ISSN: 1466-0814

THE POLITICAL ECONOMY OF A PUBLICLY PROVIDED PRIVATE GOOD WITH ADVERSE SELECTION

Sophia Delipalla and Owen O'Donnell

October 1999

Abstract

Given heterogeneity in incomes and health risks, with asymmetric information in the latter, preferences over the public-private mix in health insurance and care are derived. Results concerning crowding-out in the presence of adverse selection are established. For low-risk individuals, crowding-out depends on risk aversion. A set of such individuals prefers a mixed public-private health care system. A majority-voting equilibrium exists. Under weak assumptions about the income distribution and tax function, both public and private sectors exist in the equilibrium. Comparing information regimes, public provision is more likely to be positive, and will not be lower, under asymmetric information. In the presence of asymmetric information, the equilibrium is more complicated than the "ends-against-the-middle" variety derived elsewhere in the literature.

JEL Classification: D82, H42, H51, H11

Keywords: Public provision of private goods; health insurance; health care; adverse selection; public choice.

Acknowledgements: We thank the Athens University of Economics and Business and the University of Macedonia for their hospitality during the writing of this paper. We are grateful for comments received at the 2nd iHEA Conference, Rotterdam, June 1999. We also thank Andy Dickerson for helpful comments.

Address for correspondence: Department of Economics, Keynes College, University of Kent, Canterbury CT2 7NP, UK. Tel: (44 1227) 827924/827415; Fax: (44 1227) 827850; email: S.Delipalla@ukc.ac.uk, O.A.O'Donnell@ukc.ac.uk

THE POLITICAL ECONOMY OF A PUBLICLY PROVIDED PRIVATE GOOD WITH ADVERSE SELECTION

1. Introduction

A large part of government activity is concerned with the finance, and often direct provision, of private goods, such as health care or education. Understanding both the reasons and the consequences of such activity represent important tasks for public economics. In the literature, these tasks tend to be conducted in isolation. Normative analyses concentrate on evaluating the efficiency consequences of public provision of private goods in the presence of market failure or information constraints on redistributive policy. Positive analyses show how public provision of private goods can be understood as the result of some political process through which sections of the population sustain policies which are redistributive in their favour. Such analyses are conducted ignoring the market failure and information problems which underlie the normative literature. Two problems arise. First, the explanations for public provision of private goods generated by the positive literature are likely to be incomplete. Second, evaluation of the efficiency properties of the political equilibrium outcome is severely limited given comparison is with an infeasible first- best world. Blomquist and Christiansen (1999) address this deficiency, conducting positive and normative analyses recognising information constraints on redistributive policy but assuming perfectly functioning markets. In this paper, we present a positive analysis of public provision of a private good which is subject to a market failure.

We examine preferences over government and market provision of a private good for which demand is uncertain and information asymmetry leads to an adverse selection problem. The good can be thought of as health care. Although the mix between public and private health care varies across countries, the degree of government involvement is seldom less than substantial (OECD, 1998). This is usually attributed to distributional concerns and market failures (*c.f.* Besley and Gouveia, 1994). This paper is the first attempt to examine formally political support for publicly provided health care within an environment of market failure. Besides adverse selection, health care markets are prone to other important problems, such as incomplete consumer sovereignty and moral hazard. As in Gouveia (1997), we choose to concentrate on the first problem since heterogeneity in health risks, together with income variation, are likely to be the main determinants of the distribution of preferences over the public-private health care mix. Once heterogeneity in health risks is recognised, examination of the consequences of their imperfect observation becomes a priority. We tackle this problem by extending the model of Gouveia (op cit) to incorporate the adverse selection problem.

Positive political economy analyses of the public provision of private goods fall into three main categories. First, examination of public monopoly provision against a completely free market alternative (*c.f.* Buchanan, 1970; Spann, 1974; Usher, 1977; Wilson and Katz, 1983).[1] Support for the socialised option is a function of the distribution of tastes and income. Second, there is the Stiglitz (1974) model in which the public and private sectors can co-exist but each individual can consume only from one or the other. This generates the well-known result of non-single peaked preferences and, potentially, no majority voting equilibrium.[2] The third class of models avoids this problem by assuming individuals can consume from both sectors simultaneously. Private consumption is then a supplement to the public service. In this case, with varying degrees of justification, the potentially publicly provided good has

---

[1] Wilson and Katz (1983) consider support for a price subsidy which, unlike in the other papers cited, need not be 100%.

[2] Epple and Romano (1996a) identify the restrictions on preferences which guarantee an equilibrium in such a model and characterise the equilibria which emerge under different preferences restrictions.

been referred to as health care (Petersen, 1986; Pauly, 1992; Epple and Romano, 1996b; Gouveia, 1997). It is an obvious simplification to assume private consumption can top-up public provision of all types of health care. However, a model in which a limited quantity or range of services is provided by the public sector and the individual must go to the private sector for consumption beyond these limitations is a reasonable representation of reality in many health care systems, e.g. the U.S. Medicare system or the limited public cover provided in many European countries. We assume this supplementary relationship between private and public care.

Both Petersen (1986) and Epple and Romano (1996b) consider a model in which utility is derived from composite consumption (*c*) and a particular private good, which they refer to as health care (*h*). The latter is the sum of consumption from the market (*m*) and public (*g*) sectors. Public provision is financed by a proportional income tax. A majority-voting rule (MVR) equilibrium is shown to exist with the equilibrium *g* being the median preferred level. Income, the only source of heterogeneity, determines preferences over *m* and *g* though their relative price. Given the assumed proportionality of the tax function, individuals with incomes below (above) the mean face a tax price below (above) the market price and prefer all (no) health care to be supplied by the government. Assuming a right-skewed income distribution, the median income lies below the mean and so the equilibrium *g* will be positive. However, in equilibrium, health care is not only supplied by the public sector, a mixed public-private system (GM) being majority preferred to either government only (GO) or market only (MO) provision. As is obvious, in comparison with the first best, the equilibrium is Pareto inefficient. Further results can be obtained if restrictions are imposed on preferences, *i.e.* the relative magnitude of income and price elasticities (Kenny, 1978). Under the assumption, which has empirical support in the case of health care, that the magnitude of the income elasticity exceeds that of the price elasticity, the median voter has less than median income and the political equilibrium is of the "ends-against-the-middle" variety (Epple and Romano, 1996b). That is, due to income effects and tax burden effects, the bottom and top of the income distribution prefer lower levels of public provision in comparison with the middle income groups. Further, equilibrium *g* in the GM equilibrium will be less than that which would arise under GO (Petersen, 1986; Epple and Romano, 1996b), while aggregate *h* in the GM equilibrium exceeds that which would arise with either GO or MO (Epple and Romano, 1996b).[3]

While Petersen (1986) and Epple and Romano (1996b) refer to the good on the agenda for public provision as health care, as Blomquist and Christiansen (1999) point out, there is nothing in the model to differentiate it from any private good one would care to think of. By allowing for demand uncertainty and so introducing an insurance market, Gouveia (1997) provides a better characterisation of health care. He also relaxes the assumption of a proportional tax function. In this context, a MVR equilibrium still exists and it will not be of the GO type. However, Gouveia can only show the equilibrium is the GM type under the assumption that all loss probabilities (health risks) are equal.[4] Individuals still prefer either all *g*, or all *m*, depending upon their relative tax price being less, or greater, than 1 but now the relative price varies with health risks in addition to income. Under a restriction on preferences similar to that of Kenny (1978) and an upper bound on the correlation between income and health risks, the equilibrium is again of the "ends-against-the-middle" variety.

