{y\overline{p}}{\overline{y}} \lesseqgtr \alpha \Longleftrightarrow \frac{\partial V(.)}{\partial R_u} \mid_{\alpha=\overline{\alpha}} \gtreqless 0$.*

Proposition 1 implies that, when the individual tax price is lower (higher) than the market price of insurance, indirect utility increases (decreases) with public provision.

[23] The threshold $\tilde{\alpha}(R_u; y, p)$ is the minimun price level of private insurance that excludes type (y, p) from the private market when public provision is set at R_u.

[24] In this case, as in fig.1, indirect utility raises moving to the right.

[25] Here indirect utility increases while moving to the left. Convexity in the increasing part of the isoutility curves is a consequence of the fact that the unit subsidy obtained through public provision increases with the difference between tax and market price. A similar argument justifies concavity in the decreasing portion of the curve.

4 Voting on public health insurance

We study here the first stage problem, where consumers vote on the level of public insurance. We define *Majority Voting Equilibrium* (MVE, henceforth) a level of publicly provided health insurance R_u^{**} which is majority preferred to any feasible alternative R_u. The median voter theorem establishes that unimodality of preferences and unidimensionality of the political issue are sufficient conditions for a MVE to exist. In our model, the one-to-one mapping between tax rate and public insurance ensures that unidimensionality is satisfied. Hence, in order to prove the existence of a MVE, we only need to check unimodality.

When markets are perfect and the tax system is linear, a topping up scheme determines single-peaked preferences for each household.[26] However, the introduction of adverse selection, may produce nonsingle-peakedness in both groups as long as the price of private insurance is affected by variations in the level of public insurance.

4.1 The existence of a MVE

The optimal amount of public insurance is given by the solution to the following problem:

$$\max_{R_u \geq 0} W(R_u; y, p) = V(R_u, \alpha(R_u); y, p). \tag{14}$$

Proposition 1 points out that the impact of a change in R_u on the indirect utility function $V(.)$ depends on the relation between the individual tax price and the market price of insurance. Therefore it is necessary to carry on two separate analysis for G^1 and G^2.

Group 1

$$\frac{y\overline{p}}{\overline{y}} \leq \alpha^{*MO}. \tag{15}$$

The optimal R_u for G^1 agents is either null or positive. In the first case, preferences are always single-peaked, since utility decreases monotonically with R_u. In the second case nonsingle-peakedness may arise. Utility decreases monotonically when R_u is raised above R_u^*, as both overconsumption of public insurance and the price of private coverage increase. However, for

[26] See Epple and Romano (1996a) and Gouveia (1997).

any R_u below the individual most preferred value, an increase in public provision produces two conflicting effects. On the one hand, indirect utility raises because the level of public insurance is set closer to its optimal value, on the other hand utility is negatively affected because the market price increases, implying a higher expenditure for any unit of supplementary insurance purchased. In order to have single-peaked preferences within the G^1 group, it is necessary and sufficient that the first effect exceeds the second. Following Anderberg (1999), we get:

$$W(R_u; y, p) \mid_{R_u < R_u^*} = V_{R_u} + V_\alpha \frac{\partial \alpha^*}{\partial R_u} > 0 \Rightarrow \frac{\partial \alpha^*}{\partial R_u} < M(R_u, \alpha; y, p). \tag{16}$$

We now consider group G^2.

Group 2

$$\frac{y\overline{p}}{\overline{y}} > \alpha^{*MO}. \tag{17}$$

Condition (17) establishes that when the public sector is banned, the market price of insurance is lower than the individual tax price. Therefore, for any group member, the most preferred level of public insurance is zero. As long as the individual tax price exceeds the market price, any raise in public provision reduces utility, because of the increasing unit cost of supplementary insurance and overprovision of public coverage. In order to check global nonsingle-peakedness, it is then sufficient to verify whether utility is decreasing when agents stop supplementing. Two conditions may occur:

$$\frac{y\overline{p}}{\overline{y}} \geq \alpha \left(\widetilde{R}_u(y, p) \right) \tag{18}$$

or

$$\frac{y\overline{p}}{\overline{y}} < \alpha \left(\widetilde{R}_u(y, p) \right), \tag{19}$$

where $\widetilde{R}_u(y, p)$ represents the (minimum) level of public insurance that completely crowds out private purchases.

Condition (18) ensures that, preferences are overall single-peaked and monotonically decreasing with R_u. In fact, at the threshold level $\widetilde{R}_u$, the market price of insurance is lower than the tax price and an increase in public insurance progressively reduce indirect utility (overprovision effect).

