An Efficiency and Cost Analysis of Expanded Public Health Insurance

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Abstract: With more than 46 million Americans, or nearly 16 percent of the U.S. population, currently lacking health insurance, a vigorous debate continues at both the federal and state levels over the introduction of comprehensive public insurance programs. An important aspect of the controversy concerns the efficiency of social insurance; in particular, how much additional health care those covered by such a program would utilize, and how they would value it relative to the cost of production. Although this issue has been recognized as a critical concern, there has been surprisingly little theoretical modeling and few empirical estimates to guide policymaking. The present paper contributes to the discussion by developing a new model for measuring the consumer's valuation of care in comparison to its market cost, and providing some numerical estimates based on empirical data. The tax rate needed to finance the system is also estimated.

Keywords: medical care, moral hazard, deadweight loss
JEL codes: G22 (insurance); I11 (analysis of health care markets).

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1. Introduction

For several decades, governments around the world have wrestled with the issue of providing health insurance to their uninsured citizens. A number of Western European countries have opted to provide public insurance to all citizens, essentially eliminating the lack of health coverage. By contrast, more than 46 million Americans, or nearly 16 percent of the U.S. population, currently lack health insurance (U.S. Census Bureau, 2007). In view of this, a vigorous debate continues among academics, policymakers, and the general public over the provision of health insurance by the government. Massachusetts and Vermont have recently introduced public insurance to cover the uninsured, while more than a dozen other states are considering such legislation. At the federal level, a new proposal for national health insurance was unveiled in late 2006 by Senator Ron Wyden of Oregon (Alonso-Zaldivar, 2006); in contrast, President Bush has sought to cut funding for both Medicaid and Medicare (Havemann, 2007), and vetoed an increase in the State Childrens Health Insurance Program (Abramowitz and Weisman, 2007).

Because publicly-provided health insurance redistributes funds from healthy taxpayers to those who fall ill, and because there are invariably other potential uses for the tax revenue, the relative efficiency or inefficiency with which such funds are spent is an important question for policymakers. In particular, it is necessary to know how much additional medical treatment those covered by such a program would receive, what it would cost, and how they would value the care relative to its cost of production. Despite its importance, there is relatively little empirical work which actually measures the extent of the efficiency or welfare effects; indeed, the theoretical frameworks used for evaluation have often been inconsistent, making comparisons difficult. The present paper contributes to the discussion by developing a model for measuring the consumer's valuation of medical treatment in comparison to its cost, and providing some numerical estimates based on empirical research conducted in the U.S.

Of course, direct governmental provision of health insurance is only one possible approach to reducing the number of uninsured citizens. Other potential solutions include requiring employers to provide health insurance as a benefit for employees, and giving tax credits to low-income workers who purchase private insurance policies. Comparing these options, Meara *et al*. (2007) found that an expansion of Medicaid would reach more uninsured citizens than tax credits, and would have more beneficial effects on employment than employer mandates. The focus of the current paper is therefore on the expansion of public insurance to the uninsured and the tax rate needed to finance such a program.

The next section briefly reviews the prior literature from its inception during the War on Poverty to the present day, and presents the evaluative criterion. Section 3 introduces a formal model for measuring efficiency, and calibrates the model using parameter values from empirical studies of the demand for medical care. Section 4 gives a brief conclusion.

2. Background

One of the initiatives of President Lyndon B. Johnson's Great Society was the extension of health insurance to the poor (Medicaid) and the elderly (Medicare) in 1966. An important intellectual foundation for the public provision of health insurance was given by Kenneth J. Arrow (1963, p. 961), who argued that because pooling reduces risk, "the welfare case for insurance policies of all sorts is overwhelming. It follows that the government should undertake insurance in those cases where this market, for whatever reason, has failed to emerge."[1, 2]

In contrast, Mark V. Pauly (1968) expressed greater skepticism regarding the efficiency of publicly provided health insurance. In a famous comment on Arrow's (1963) essay, Pauly (1968) emphasized that health insurance results in *ex post* moral hazard: those covered by insurance and facing reduced out-of-pocket expenses for treatment utilize excess medical care whose value to them is less than its cost of production.[3] Pauly's (1968) analysis considered an ill consumer's downward-sloping demand curve for medical care as depicted by curve *D* in Figure 1. At a market price of P_0, the uninsured consumer who becomes ill would purchase Q_u units of medical care. (For concreteness, units of medical care may be thought of as the number of days spent in the hospital, the number of visits to a physician, prescriptions, or some other non-monetary quantity.) If the individual is covered by an insurance policy having a coinsurance rate $c < 1$, then upon becoming ill (s)he faces an effective per-unit price of cP_0 and because the demand curve exhibits some degree of price-elasticity, the consumer purchases Q_i units of treatment. However, the additional quantity of care is provided at a fixed production cost of P_0; consequently, the extra units of care cost more to produce than they are worth to the consumer,

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[1] Pooling reduces risk in the following manner. For *n* identical individuals each facing an expected loss of μ with a standard deviation of σ, a 95 percent confidence interval for the mean loss per person is given by $\mu \pm 1.96\sigma/(n^{.5})$. A larger pool of policyholders (*n*) therefore narrows the confidence interval, making the insurer's forecast of losses more precise and thereby allowing a lower insurance premium to be charged on each policy.