The Gouveia (1997) paper is valuable in demonstrating the assumptions which must be made for results to carry over to an environment with uncertainty and heterogeneity in risks and income. However, few new results are generated. The reason is that the insurance

---

[3] The latter result requires homothetic preferences.
[4] In addition to the more innocuous assumptions of a right-skewed income distribution and a non-regressive tax function.

market is assumed to operate perfectly. The motivation for individuals to support public provision remains the opportunity to affect redistribution in their favour. As Blomquist and Christiansen (1999) argue, and Epple and Romano (1996b) concede, this motivation would disappear if the tax function were allowed to be sufficiently flexible. Given perfect markets and no information constraints on tax policy, cash redistribution Pareto dominates tax financed in-kind transfers. Blomquist and Christiansen (1999) show, without resorting to *ad hoc* restrictions on the tax function, that public provision of private goods can emerge as the outcome of the political process when information constraints on tax policy are recognised. In this paper, we show political support for public provision of private goods can arise when the assumption of perfect markets, in particular insurance markets, is relaxed. Whereas Blomquist and Christiansen show that, in part, political support for public provision derives from the consequent slackening of the self-selection constraint on the optimal tax, in our case public provision slackens the self-selection constraint on the insurance market equilibrium.

There is a substantial literature on the adverse selection problem in insurance markets with normative evaluation of the government role. The famous papers of Akerlof (1970) and Rothschild and Stiglitz (1976) demonstrated that, when there is asymmetric information on loss probabilities, a pooling equilibrium is not possible and a separating Nash equilibrium may not exist. Wilson (1977) found equilibrium always exists if the assumption of Nash behaviour is replaced by a specific kind of foresight. Miyazaki (1977) and Spence (1978) combined the idea Wilson foresight with cross-subsidisation across high-risk and low-risk contracts to give the Wilson-Miyzaki-Spence (WMS) equilibrium. This always exists and is second-best (information constrained) efficient (Crocker and Snow, 1985a). The efficiency result arises because by susbidising high-risk contracts, the self-selection constraint is slackened, allowing better low-risk contracts to be offered. With respect to the normative role of government, Crocker and Snow (1985a, 1985b) demonstrate that any second-best efficient allocation can be sustained as either a WMS or a Nash equilibrium through the levy of an appropriate set of taxes and subsidies on insurance contracts. Dahlby (1981) has shown that compulsory public insurance with supplementation allowed through the private market can duplicate the WMS equilibrium and hence achieve second-best efficiency. The public insurance effectively works as a (poll) tax financed subsidy from low- to high-risks.

Our departure from this adverse selection literature is threefold. First, we seek to understand the political motivation for government intervention in the presence of adverse selection, rather than evaluating the efficiency consequences of such intervention. Second, the normative literature is based on the Rothschild-Stiglitz model in which there is heterogeneity only in loss probabilities. We add income variation. Third, the monetary loss in the Rothschild-Stiglitz model is exogenous. In our model, the individual faces the prospect of an exogenous loss in health but the monetary implications of this are endogenous – the individual chooses how much to spend on health care and this will vary across individuals with their income level.

The paper is organised as follows. In the next section we describe the model and examine preferences over private health care, private insurance and public provision. As in the Rothschild-Stiglitz model, it is shown that low-risks cannot be offered full insurance contracts. Results concerning the crowding-out of private by public care are derived. In section 3, we examine the existence and nature of the political equilibrium, focussing on the public-private mix and the relation between income and preferences for public provision relative to the equilibrium level. The final section concludes.

2. The model

2.1 Set up and assumptions

The set up of the model draws heavily on Gouveia (1997). We extend the latter to allow asymmetric information in loss probabilities and, given this, restrict attention to the simple case with two risk types. For high-risk types the probability of becoming sick is p^B, and for low-risk types it is $p^G < p^B$. The proportion of the population who are high (or bad) risks is λ. The population is divided into K income groups. Within income group *k*, each individual has income y_k and the proportion of high-risks is λ_k.

There are two states of nature: health (state 1) and sickness (state 2). In state 1, utility is $U_1 = u(c_1)$, where c_1 is consumption of the numeraire good. We assume, $u'(.) > 0$, $u''(.) < 0$, $c \in R^+$ and $u'(c) \to \infty$ as $c \to 0$. In state 2, utility is $U_2 = u(c_2) + \upsilon(h)$. That is, utility depends on both consumption of the numeraire good and health care, *h*. We assume, $\upsilon(0) < 0$, $\upsilon'(.) > 0$, $\upsilon''(.) < 0$ and $\upsilon'(h) \to \infty$ as $h \to 0$. So, preferences over medical care are introduced explicitly, in contrast to the standard adverse selection model of health insurance which assumes a fixed expenditure on medical care in the sickness state (*c.f.* Zweifel and Breyer, 1997).

Potentially, both the public (*g*) and private (*m*) sectors provide health care. The sectors are assumed to be supplementary, such that, $h = m + g$. Note it is assumed there are no quality differences between the two sectors. We also assume the government sector is as cost-efficient as the private market, with health care being produced at a constant marginal cost, γ. The private sector is assumed competitive. The difference between public and private supply is in the quantities available and the prices charged. A fixed amount of public care is available, at no charge, to all individuals who become sick. The quantity of private care consumed is constrained only by the individual's budget.

There is a competitive health insurance market where firms hold Nash-conjectures and face zero transaction costs. Contracts are therefore priced at fair premiums, $\pi^i = p^i$, $i = B, G$; where π^i is price per unit of insurance. Knowledge of p^i is private information. Everything else is public information. This set up leads to a problem of adverse selection with an endogenous monetary loss (γm). In the conventional adverse selection model of insurance, the monetary loss is exogenous. As noted above, in the context of health insurance, such a model does not capture the motivation for expenditure on health care. In our model, the health loss faced by the individual is exogenous but the monetary consequences of this loss, i.e. health care expenditure, depend upon their preferences and, ultimately, their income. Placing health care expenditure within the control of the individual might be expected to result in a moral hazard problem. In order to avoid this, we assume the insurance company can observe the state of nature, and pays out the sum insured accordingly. Examination of the adverse selection problem with an endogenous monetary loss is a by-product of our analysis.

Demand for private care, and therefore insurance, varies with income. A competitive insurance market will respond with different levels of insurance offered to suit the optimal quantity of each income group. With asymmetric information in loss probabilities, this potentially leads to a complicated problem in which contracts must be offered such that high risks do not prefer a contract offered to low risks in their own, or any other, income group. In order to avoid this complexity, we assume income is public information and the insurance market separates by income group. That is, an individual can only purchase a contract written for their income group. The prevalence of employer based health insurance suggests the market does operate with good income information.

Turning to government supply, we assume universal provision of an amount of health care, g, to all sick individuals at a cost γg. Finance is by an income tax, $\tau_k = \tau(y_k)$,

$\tau'(.) > 0$.[5] If we denote by N the total number of individuals in the population, and by n_k the number of individuals within income group k, the government's (per capita) budget constraint is given by

$$\sum_k \delta_k \overline{p}_k \gamma g \le \sum_k \delta_k \tau(y_k) \tag{2.1}$$

where $\delta_k = \frac{n_k}{N}$ and $\overline{p}_k = \lambda_k p^B + (1-\lambda_k) p^G$.

The tax price of health insurance relative to the market price is then

$$T_k^i = \frac{\tau(y_k)}{p^i \gamma g} = \frac{\tau(y_k)}{\sum_k \delta_k \tau(y_k)} \frac{\overline{p}}{p^i} = t(y_k) \frac{\overline{p}}{p^i}, \tag{2.2}$$

where $\overline{p} = \sum_k \delta_k \overline{p}_k$; the second equality in (2.2) follows from (2.1) assuming a binding constraint and the last equality is simply definitional. As with other papers in the literature, this relative tax price plays an important role in the results.

We model an individual's choice as a three-stage problem and solve it using backwards induction. In the first stage individuals vote on g. In the second stage, firms offer insurance contracts and individuals select a level of cover (I) for a given g.[6] In the final stage, the state of nature is revealed and, if sick, individuals choose a level of private health care m for a given I and g.