On the contrary, if (19) holds, a standard revealed preferences argument establishes that a marginal increase in public insurance at $\widetilde{R}_u$ locally rises indirect utility.[27] This produces a local inversion of preferences which may jeopardise the existence of a MVE. The result follows from the low cost of getting additional units of insurance through the public sector which makes increases in R_u (locally) desirable to consumers. [28]

Proposition 2 summarises the discussion.

Proposition 2 *Necessary and sufficient conditions for each agent to exhibit single-peaked preferences are:*

$$\frac{\partial \alpha^*}{\partial R_u} < M(R_u, \alpha; y, p) \quad \textit{for any agent } \in G^1, \tag{20}$$

$$\frac{y\overline{p}}{\overline{y}} \geq \alpha\left(\widetilde{R}_u(y,p)\right) \quad \textit{for any agent} \in G^2. \tag{21}$$

Proposition 2 states sufficient conditions for a MVE and additional intuition for the result can be provided. Adverse selection induces a feedback between public provision and the market price of insurance. Even when the optimal level of public cover for G^1 agents is positive, an increase in R_u may result in a reduction in utility because of the raise in the cost of residual private coverage.[29] Condition (20) ensures that the negative price effect does not prevail on the positive effect derived from a level of public provision closer to the most preferred one.

As G^2 agents are harmed by the redistributive effects of public provision, they prefer to purchase insurance through the private sector. Nonetheless, if the market price is above the individual tax price and the demand for supplementary insurance is strictly positive, they may have their utility locally increased by a raise in R_u. Condition (21) ensures that when agents

[27]It is important to notice that under (19) consumers have a positive supplementation at $\tilde{R}_u - \varepsilon$, even if the price of private insurance is already above the tax price. This implies that the amount of insurance at $\tilde{R}_u$ is such that its increase is beneficial to the consumer, if obtained at the tax price $y\overline{p}/\overline{y} < \alpha(\tilde{R}_u)$.

[28]When R_u is largely above the threshold $\widetilde{R}_u$, an overconsumption effect sets in and utility decreases again.

[29]For any G^1 agent, any increase of R_u above R_u^* reduces indirect utility because of overconsumption. Therefore we focus the discussion on R_u varying between zero and the individual most preferred level R_u^*.

stop supplementing, the private sector is still the preferred way of receiving additional units of insurance.

Intuitively, conditions (20) and (21) impose an upper bound on the rate of growth of the price of private insurance in response to a rise in public provision.

4.2 Characterisation of the political equilibrium

The following additional assumption is useful in order to characterise the political equilibrium.

Assumption 3

The p.d.f. of income $f(y)$ is such that median income is not above mean income.

Assumption 3 is widely supported by empirical evidence and it is a weaker version of the one traditionally adopted in the literature.[30]

In the following of the paper, we assume that conditions (20) and (21) as well as assumptions 1 - 3 are satisfied.

Lemma 3 *The share of the population supporting a ban of the public sector on redistributive grounds (i.e. the G^2 group) is always a minority.*

`Proof`. By proposition 2 a MVE always exists. Assumption 3 ensures that median income does not exceed average income, while assumption 1 guarantees that $\alpha^{*MO} > \overline{p}$. Since the partition between G^1 and G^2 depends exclusively on income, the two results together are sufficient for G^1 to collect more than half of the population. ■

We can now state the following proposition:

Proposition 3 *In equilibrium, the public provision of insurance corresponds to the most preferred level for the j-th consumer such that $j \in G^1$ and the union between all G^2 members and those members of G^1 whose $R_u^* > R_u^*(y_j, p_j)$ collects half of the population.*

[30] It is usually required that the marginal distribution of income is right skewed. Our results hold also for symmetric distributions of income and are more general than what could have been obtained under the standard assumption.

`Proof`. By proposition 2 a MVE exists and the pivotal voter is characterised by the median preferred level of R_u. By Lemma 3, we know that the pivotal voter belongs to G^1. The voting equilibrium R_u^{**} identifies three coalitions of households. One opposes any increase in public insurance and collects all G^2 members; a second one includes group 1 households who support an increase in R_u, (G^{1A}), and a third one the members of the same group who oppose it (G^{1B}).