It will prove convenient for later, to define

$$w_{k1}^i = y_k - T_k^i p^i \gamma g - \pi^i \gamma I \tag{2.3}$$

and

---

[5] This could be an earmarked tax but it need not be. The function simply represents the distribution of the extra tax burden arising from health care expenditure.
[6] To be precise, there are really two stages here. Firms offer insurance contracts in the first stage and individuals select from these in the second.

$$w^i_{k2} = y_k - T^i_k p^i \gamma g + (1-\pi^i)\gamma I - \gamma m \tag{2.4}$$

for wealth, net of tax and health insurance and care payments, in state 1 and state 2 respectively of an individual in risk group *i* and income group *k*.

2.2 Stage three: Choice over private health care

Each (i,k) type faces the following problem after the state of nature is revealed,

$$\max_{m} u(y_k - T^i_k p^i \gamma g + (1-\pi^i)\gamma I - \gamma m) + \upsilon(g+m) \tag{2.5}$$

subject to $m \geq 0$. The complementary-slackness condition

$$-u'(w^i_{k2})\gamma + \upsilon'(g+m^*) \leq 0, \quad m^* \geq 0, \quad m^*[-u'(w^i_{k2})\gamma + \upsilon'(g+m^*)] = 0 \tag{2.6}$$

determines the demand for private health care, $m^*(g, I; \gamma, y_k, p^i)$. Then, we get

Proposition 1: *For positive quantities, the demand for private health care is affected by*

(a) private insurance as

$$0 < \frac{\partial m^*}{\partial I} = \frac{(1-\pi^i)\gamma}{\gamma + \dfrac{\upsilon''(g+m^*)}{u''(w^i_{k2})\gamma}} < 1 \tag{2.7}$$

and

(b) public insurance, at a given private insurance level, as

$$\left.\frac{\partial m^*}{\partial g}\right|_I = -\frac{T^i_k p^i \gamma + \dfrac{\upsilon''(g+m^*)}{u''(w^i_{k2})\gamma}}{\gamma + \dfrac{\upsilon''(g+m^*)}{u''(w^i_{k2})\gamma}} < 0, \tag{2.8}$$

with

$$\left|\frac{\partial m^*}{\partial g}\right| \gtreqless 1 \quad as \quad T_k^i p^i \gtreqless 1. \tag{2.9}$$

Proof: Equations (2.7) and (2.8) are derived applying the implicit function theorem in (2.6) for $m^* > 0$. ||

(a) Note that $\frac{\partial m^*}{\partial I}$ is just an income effect. Since both consumption of the numeraire good and health care are normal, (2.7) is positive and less than one. The expression depends upon π^i and γ since these parameters determine the cost of a unit expansion in *I* and therefore its impact on net wealth (w_2).

(b) Public provision crowds out private demand, at given *I*.[7] The degree of this direct crowding out depends upon the individual's tax payment relative to the average (see (2.9) and (2.2)). Direct crowding out can only be 100%, or higher, if the individual is greater than an average taxpayer. If we assume non-regressivity of the tax function and a right-skewed income distribution, such that median income is less than that consistent with the average tax payment, then direct crowding out will be less than 100% for the majority of individuals. The intuition behind this crowding out result is simple. A unit of public care substitutes for a unit of private care with no change in utility and a saving of γ from reduced private expenditure. However, tax expenditure rises by $T_k^i p^i \gamma$. If $T_k^i p^i = 1$, the two effects on net income cancel out and total health care demand remains constant. If $T_k^i p^i < 1$, net income rises, the demand for health care increases and so private care falls by less than the increase in public care. The opposite is true if $T_k^i p^i > 1$.

[7] Public provision (*g*) also has an indirect effect on private health care demand (*m*) through the choice of insurance level (*I*). We will see this in the next section.

2.3 Stage two: Choice over level of private insurance

In the second stage, for a given level of *g*, firms offer insurance contracts and individuals select from them, taking into account the effect on the optimal level of private health care, $m*$. As stated above, firms are assumed to observe incomes and are therefore able to restrict individuals to purchase a contract consistent with their own income group. The Nash equilibrium within each market, defined by income group, is then given as the solution to the following problem (income subscripts have been dropped):[8]

$$\max_{I^G, I^B} (1-p^G)u(w_1^G) + p^G[u(w_2^G) + \upsilon(g + m*^G)] \tag{2.10}$$

subject to

$$(1-p^B)u(w_1^B) + p^B[u(w_2^B) + \upsilon(g + m*^B)] \geq (1-p^B)u(w_1^G) + p^B[u(w_2^G) + \upsilon(g + m*^G)] \tag{2.11}$$

$$\pi^i = p^i \quad i = B, G \tag{2.12}$$

$$I^B \geq 0, \quad I^G \geq 0, \tag{2.13}$$

where (I^B, I^G) are the levels of insurance cover provided by high-risk and low-risk contracts respectively and $(m*^B, m*^G)$ are the optimal values for private health care given by (2.6) for each *I* and *g*. (w_1^B, w_1^G) and (w_2^B, w_2^G) are the consequent net income levels in state 1 and 2 (all for a given income group).

So, equilibrium levels of insurance, (I^{G*}, I^{B*}), solve the problem of maximising expected utility for the low-risk individuals, subject to the self-selection constraint for the

---

[8] We assume a Nash equilibrium exists. From Rothschild and Stiglitz (1976), it is well known that a Nash equilibrium need not exist (if there are sufficiently few high-risks).

high risks (2.11), and break-even constraints on each contract (2.12). The first-order conditions are:

$$-(1-p^G)p^G\gamma[u'(w_1^G)-u'(w_2^G)]-p^G\frac{\partial m^G}{\partial I^G}[u'(w_2^G)\gamma-\upsilon'(g+m^G)]+$$
$$\mu\{\gamma[(1-p^B)p^G u'(w_1^G)-(1-p^G)p^B u'(w_2^G)]+p^B\frac{\partial m^G}{\partial I^G}[u'(w_2^G)\gamma-\upsilon'(g+m^G)]\}\leq 0;$$
$$I^G\geq 0 \tag{2.14}$$

with respect to I^G;

$$\mu\{-(1-p^B)\gamma[u'(w_1^B)-u'(w_2^B)]+[\upsilon'(g+m^B)-u'(w_2^B)\gamma]\frac{\partial m^B}{\partial I^B}\}\leq 0;\quad I^B\geq 0 \tag{2.15}$$

with respect to I^B; and

$$(1-p^B)u(w_1^B)+p^B[u(w_2^B)+\upsilon(g+m^B)]-(1-p^B)u(w_1^G)-p^B[u(w_2^G)+\upsilon(g+m^G)]\geq 0;$$
$$\mu\geq 0 \tag{2.16}$$

with respect to the multiplier; all three with complementary slackness.

Consider the optimal insurance contract for high-risks. Equations (2.6) and (2.15) imply that $I^{B*}=0$ when $m^{B*}=0$, and $I^{B*}>0$ when $m^{B*}>0$. In the latter case, equations (2.6) and (2.15) imply that residual incomes must be the same in both states of nature (i.e. $w_1^B=w_2^B\Rightarrow I^B=m^B$). So, the conventional result of full insurance for bad risks extends to the case of an endogenous monetary loss. In this context, full insurance means that insurance cover is equal to the amount the individual chooses to spend on medical care, given that level of cover. For a given *I*, the individual knows their optimal expenditure on medical care (*m**). The individual chooses I taking into account the impact on both the marginal utility of wealth and the marginal utility of health care. Optimal $I*$ is achieved when $u'(w_1) = u'(w_2) = \frac{\upsilon'(h)}{\gamma}$.

For the low-risks, equations (2.6) and (2.14) imply that $m^{G*} > 0$ and $I^{G*} > 0$ when the following holds:

$$-u'(w_1^G)p^G[(1-p^G)-\mu(1-p^B)] + u'(w_2^G)(1-p^G)(p^G - \mu p^B) = 0. \tag{2.17}$$

Re-arranging,

$$\frac{u'(w_2^G)}{u'(w_1^G)} = \frac{(1-p^G)p^G - \mu(1-p^B)p^G}{(1-p^G)p^G - \mu(1-p^G)p^B}. \tag{2.18}$$

If the self-selection constraint is binding $(\mu > 0)$, full insurance is not possible. The only feasible solution is under-insurance (i.e. $w_1^G > w_2^G \Rightarrow I^G < m^G$).[9]

Proposition 2: *When private health insurance is supplementary, there is asymmetric information in respect of sickness probabilities, and private medical care is chosen by the individual, then, in the Nash equilibrium, the private market delivers full insurance for high risks and under-insurance for low risks at fair premiums.*

---

[9] If $\mu < (p^G / p^B)$, the numerator and denominator of the right-hand-side (2.18) are both positive and the numerator is greater than the denominator due to the relative sizes of p^G and p^B. If $(p^G / p^B) < \mu < 1$, the denominator is negative and the numerator positive, which is not feasible given the left-hand-side. If $\mu > 1$, both the denominator and numerator are negative, with the absolute value of the former exceeding that of the latter. This would indicate over-insurance. This is also a potential solution in the Rothschild-Stiglitz model but is ruled out by the assumption that the indifference curves of low risks are steeper everywhere than those of high risks.

This result is familiar from the standard literature on adverse selection in insurance markets. The contribution here is to show that the result extends to an environment with an endogenous monetary loss; that is, when the medical expenditure in the bad state is not exogenously given but is determined by individual choice.

Due to the differences in insurance cover provided by the market, the impact of public provision on private insurance and care differs between the two risk groups. For high-risks, the crowding-out effect is identical to that given in Gouveia (1997, p.231) for the case in which there is perfect information and so all individuals are fully insured.

Proposition 3: *For high-risks, the effect of publicly provided health care on the demand for private health insurance and care is given by*

$$\frac{\partial I^B}{\partial g} = \frac{\partial m^B}{\partial g} = -\frac{T_k^B p^B \gamma + \dfrac{\upsilon''(g + m^{*B})}{u''(w_2^B)\gamma}}{p^B \gamma + \dfrac{\upsilon''(g + m^{*B})}{u''(w_2^B)\gamma}} < 0, \tag{2.19}$$

with

$$\left|\frac{\partial I^B}{\partial g}\right| = \left|\frac{\partial m^B}{\partial g}\right| \begin{matrix} > \\ - \\ < \end{matrix} 1 \quad as \quad T_k^B \begin{matrix} > \\ - \\ < \end{matrix} 1.$$

Proof: Bad risks are fully insured, $I^{B*} = m^{B*}$. Substitution of this equality in (2.6) and applying the implicit function theorem gives (2.19). ||

This differs from the effect given in Proposition 1(b) in that the latter was derived holding the level of private insurance constant. In that case, the magnitude of the crowding-out effect depended on the tax price of public care ($T_k^i p^i \gamma$) relative to the out-of-pocket price of private care (γ). When the insurance level is allowed to vary, the total crowding-out effect depends upon the tax price relative to the private insurance price $(p^B\gamma)$. Given $I^{B*} = m^{B*}$, when a unit of public care is substituted for a unit of private care, there is a saving of $p^i\gamma$ in insurance payments. However, tax expenditure rises by $T_k^i p^i \gamma$. If the relative tax price is 1, residual income remains constant and there is no change in the demand for health care. Crowding-out is 100%. When $T_k^i > 1$, substitution of a unit of public insurance for a unit of private results in a fall in residual income. The demand for health care falls and crowding-out must be greater than 100%.

Low-risks are underinsured and so the crowding-out effect on private care is not constrained to be equal to that on private insurance. The total effect of public provision on the demand for private health care is given by

$$\frac{dm^G}{dg} = \left.\frac{\partial m^G}{\partial g}\right|_I + \frac{\partial m^G}{\partial I^G}\frac{\partial I^G}{\partial g}. \qquad (2.20)$$

Then, using Proposition 1, we have

Proposition 4: *For low-risks, the total effect of publicly provided health care on the demand for private health care is given by*

$$\frac{dm^G}{dg} = -\frac{T^G p^G \gamma + \dfrac{\upsilon''(g+m^{*G})}{u''(w_2^G)\gamma}}{\gamma + \dfrac{\upsilon''(g+m^{*G})}{u''(w_2^G)\gamma}} + \frac{(1-p^G)\gamma}{\gamma + \dfrac{\upsilon''(g+m^{*G})}{u''(w_2^G)\gamma}}\frac{\partial I^G}{\partial g}, \qquad (2.21)$$

with

$$\frac{\partial I^G}{\partial g} = -T^G\left\{\frac{\dfrac{u''(w_1^G)}{u'(w_1^G)} - \dfrac{u''(w_2^G)}{u'(w_2^G)}}{\dfrac{u''(w_1^G)}{u'(w_1^G)} + \dfrac{u''(w_2^G)}{u'(w_2^G)}\dfrac{(1-p^G)}{p^G}}\right\}. \qquad (2.22)$$

Proof: Equation (2.22) is derived applying the implicit function theorem on (2.17). ||

Note that (2.22), and therefore (2.21), can be either positive or negative depending on assumptions about risk-aversion.[10] With decreasing (increasing) absolute risk-aversion, (2.22) is positive (negative). When g rises, net income falls. With decreasing absolute risk aversion, the degree of under-insurance the individual is willing to bear will decrease. Private insurance must rise relative to private care. A positive sign on (2.22), together with (2.7), ensures this. On the other hand, with increasing risk aversion, under-insurance must rise with a fall in net income. Private insurance must fall relative to private care which, given (2.7), requires a negative sign on (2.22).

For bad risks, the crowding-out effect is unambiguously negative. There is a direct substitution of public for private care and, depending upon the relative tax price, there may be an income effect, which will either exaggerate or mitigate this direct substitution. For the good risks, there is a direct substitution of public for private care but there is also an effect through private insurance which depends upon risk-preferences. With decreasing absolute risk-aversion, the two effects go in opposite directions. With increasing absolute risk-aversion, both effects are negative. This is a very interesting result: the presence of asymmetric information can affect both the sign and magnitude of the crowding-out effect for good risks. Under the more plausible assumption of decreasing absolute risk aversion, the total crowding-out effect is ambiguous. Crowding-in is theoretically possible but is unlikely to arise in practice. However, the magnitude of the crowding-out effect is reduced relative to that derived under the assumption of full information.

---

[10] The Arrow-Pratt measure of absolute risk-aversion is, $-u''(w)/u'(w)$.

2.4 Stage one: Choice over level of public health care

In the first stage, individuals vote on the level of public health care, taking into account the effect on the optimal demand for private insurance and care. In establishing preferences over public provision, it will be convenient to refer to a level of provision, $\hat{g}$, such that $g \in [0, \hat{g})$ implies $m^* > 0$, and $g \in [\hat{g}, G]$ implies $m^* = 0$. For high-risks, the existence of such a threshold follows from (2.19). For low-risks, given (2.21), a threshold is guaranteed to exist under increasing absolute risk aversion. For the case of decreasing absolute risk aversion, we assume the total effect of *g* on *m* is always negative.

For high-risk individuals, who can finance supplementary private care through full insurance, preferences over public care are the same as those given in Lemma 4 of Gouveia (1997). That is,

Proposition 5: *When private health care is supplementary and there is asymmetric information in respect of sickness probabilities, the preferences of high-risk individuals over public care are single peaked with the ideal point given by:*

$$g^{B*}(y_k, p^B) = \begin{cases} H(T_k^B \gamma, y_k, p^B) & if \quad T_k^B \leq 1 \\ 0 & if \quad T_k^B > 1 \end{cases} \tag{2.23}$$

where $H(T_k^B \gamma, y_k, p^B)$ *is demand for total health care purchased at a price of* $T_k^B \gamma$ *(equivalently, preferred provision in a purely public system).*

Proof: See Appendix and Gouveia, (1997, p.243). ||

Individuals with $T_k^B > 1$ can get full insurance in the private market at a fair premium. They will not want any government insurance at a less than fair premium. For individuals with $T_k^B = 1$, the prices of public and private care are identical. Thus, they care only about the amount of total health care and are indifferent to its composition. For convenience, we assume $g^{B*}(y_k, p^B) = H(\gamma, y_k, p^B)$, where the latter is optimal total health care demanded at a price of $T_k^B\gamma = \gamma$. If $T_k^B < 1$, the tax price of health care is less than the market price. If the individual were to purchase some positive *m*, an increase in *g* would always make them better off (since they replace *m* with *g* at a lower cost).