In equilibrium it must hold that:

$$\iint_{(y,p)\in G^2} \phi(y,p)\,dydp + \iint_{(y,p)\in G^{1B}} \phi(y,p)\,dydp = \iint_{(y,p)\in G^{1A}} \phi(y,p)\,dydp = 0.5 \tag{22}$$

By (22) it follows that R_u^{**}corresponds to the most preferred level of public insurance for the agent who has the lowest demand for R_u within coalition G^{1A}. By construction, such agent is the j-th consumer as defined in the proposition.[31] ■

Remark 1 *In principle we cannot exclude that public provision is zero in equilibrium. However this occurs only if each household in G^{1B}, despite preferring a GO to a MO regime, demands zero public coverage. Empirical evidence suggests that the fraction of people who want neither public nor private health insurance is so small, that we can restrict to the case of strictly positive public provision.*[32]

Proposition 3 identifies the pivotal voter, but does not characterise the coalitions in terms of income (or ill risk). Within G^1, the demand for public insurance depends both on income and risk, therefore, to get further insights, we restrict the attention to the average income of coalitions. Some preliminary results are needed. Let RRA be the Arrow-Pratt index of relative risk aversion $-\frac{u''(c)c}{u'(c)}$.

Lemma 4 *For any G^1 household:*

[31] It is important to notice that agents j can be characterised by different vectors (y,p). The common feature of these different types is that they all display the same (median) demand for public insurance.

[32] If p is sufficiently high, the fraction of consumers who belong G^{1B} and whose $R_u^* = 0$ is null.

1. $\frac{dR_u}{dp} > 0$;

2. $RRA \leq 1 \Longrightarrow \frac{dR_u}{dy} < 0$;

3. $RRA > 1$ *is a necessary condition for* $\frac{dR_u}{dy} > 0$.

`Proof`: see appendix.

The intuition for lemma 4.1 is straightforward, while for 4.2 and 4.3, we must recall that a raise in y induces a negative substitution and a positive income effect on the demand for public insurance. The former stems both from the raise in the tax rate and the substitutability between income and indemnity in state 0. When the degree of risk aversion is low, benefits from risk spreading are low as well, and households tend to allocate additional resources to consumption rather than to the increasingly expensive public insurance. On the contrary a high degree of risk aversion is necessary for the income effect to prevail and raise the demand for public insurance with increasing levels of y.

We can now state the following proposition:

Proposition 4

1. *If* $RRA \leq 1$, *the ordering of coalitions according to the demand for public insurance in equilibrium reflects their average income.*

2. $RRA \leq 1$ *is a necessary condition for the political equilibrium to assume an "ends-against-the-middle" configuration.*

`Proof`: See appendix

4.3 Discussion

Proposition 4 shows that individual risk aversion is crucial for the structure of the political equilibrium.[33]

According to proposition 4.1 a low degree of risk aversion produces a standard MVE, even if expressed in terms of average rather than individual incomes. The poorest half of the population (G^{1A}) favours an increase in public provision, while the richest half ($G^{1B} \cup G^2$) opposes it. The coalition

[33]We will show later on that this feature plays a significant role also in evaluating the impact of adverse selection on the equilibrium amount of public provision.

supporting a reduction in the size of the public sector is formed by two separate subsets of agents. Citizens in the high income subset (G^2) vote for a complete ban of public provision for redistributive reasons. On the contrary, in the other group (G^{1B}) the demand is in general positive, although below R_u^{**}, and weighs the burden of redistribution ($\frac{y}{\overline{y}}$) against the relative efficiency of the public and private sector ($\frac{\overline{p}}{\alpha^*_{MO}}$).

Proposition 4.2 outlines that, if households have a high degree of risk aversion, a different equilibrium configuration is also possible, where coalitions opposing an increase in public provision (G^{1B} and G^2) are located at the extremes of the income distribution. That is, both the poorest and the richest class vote for a reduction in public provision.[34] On the contrary, the middle income group (G^{1A}) supports an increased level of public insurance.

Final considerations concern the impact of adverse selection on the size of the public sector. We have seen that the impossibility of premium segmentation raises the average cost of private insurance. On average, this might suggest a higher propensity for the public sector which induces a larger amount of public provision in equilibrium. We argue that, contrary to expectations, this is not likely to occur.

In particular, the size of the public sector tends to be unaffected, or at most to decrease, if the equilibrium is of the kind illustrated by proposition 4.1. The assumption that private insurers are able (or allowed) to fairly price risk implies that the choice between the public and the private sector depends also on individual sickness probability. Agents who do not change their most preferred regime, do not modify their demand for public insurance in the new environment, since the private cost of public provision is kept constant at $\frac{y\overline{p}}{\overline{y}}$. Hence the political equilibrium changes only if the identity of the median voter changes. When premia are determined on actuarially fair basis, the households in G^1, who initially preferred a GO regime, may opt for private provision if they are low-risk, high-income types. However, by lemma 4.1-4.2, we know that they belong to G^{1B} and thus oppose an increase in public provision even under adverse selection. Therefore, such shifts do not affect the equilibrium amount of public provision.