We now examine the effect of varying *g* on the optimised expected utility of good risks. At any $g \in [0, \hat{g}]$, this effect is obtained by applying the envelope theorem on the Lagrange function of problem (2.10)-(2.13), evaluated at the optimal solution (I, m^*), and using (2.17):

$$\frac{dU^G}{dg} = (p^G - \mu p^B)[-u'(w_{k2}^G)\gamma T_k^G + \upsilon'(g + m^{G*})] + \mu p^B[-u'(w_{k2}^B)\gamma T_k^B + \upsilon'(g + m^{B*})] \qquad (2.24)$$

At any $g \in [\hat{g}, G]$, the effect is given by[11]

$$\frac{dU^G}{dg} = -u'(w_{k2}^G)T_k^G\gamma + \upsilon'(g). \qquad (2.25)$$

Note that (2.25) can only be zero and consistent with (2.6) if $T_k^G \leq 1$. So, there cannot be a solution for *g* which implies $m^{G*} = 0$ if $T_k^G > 1$. The same argument applies for high-risks.

Proposition 6: *When private health care is supplementary and there is asymmetric information in respect of sickness probabilities, the preferences of low-risk individuals over the level of public health care are single-peaked, with the ideal point given by:*

[11] Using $w_1^G = w_2^G$ when $m^G = I^G = 0$.

$$g^{G*}(y_k, p^G, p^B) = \begin{cases} H(T_k^G \gamma, y_k, p^G) & if \;\; T_k^G \leq 1 \\ 0 < g^{G*}(y_k, p^G, p^B) < H(T_k^G \gamma, y_k, p^G) & if \;\; T_k^G > 1 \; and \; T_k^B < 1 \\ 0 & if \;\; T_k^G > 1 \; and \; T_k^B \geq 1 \end{cases}$$

(2.26)

Proof: See Appendix**.** ||

These preferences differ from those derived previously in the literature where individuals either preferred no government provision $(g^* = 0)$ or all government provision $(g^* = H)$ depending upon whether the relative tax price is greater or less than 1 (Petersen, 1986; Epple and Romano, 1996b; Gouveia, 1997). In our model, there is a set of individuals who face a relative tax price greater than 1 but prefer a mixed public-private system. For such individuals, the direct impact of government expenditure on their utility is negative, given the government supplies health insurance at a cost greater than the free market price. However, these individuals are underinsured. Provided the high-risks within an income group benefit from public supply, i.e. $T_k^B < 1$, an increase in g can also benefit the low-risks through relaxation of the self-selection constraint. The increase in g raises the reservation utility of the high-risks and so allows the market to increase the amount of insurance offered on low-risk contracts. This is the same mechanism that lies behind the optimal tax/subsidy and compulsory public insurance policies analysed by Crocker and Snow (1985a, 1985b) and Dahlby (1981) respectively. We will now examine the political consequences of these preferences. Given there is a group which prefers a positive level of public provision despite facing a tax price greater than the market price, one might conjecture that public provision is more likely to be a feature of the political equilibrium in this model than in one which assumes perfect information. This will be proved in the next section.

3. Political Equilibrium

3.1 Existence of Equilibrium

For convenience, we summarise preferences for public provision across the whole population as follows.

Proposition 7: *When private health care is supplementary and there is asymmetric information in respect of sickness probabilities, preferences over publicly provided health care are single peaked with the ideal point given by:*

$$g^{i*}(y_k, p^G, p^B) = \begin{cases} H(T_k^i \gamma, y_k, p^i) & \text{if } \; T_k^i \leq 1 \\ 0 < g^{G*}(y_k, p^G, p^B) < H(T_k^i \gamma, y_k, p^i) & \text{if } \; i = G,\ T_k^G > 1 \text{ and } T_k^B < 1 \\ 0 & \text{otherwise} \end{cases} \tag{3.1}$$

Proof: See proofs of Propositions 5 and 6. ||

Using the conventional definition of a majority rule equilibrium (Mueller, 1989), we have:

Proposition 8: *A majority rule equilibrium g_m exists and is the median $g^{i*}(y, p^G, p^B)$.*

Proof: By Proposition 7, we have single peaked preferences defined over a one- dimensional issue and so Black's theorem applies (Mueller, 1989). ||

This result depends on the assumption that the nature of the tax function is determined outside of the model and it is restricted to be linear in a single parameter. Given this assumption, there is a one to one correspondence between each *g* and the value of the tax parameter and so voting is over a one-dimensional issue. Generalising the analysis to a non-linear tax system would introduce two complications. First, voting would no longer be over a one-dimensional issue and a MVR equilibrium may no longer exist (Mueller, 1989). Second, extending the argument of Blomquist and Christiansen (1999), the redistribution possibilities made available by a non-linear tax will reduce support for public provision of a private good. However, unlike earlier models, political support would not completely disappear since, besides its redistributive role, public provision attracts support through its impact on the private insurance market.

3.2 Characteristics of Equilibrium: The Public-Private Mix

In the models of Petersen (1986) and Epple and Romano (1996b), equilibrium public provision is positive under the assumptions of a non-regressive tax and a right-skewed income distribution. In Gouveia's (1997) model, with a perfect insurance market, this result can only be generated under the further assumption of homogeneous loss probabilities. In our model, with an imperfect insurance market, the result holds without this restrictive assumption.

Proposition 9: *If the tax system is not regressive, the income distribution is right-skewed and there is asymmetric information in loss probabilities, equilibrium public provision is positive* ($g_m > 0$)*.*

Proof: See Appendix.

Comparison of this result with that of Gouveia (1997) leads to the interesting corollary that public provision is more likely to be a feature of the political outcome when the market is impeded by information problems.

***Corollary 1**: Under the restrictions on the tax function and income distribution stated in Proposition 9, equilibrium public provision is more likely to be positive when there is asymmetric information in loss probabilities than when information is perfect.*

Proof: Let $g^{i**}(y_k, p^i)$ represent an individual's optimal *g* under perfect information. From Gouveia (1997), $g^{i**}(y_k, p^i) > 0$ i.f.f. $T_k^i = \frac{\overline{p}}{p^i} \frac{\tau(y_k)}{E(\tau(y))} \leq 1$. At $y_k = y_a$ (see proof of Proposition 9), $T_a^B < 1$ but $T_a^G > 1$. Therefore, unlike the imperfect information case discussed above, a majority with $y \leq y_a$, which follows from the stated assumptions, is not sufficient for $g_{m2} = Med(g^{**}) > 0$. When information is imperfect, $T_a^B < 1$ is sufficient for $g_m > 0$. But when information is perfect, low risks with $y = y_a$ have $g^{G*} = 0$. For $g_{m2} > 0$, there must be a sufficiently large number of high risks with $y_k > y_a$ and $T_k^B \leq 1$ and low risks with $y_k < y_a$ and $T_k^G \leq 1$. ||

With asymmetric information, the relevant parameter in establishing whether an individual benefits from some positive level of public provision is the relative tax price of a high risk individual with the same income level. When information is perfect, it is the individual's own relative tax price which is relevant. Since, for any given income level, the relative tax price of the high risk is less than that of the low risk, preferences for government intervention will be stronger in the absence of perfect information. A (weak) comparison of the equilibrium levels of public provision under the two information regimes is also possible.

Corollary 2: *Under the restrictions on the tax function and income distribution stated in Proposition 9, the equilibrium level of public provision under asymmetric information in loss probabilities will not be less than that with perfect information.*

Proof: g^{**} differs from g^{*} only for low-risks with incomes consistent with $(\mathrm{T}_k^B < 1, \mathrm{T}_k^G > 1)$. These individuals have $g^{**} = 0$ when information is perfect but $g^{*} > 0$ under asymmetric information. Since $g^{*} \geq g^{**}$ for all individuals, $Med(g^{*}) \geq Med(g^{**})$. If $Med(g^{**}) = 0$, from Proposition 9, $Med(g^{*}) > Med(g^{**})$. If $Med(g^{**}) > 0$, then $Med(g^{*}) > Med(g^{**})$, if there is at least one low-risk with $(\mathrm{T}_k^B < 1, \mathrm{T}_k^G > 1)$ and $g^{*} > Med(g^{**})$. ||

Proposition 9 and its corollaries indicate important interactions between information imperfections in insurance markets and the extent of government intervention. Note the results are positive predictions of public provision, not normative arguments for government intervention in the presence of adverse selection. Of course, the positive and the normative results are related. If government action can realise a Pareto improvement, that action will be supported in a democratic system. The results suggest that decreases in information asymmetry, for example through genetic testing or greater use of risk categorisation, could reduce support for the public supply of insurance. With better information, the self-selection constraint on low risk contracts will be relaxed and more complete insurance provided by the market. The low risks would then have less incentive to cross-subsidise the high risks through tax-financed public provision. The same reasoning suggests our results might be sensitive to the assumed operation of the market. If WMS cross-subsidising contracts were available on the market, then low risks would not have an incentive to further cross-subsidise through the tax system. However, there is no guarantee that market agents will behave in the manner required to achieve the WMS equilibrium in the presence of adverse selection.

As with earlier papers (e.g. Proposition 4, Gouveia, 1997), any proposal to outlaw private supply will not receive majority support.[12] This, combined with Proposition 9, means there will be a positive mix of public and private provision in equilibrium i.e. GM type. In other models (Petersen, 1986; Epple and Romano, 1996b; Gouveia, 1997) the GM equilibrium that emerges is, in a sense, a compromise. All individuals would prefer either no government provision or all government provision. But, given the level of provision which emerges from the majority voting process, some individuals will want to supplement this with private consumption and a majority will allow them to do so. In the present model, a GM equilibrium is actually preferred by a group of voters.

3.3 Characteristics of Equilibrium: Distributional Features

We now identify which population sub-groups prefer more and less public provision relative to that which would emerge from a majority voting process. Specifically, we examine relationships between both income and risk and preferred public provision relative to the equilibrium level. In order to concentrate on the relationship between preferences and income, we begin by examining the two risks groups separately.

---

[12] The proof is almost directly from Gouveia (1997, p.236). With no market alternative (GO), all individuals prefer positive public provision ($g^*_{GO} > 0$). Moving from GO to GM, will result in individuals with an income consistent with $T^B_k > 1$, switching from $g^*_{GO} > 0$ to $g^* = 0$. If g^*_{GO} lies below the GO median value (g_{me}) for all such individuals, there will be no impact on the median and the movement from GO to GM is a Pareto improvement. If g^*_{GO} lies above the g_{me} for some individuals who switch to $g^* = 0$, then $g_m < g_{me}$. The 50% of individuals with $g^* \leq g_m$ would then oppose a proposal to ban the private sector. Given continuity of preferences, there will be at least one individual with $g_m < g^* < g_{me}$ who prefers g_m to g_{me}, which guarantees a strict majority against such a proposal.

Starting with the bad risks, and given Propositions 7 and 9, the following coalitions can be defined:[13]

$$\Pi_1^B = \{(y, p^B) \mid g^* > g_m \text{ and } T^B \le 1\}$$
$$\Lambda_1^B = \{(y, p^B) \mid g^* \le g_m \text{ and } T^B \le 1\}$$
$$\Lambda_2^B = \{(y, p^B) \mid g^* \le g_m \text{ and } T^B > 1\}$$

We now introduce a popular assumption in the literature originally due to Kenny (1978).

Assumption 1: g_{GO}^* is everywhere increasing in income.

As demonstrated by Kenny, this amounts to assuming that the direct (positive) income effect on demand for a solely publicly supplied good outweighs a price effect arising from dependence of the tax which finances the good on income.[14] As argued by Epple and Romano (1996b) and Gouveia (1997), there is strong empirical support for such an assumption in the case of health care.

Define $y(C)$ to be the average income within a coalition, i.e. $y(C) = E[y \mid (y, p) \in C]$. Then, the relationship between preferences for *g* and income within the bad risk group is as follows.

Proposition 10: *Given assumption 1, in equilibrium:* $y(\Lambda_2^B) > y(\Pi_1^B) > y(\Lambda_1^B)$.

---

[13] Gouveia (1997) identifies these coalitions but does not acknowledge that their definition relies on $g_m > 0$. This is problematic in Gouveia's model since he was only able to show $g_m > 0$ under the assumption of homogeneous loss probabilities.

[14] Epple and Romano (1996b) refer to this assumption as SRI (slope rising in income).

Proof: Proposition 7 and assumption 1 gives $y(\Pi_1^B) > y(\Lambda_1^B)$. The definition of T^B and the restriction that $\tau(.)$ be an increasing function, gives $y(\Lambda_2^B) > y(\Pi_1^B)$. ||

Within the bad risk group, under the conventional assumption 1, the equilibrium has the 'ends-against-the-middle' characteristic (Epple and Romano, 1996b; Gouveia, 1997). That is, the bottom and top sections of the income distribution prefer lower public provision relative to the middle income range. Provided income is sufficiently low such that the tax price lies below the market price, given assumption 1, preferences for public provision are increasing with income. However, when income crosses the threshold at which the market price falls below the tax price, preferences switch from public to completely private provision.

For good risks, again using Propositions 7 and 9, coalitions are defined:

$$\begin{aligned}
\Pi_1^G &= \{(y, p^G) \mid g^* > g_m \text{ and } T^G \leq 1\} \\
\Pi_2^G &= \{(y, p^G) \mid g^* > g_m \text{ and } T^G > 1, T^B < 1\} \\
\Lambda_1^G &= \{(y, p^G) \mid g^* \leq g_m \text{ and } T^G \leq 1\} \\
\Lambda_2^G &= \{(y, p^G) \mid g^* \leq g_m \text{ and } T^G > 1, T^B \geq 1\} \\
\Lambda_3^G &= \{(y, p^G) \mid g^* \leq g_m \text{ and } T^G > 1, T^B < 1\}
\end{aligned}$$

Coalition formation is more complex because some good risks have a relative tax price greater than one but have an optimal g^* which is not zero and may be more or less than the median preferred value.

Proposition 11: *Given assumption 1, in equilibrium*

$$y(\Lambda_2^G) > y(\Pi_2^G) > y(\Lambda_3^G) > y(\Pi_1^G) > y(\Lambda_1^G).$$

Proof: The definition of T^i and the restriction that $\tau(.)$ is an increasing function gives $y(\Lambda_2^G) > y(\Lambda_3^G)$, $y(\Lambda_2^G) > y(\Pi_2^G)$ and $y(\Lambda_3^G) > y(\Pi_1^G)$. Proposition 7 and assumption 1 are sufficient for $y(\Pi_2^G) > y(\Lambda_3^G)$ and $y(\Pi_1^G) > y(\Lambda_1^G)$.[15] ||

Within the group of low risk individuals, the equilibrium is more complicated than the 'ends-against-the-middle' variety described above. Both extremes of the income distribution still prefer public provision to be less than the equilibrium value. Again, this is due to a high tax price discouraging the top income group and an income effect reducing demands of the poorest group. However, the extremes are joined by a group from the middle of the distribution, who also prefer lower than equilibrium public provision. Moving from the top of the income distribution, there is a threshold income at which the preferred public provision becomes positive and exceeds the median preferred value, even though the relative tax price still exceeds one. This is because of the positive impact of *g* on the insurance market self-selection constraint. As income continues to fall, an income effect reduces the optimal *g* and this will eventually fall below the equilibrium value. However, once income falls sufficiently for the relative tax price to fall below one, preferences for *g* rise once more above the equilibrium level. Further reductions in income reduce optimal *g*, through an income effect, and the preferred value drops below the median once more.