[34] The motivation for the voting decision differs in the two sub-groups. Low income households oppose public provision because the marginal utility of income prevails on redistributive benefits, while high income households do it because they bear the burden of redistribution.

Switches from a MO to a GO regime can be observed when the illness probability is so high that a G^2 household prefers the public sector to an actuarially fair private market, despite a high tax burden. The negative correlation between income and risk suggests that the share of the population with such characteristics is small. Moreover, the high income makes it unlikely for them to demand public insurance above the median level. Therefore such shifts are unlikely to affect public provision in equilibrium and if this happens, a more accurate price segmentation increases rather than decreases the size of the public sector.

Slightly different conclusions can be derived in case of the "ends-against-the-middle" equilibrium described by proposition 4.2. For switches of G^{1B} and G^2 households in favour of the MO and GO regimes respectively, the same arguments of the previous case apply. On the contrary, a shift of G^{1A} agents towards a MO regime can reduce the amount of publicly provided health insurance. Nonetheless, any household in G^{1A} is characterised by a high demand for public insurance, attesting that he is a relatively high risk type. Therefore we do not expect a substantial proportion of them to support the private sector, when premium is fixed on a fair basis.

5 Conclusions

We have studied a model of mixed public/private provision of health insurance in a context where government intervention is decided according to majority rule and private markets are affected by adverse selection. Once the political decision on the amount of public coverage is taken, consumers, who differ in income and ill risk, can choose to top it up in the private sector. An important characteristic of the model is that insurers are not able to differentiate premia according to risk classes. Prohibitions on policy underwriting is an increasingly used tool as remedy for the impossibility to get insurance against the occurrence of being classified bad risk. Therefore the pricing constraint can derive from high monitoring costs but also from public regulation aimed at favouring the access to the private market of bad risks.

The linear premium schedule implemented in the insurance market introduces an implicit subsidy from good to bad risks, since the unit price of coverage does not change with sickness probability. Consequently, agents who bear the subsidy burden underinsure themselves, while those benefiting from it purchase more coverage than under a fair premium scheme. This determines an unbalanced pool of policy holders where bad risks are overrepresented and forces private insurers to fix the premium above the average illness probability. Furthermore, any change in the amount of public provision influences the equilibrium price of the private market. Under regularity conditions, marginal increases in public coverage monotonically raise the price of insurance since crowding out affects good risks more intensively. This feedback effect is at the origin of potential nonsingle-peakedness of preferences which can compromise the stability of the political outcome.

We have shown that, for any joint distribution of income and ill risk, it is possible to identify an income threshold that divides the population into two groups. The high income class favours the ban of the public sector, while the low income class supports a positive level of public provision. Conditions that ensure the existence of a majority voting equilibrium differ between the two groups, although they have a similar intuitive interpretation: i.e. the average risk in the insured pool does not have to increase too quickly in response to a larger public coverage.

By means of additional conditions on income and risk distribution, it is possible to characterise political equilibria in terms of the average income of the coalitions. As highlighted by related literature, the mixed public/private system is the solution which receives support by the majority of the population. In our model, both the public and private sector implicitly redistribute from good to bad risks, but the former does it also from the rich to the poor. At the same time, the public sector is on average a more convenient channel to transfer purchasing power from the healthy to the ill state, since it is not affected by the individual strategic behaviour that worsen the risk pool. Contrary to expectations, this feature does not induce a stronger support for public provision when the private market are affected by adverse selection. The main justification being that, given the standard characteristics of the income-risk distribution, good risks, who benefit from a fair insurance market, oppose any raise in public provision in both institutional settings.

A severe regulatory intervention which limits premium discrimination assigns to the private sector a relevant redistributive role between risks and limits the market size because it raises the average premium. Nonetheless, according to a political economy argument, there doesn't seem to be an additional crowding out effect driven by a regulation-induced support for public provision, as sometimes argued.