Putting the two risk-groups makes distributional analysis of the equilibrium more difficult since there is heterogeneity in both incomes and risks. Gouveia (1997) introduces a

---

[15] Assumption 1 refers to the impact of income on g^*_{GO} but, from Proposition 6, $g^* \neq g^*_{GO}$ for Π_2^G and Λ_3^G. However, assumption 1 is sufficient for g^* also to be increasing in income within Π_2^G and Λ_3^G. The proof is available from the authors.

generalisation of assumption 1 and an upper bound on the correlation between income and risk which allow incomes to be compared across coalitions.[16] Define the following coalitions:

$$\Pi_1 = \Pi_1^B \cup \Pi_1^G, \quad \Lambda_1 = \Lambda_1^B \cup \Lambda_1^G \text{ and } \Lambda_2 = \Lambda_2^B \cup \Lambda_2^G$$

Proposition 12: *Given assumption 1 and assumptions 1b and 2 from Gouveia (1997), in equilibrium the relationship between income and preferences for public provision is given by:* $y(\Lambda_2) > y(\Pi_2^G) > y(\Lambda_3^G) > y(\Pi_1) > y(\Lambda_1)$.

Proof:

i) $y(\Lambda_2) > y(\Pi_2^G)$ from definition of T^B and $\tau'(y) > 0$.

ii) $y(\Pi_2^G) > y(\Lambda_3^G)$ from assumption 1.

iii) $y(\Lambda_3^G) > y(\Pi_1)$ from assumption 2 of Gouveia (1997). From the definition of T^G and $\tau'(y) > 0$, $y(\Lambda_3^G) > y(\Pi_1^G)$. But this is not sufficient since there may be high risks in Π_1^B with higher incomes than some of the low risks in Λ_3^G. Assumption 2 can be seen as assuming there is not a sufficiently large number of such high-risk, higher- income types. Their incomes cannot be too high, in any case, since then they would have $T^B > 1$.

iv) $y(\Pi_1) > y(\Lambda_1)$ from assumption 1b of Gouveia (1997). ||

Under the stated assumptions, the relationship between incomes and preferences for public provision in the whole population is the same as that for the good risks only. That is, the equilibrium can no longer be characterised as one in which attempts by the whole of the

---

[16] In Gouveia (1997) the first assumption is 1b: $E[y \mid g^* = H(T(y,p)\gamma; y, p) = \overline{H}]$ is strictly increasing in $\overline{H}$. The second is assumption 2: $E[y \mid T(y,p) = \overline{T}]$ is strictly increasing in $\overline{T}$.

middle of the income distribution to raise public expenditure are constrained by opposition from both extremes. There is a group from the middle of the distribution who support the extremes.

The model allows us to identify the groups in the population who will purchase private insurance in equilibrium. Given Propositions 7 and 9, the median voter cannot be in Λ_2. If the median voter is in Λ_1, then, from Proposition 7, she will not purchase private insurance. On the other hand, if the median voter is in Λ_3^G, then she will purchase private insurance. This result differs from Gouveia (1997), where, assuming $g_m > 0$, the median voter does not purchase private insurance. Irrespective of whether the median voter purchases private insurance, those from the bottom of the income distribution, i.e. Λ_1, will not. All other groups may, or may not, purchase private insurance.

4. Conclusions

With heterogeneity in income and asymmetric information in health risks, we examined individual preferences over the public-private mix in health insurance and care. We extended the standard model of adverse selection in health insurance by allowing individuals to decide how much to spend on health care when sick. This did not affect the market outcome under competitive Nash behaviour. Actuarially fair, full insurance contracts are only available to high risks. Low risks are constrained to purchase an amount of insurance that is less than their optimal expenditure on health care given this insurance. For low risks, the presence of adverse selection affects the magnitude, and can affect the sign, of the crowding-out effect of public provision on private insurance and care. Crowding-out depends on risk-aversion. With decreasing absolute risk aversion, crowding-out is less than would be predicted assuming perfect information. This is an interesting result given the importance of crowding-out predictions for the evaluation of public sector interventions.

In previous models, every individual preferred either all public or all private provision depending upon their relative tax price of public care. In our model, a set of low-risk individuals, despite facing a relative tax price greater than one, prefer a mixed public-private health care system. Within this group, political support for public provision derives from the slackening of the self-selection constraint on the private insurance market equilibrium. So, unlike many other models, we do not predict political support for public provision of a private good simply as a consequence of imposing a linear tax function and therefore restricting the opportunities for cash redistribution. A MVR equilibrium exists, and under (weak) assumptions about the income distribution and the tax function, equilibrium public provision is positive. A majority will allow the private sector to co-exist with public provision. As noted above, unlike previous models, the mixed public-private system, which emerges from the political process, coincides with the preferences of some individuals. In comparison with an environment of perfect information, public provision is more likely to be positive, and will not be lower, under asymmetric information. Thus, if better information on health risks becomes available through, for example, genetic testing or greater use of risk-categorisation, the level of public health care would be expected to fall.[17]

Our final result relates to the distributional nature of the political equilibrium. The "ends-against-the-middle" equilibrium has been a characteristic of previous positive models of public provision of a private good. That is, both extremes of the income distribution support reduced public provision in comparison with the middle income groups. We have

[17] We are assuming private insurers could obtain the results of genetic tests. If this were not the case, then the information asymmetry would be exacerbated and public provision may increase.

shown that when asymmetric information is introduced the equilibrium is more complex. The extremes of the income distribution still support reduced public provision relative to the equilibrium value but they are joined by a low-risk group from the middle of the distribution.

This paper is the first to examine, formally, political support for publicly provided health care in presence of asymmetric information. As demonstrated by the results summarised directly above, it adds to the understanding of the political economy of health care. However, the analysis is subject to a number of limitations and these motivate future research. Besides adverse selection, health care markets are prone to other problems, such as moral hazard and incomplete consumer sovereignty. Examining the political economy consequences of their presence would be of great interest and practical importance. Our results are positive predictions of public provision. It would be very interesting to establish the normative properties of the political equilibrium and so relate this paper to the normative literature on adverse selection in insurance markets (Crocker and Snow, 1985a). This might also involve relaxing our assumption of Nash behaviour in the private insurance market. We assumed there are no quality differences between the public and private sectors, and the government is as cost-efficient as the private market. Relaxing these assumptions might generate different results.

References

Akerlof, G.A., 1970, The market for 'lemons': Quality uncertainty and the market mechanism, *Quarterly Journal of Economics* 84, 488-500.

Besley, T. and M. Gouveia, 1994, Alternative systems of health care provision, *Economic Policy* 19, 200-258.

Blomquist, S. and V. Christiansen, 1999, The political economy of publicly provided private goods, *Journal of Public Economics* 73, 1, 31-54.

Buchanan, J.M., 1970, Notes for an economic theory of socialism, *Public Choice* 8, 29-43.

Crocker, K.J. and A. Snow, 1985a, The efficiency of competitive equilibria in insurance markets with adverse selection, *Journal of Public Economics* 26, 207-19.

Crocker, K.J. and A. Snow, 1985b, A simple tax structure for competitive equilibrium and redistribution in insurance markets with asymmetric information, *Southern Economic Journal* 51, 4, 1142-50.

Dahlby, B., 1981, Adverse selection and Pareto improvements through compulsory insurance, *Public Choice* 37, 547-58.

Epple, D. and R.E. Romano, 1996a, Ends against the middle: Determining public service provision when there are private alternatives, *Journal of Public Economics* 62, 297-325.

Epple, D. and R.E.Romano, 1996b, Public provision of private goods, *Journal of Political Economy* 104, 57-84.

Gouveia, M., 1997, Majority rule and the public provision of a private good, *Public Choice* 93, 221-44.

Kenny, L.W., 1978, The collective allocation of commodities in a democratic society: A generalization, *Public Choice* 33, 117-20.

Miyazaki, H., 1977, The rat race and internal labor markets, *Bell Journal of Economics* 8, 394-418.

Mueller, D.C.,1989, *Public Choice II*, Cambridge University Press, Cambridge.

OECD, 1998, *OECD Health Data*, OECD, Paris.

Pauly, M.V. 1992, The normative and positive economics of minimum health benefits, In P. Zweifel and H.E. Frech III (eds.), *Health Economics Worldwide*, Kluwer, Boston.

Petersen, N.C., 1986, A public choice analysis of parallel public and private provision of health care, In A.J. Culyer and B. Jonsson (eds.), *Public and Private Health Services*, Basil Blackwell, Oxford.

Rothschild, M. and J.E. Stiglitz, 1976, Equilibrium in competitive insurance markets: An essay on the economics of imperfect information, *Quarterly Journal of Economics* 90, 629-50.

Spann, R.M., 1974, Collective consumption of private goods, *Public Choice* 20, 63-81.

Spence, M., 1978, Product differentiation and performance in insurance markets, *Journal of Public Economics* 10, 427-47.

Stiglitz, J.E., 1974, The demand for education in public and private school systems, *Journal of Public Economics* 3, 349-85.

Usher, D., 1977, The welfare economics of the socialization of commodities, *Journal of Public Economics* 8, 151-68.

Wilson, C., 1977, A model of insurance markets with incomplete information, *Journal of Economic Theory* 12, 167-207.

Wilson, L.S. and M.L. Katz, 1983, The socialization of commodities, *Journal of Public Economics* 20, 347-56.

Zweifel, P. and F. Breyer, 1997, *Health Economics*, Oxford University Press, Oxford.

APPENDIX

Proof of Proposition 5:

The result is the same as Lemma 4 in Gouveia (1997) which assumes perfect information and so has full insurance for all individuals. The proof can be found there. We reproduce it here for convenience. The ideal level of public provision is the solution to

$$\max_{g} U^B = u(w_k^B) + p^B \upsilon(g + m^{B*}) \tag{A.1}$$

where $w_k^B = w_{k1}^B = w_{k2}^B$.

Differentiating (A.1) with respect to *g*,

$$\frac{dU^B}{dg} = p^B[-u'(w_k^B)T_k^B\gamma + \upsilon'(g + m^{B*})] + p^B[-u'(w_k^B)\gamma + \upsilon'(g + m^{B*})]\frac{\partial m^{B*}}{\partial g}. \tag{A.2}$$

The second term is zero by the envelope theorem.

(a) For individuals with $T_k^B > 1$, the term in the first bracket of (A.2) is less than that in the second. Then, (2.6) and (A.2) imply utility is decreasing for any level of *g*. Therefore, $g^{B*}(y_K, p^B) = 0$.

(b) Consider individuals with $T_k^B = 1$. For these cases the terms in the first and second brackets of (A.2) are identical. For any $g \in [0, \hat{g})$, (2.6) and (A.2) imply $\frac{dU^B}{dg} = 0$. For any $g \in [\hat{g}, \tilde{G}]$, (2.6) and (A.2) imply $\frac{dU^B}{dg} \leq 0$. We assume $g^{B*}(y_K, p^B) = H(\gamma, y_k, p^B)$ where the latter is optimal health care demanded at a price of $T_k^B\gamma = \gamma$.

(c) Consider individuals with $T_k^B < 1$. For any $g \in [0, \hat{g})$, (2.6) and (A.2) imply utility is increasing with *g*. Thus, $g^{B*}(y_K, p^B) > 0$. For any $g \in [\hat{g}, \tilde{G}]$, (A.1) reduces to

$$\max_{g > 0} U^B = u(y_k - T_k^B p^B \gamma g) + p^B \upsilon(g),$$

with the solution, $g^{B*}(y_K, p^B) = H(T_k^B\gamma, y_k, p^B)$. This problem involves strictly quasi-concave preferences defined over a convex set and so utility is single peaked on *g*. ||

Proof of Proposition 6:

(a) Consider cases with y_k, such that $T_k^G > 1$ and $T_k^B \geq 1$. For any $g \in [0, \hat{g})$, (2.6) and $\mu < \frac{p^G}{p^B}$ imply equation (2.25) is negative. For any $g \in [\hat{g}, \tilde{G}]$, (2.26) and (2.6) imply $\frac{dU^G}{dg} < 0$. Utility is decreasing in *g* over the full range and so, $g^{G*}(y_k, p^G) = 0$.

(b) Consider $T_k^G > 1$ and $T_k^B < 1$. As with the previous case, utility is declining in *g* over the range in which $m^{G*} = 0$. Over the range in which $m^{G*} > 0$, equation (2.25) cannot be signed unambiguously. The first term is negative, but the second term is either positive (if $m^{B*} > 0$) or ambiguous (if $m^{B*} = 0$). Setting (2.25) equal to zero, it defines an optimum point, $0 < g^{G*}(y_k, p^G) < H(T_k^G\gamma; y_k, p^G)$. Optimum *g* is positive but less than total health care demand since $m^{G*} > 0$. Given concavity of the utility function, the second order condition for a maximum is satisfied,

$$\frac{d^2U^G}{dg^2} = (p^G - \mu p^B)[u''(w_{k2}^G)(\gamma T_k^G)^2 p^G + \upsilon''(g + m^{G*})] + \mu p^B[u''(w_{k2}^B)(\gamma T_k^B)^2 p^B + \upsilon''(g + m^{B*})] < 0$$

Hence, in the range $g \in [0, \hat{g})$, there is a unique optimum and utility is declining in *g* outside of this range. Preferences are single-peaked.

(c) Consider $T_k^G \leq 1$ and $T_k^B < 1$.[18] For any g such that $m^{G*} > 0$ and $m^{B*} > 0$, (2.6) implies (2.25) is positive. Consider g such that $m^{G*} > 0$ and $m^{B*} = 0$. By re-arranging (2.25) we get,

$$\frac{dU^G}{dg} = p^G[-u'(w_{k2}^G)\gamma T_k^G + \upsilon'(g+m^{G*})] + \mu p^B[(u'(w_{k2}^G)\gamma T_k^G - u'(w_{k2}^B)\gamma T_k^B) + (\upsilon'(g) - \upsilon'(g+m^{G*}))] \quad \text{(A.3)}$$

Condition (2.6) implies the first term in (A.3) is positive. Given $w_{k2}^G < w_{k2}^B$, since $m^{G*} > m^{B*} = 0$, and $T_k^G > T_k^B$, by definition, the second term is also positive. So, utility is increasing in g over the full range of $g \in [0, \hat{g})$. For $g \in [\hat{g}, \tilde{G}]$, the optimal g is found by setting (2.26) equal to zero. Again, we return to a conventional maximisation problem with strictly quasi-concave preferences defined over a convex set and so utility is single-peaked on g. ||

Proof of Proposition 9:

Assume: (A.i) The tax system is not regressive; (A.ii) The income distribution is right-skewed.

Let *E*( ) and *Med*( ) be the mean and median operators respectively. Using (A.ii) and the restriction that $\tau(y)$ is an increasing function: $\tau(E(y)) > \tau(Med(y))$. Then, using (A.i), which implies $E(\tau(y)) \geq \tau(E(y))$,

$$\frac{\tau(Med(y))}{E(\tau(y))} < 1. \quad \text{(A.4)}$$

[18] Note, if $T_k^G \leq 1$, then $T_k^B < 1$ by definition.

Define y_a such that $\tau(y_a) = E(\tau(y))$. Then, from (A.4), $\sum_{\underline{y}}^{y_a} \Pr(y) > 0.5$. That is, a majority has an income less than or equal to that consistent with the average tax payment. From Proposition 7, at a given y_k, $g^{i*}(y_k, p^G, p^B) > 0$ if $T_k^B = \frac{\overline{p}}{p^B} \frac{\tau(y_k)}{E(\tau(y))} < 1$.

Since $p^B > \overline{p}$, $T_k^B < 1 \;\; \forall \; y_k \leq y_a$. Given we have established a majority has an income less than or equal to y_a, a majority has an income consistent with $T_k^B < 1$ and so $g^{i*} > 0$, which implies $g_m > 0$. ||