6 Appendix

6.1 Proof of Lemma 1

By differentiating (6) - (7) and applying Cramer's rule we get:

$$\frac{dR_r}{dp} = \frac{\det B^p_{R_r}}{\det A} > 0 \; ; \; \frac{dR_r}{dy} = \frac{\det B^y_{R_r}}{\det A} \text{ undetermined} \tag{23}$$

with:

$$\det A = (1-p)\gamma^2 u^{''}_{00} u^{''}_{11}\alpha^2 + p u^{''}_{00} v^{''}_{qq} (1-\alpha)^2 + (1-p) u^{''}_{11} v^{''}_{qq} \alpha^2 > 0, \tag{24}$$

$$\det B^p_{R_r} = -\gamma^2 (1-\alpha) u^{''}_{00} u^{'}_0 - \gamma^2 \alpha u^{''}_{00} u^{'}_1 - (1-\alpha) v^{''}_{qq} u^{'}_0 - \alpha v^{''}_{qq} u^{'}_1 > 0,$$

$$\det B^y_{R_r} = (1-t)\left[(1-p) v^{''}_{qq} u^{''}_{11} + \gamma^2 (1-p)\alpha u^{''}_{00} u^{''}_{11} - p(1-\alpha) u^{''}_{00} v^{''}_{qq}\right],$$

where the sign of the last expression cannot in general be established. ■

6.2 Proof of Lemma 4

By construction, in the first stage, any G^1 household solves the following problem:

$$\max_{R_u} W(\cdot) = (1-p)\left\{u\left[y\left(1-\frac{\bar{p}R_u}{\bar{y}}\right)\right]\right\} + p\left[y + \left(1-\frac{y\bar{p}}{\bar{y}}\right)R_u - \gamma q^*\right] + v(q^*),$$

where the amount of q and R_r, is optimally chosen.

By the envelope theorem, the first order condition becomes:

$$(1-p)u^{'}_1(\cdot)\left(-\frac{\bar{p}y}{\bar{y}}\right) + p u^{'}_0(\cdot)\left(1-\frac{\bar{p}y}{\bar{y}}\right) = 0 \tag{25}$$

By total differentiating (25), we can prove part 1 of the lemma:

$$\frac{dR_u}{dp} = -\frac{u^{'}_0\left(1-\frac{y\bar{p}}{\bar{y}}\right) + u^{'}_1\left(\frac{y\bar{p}}{\bar{y}}\right)}{p u^{''}_{00}\left(1-\frac{y\bar{p}}{\bar{y}}\right)^2 + (1-p)u^{''}_{11}\left(\frac{y\bar{p}}{\bar{y}}\right)^2} > 0.$$

By total differentiating, (25), we get:

$$\frac{dR_u}{dy} = -\frac{p\left[u_{00}^{''}(1-t)\left(1-\frac{y\overline{p}}{\bar{y}}\right)-u_0^{'}\frac{\overline{p}}{\bar{y}}\right]-(1-p)\left(\frac{\overline{p}}{\bar{y}}\right)\left[u_{11}^{''}y(1-t)+u_1^{'}\right]}{pu_{00}^{''}\left(1-\frac{y\overline{p}}{\bar{y}}\right)^2+(1-p)u_{11}^{''}\left(\frac{y\overline{p}}{\bar{y}}\right)^2} \tag{26}$$

Recalling that $y(1-t) = c_1$, it immediately follows that relative risk aversion below 1 is a sufficient condition for (26) to be negative. This proves part 2 of the lemma. Again, by inspection of (26), it turns out that a relative risk aversion above 1 is necessary but not sufficient for the demand for public insurance to increase with y, as stated in part 3 of the lemma. ■

6.3 Proof of Proposition 4

Lemma 4.1 shows that for any income class in G^1, the demand for public insurance raises with ill risk. By lemma 4.2, if the relative risk aversion is below 1, demand decreases with income within any risk class. Together with the fact that income and risk are negatively correlated, this proves that:

$$E\left(y|\left(y,p\right)\in G^{1A}\right) < E\left(y|\left(y,p\right)\in G^{1B}\right). \tag{27}$$

Recalling that the endowment for any household in G^2 is above the one of any agent in G^1, expression (27) is sufficient to prove proposition 4.1.

By lemma 4.3, a relative risk aversion above 1 is necessary, although not sufficient, for:

$$E\left(y|\left(y,p\right)\in G^{1A}\right) > E\left(y|\left(y,p\right)\in G^{1B}\right). \tag{28}$$

If condition (28) is satisfied the political equilibrium assumes the "ends-against-the middle configuration" since agents supporting a reduction in public provision belong both to the poorest $\left(G^{1B}\right)$ and to the richest (G^2) coalitions. This proves part 4.2 of the proposition ■

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