[2] There were of course, antecedents, including unemployment insurance and the Old Age, Survivors, and Disability Insurance program (i.e., Social Security) created during the Great Depression. Even Friedrich Hayek, best known for arguing that socialist planning would lead society down "the road to serfdom", advocated government provision of health insurance. Hayek (1944, p. 120-121) observed, "Where, as in the case of sickness and accident, neither the desire to avoid such calamities nor the efforts to overcome their consequences are as a rule weakened by the provision of assistance—where, in short, we deal with genuinely insurable risks—the case for the state's helping to organize a comprehensive system of social insurance is very strong." I thank Ted Schmidt for this reference.

[3] *Ex ante* moral hazard occurs if the insured takes greater health risks, increasing the probability of filing claims. Empirically, *ex ante* moral hazard appears to be much less important than *ex post* moral hazard. For an extensive survey, see Zweifel and Manning (2000).

as indicated by the demand curve. On this basis, Pauly (1968) concluded that a program of national health insurance financed through compulsory taxation could create inefficiency. Pauly (1968, 1969) explained that in the absence of income effects, the inefficiency cost, or deadweight loss, would be measured by the area labeled *abd* in Figure 1.[4] Importantly, this deadweight loss is measured in monetary units (e.g., dollars); the most reasonable basis for comparison is therefore the monetary value of the insurance claims—i.e., the funds redistributed to the claimant. Using rough empirical estimates available at the time, Pauly (1969, p. 286) found that about 9.375 percent of health insurance claims involved deadweight loss—a magnitude he considered "important but not crucial". Pauly's analysis became the basis for several other prominent empirical reports, such as Feldstein's (1973) study, which found somewhat larger welfare losses associated with excess health insurance coverage, advocated a doubling of coinsurance rates, and set the stage for the era of managed care.[5]

Pauly's (1968, 1969) analysis, however, explicitly assumed the absence of any income-elasticity in the demand function. Recognizing that income effects might in fact be present, de Meza (1983) pointed out that an *uninsured* consumer's demand curve for medical care when ill is derived from the maximization of utility subject to a budget constraint which provides a brake on the quantity of care demanded, so that the patient's effective demand for treatment is likely to be lower than his or her latent or potential demand. The insurance mechanism, however, transfers resources from the healthy to the unhealthy, so that an *insured* consumer receives a subsidy when ill, which relaxes the budget constraint. Thus, de Meza (1983, p. 48) suggested, "in enabling income to be transferred across states of the world, actuarially fair insurance permits potential demand for health care to be turned into effective demand" so that "insurance may

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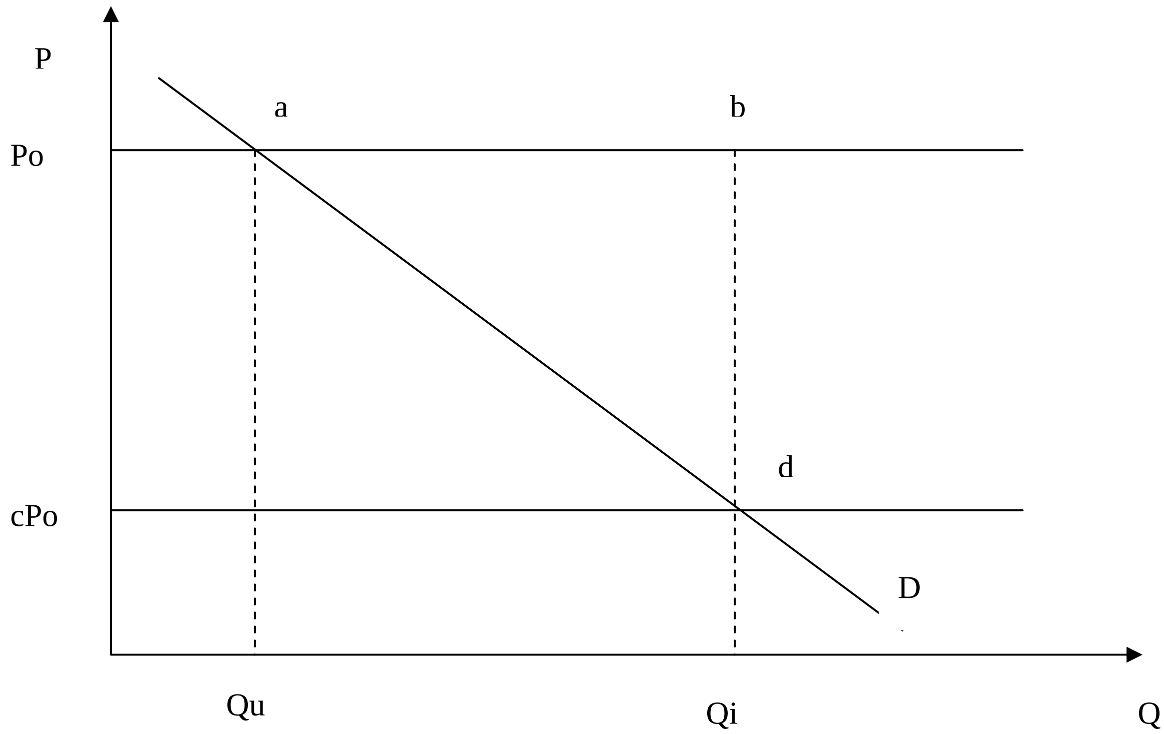
[4] The area of deadweight loss in Figure 1 is a triangle if the demand curve is linear, but this need not be the case. In section 3 below the demand curve is assumed to be log-linear.

[5] Subsequent empirical studies include those by Feldman and Dowd (1991) and Manning and Marquis (1996).

Figure 1. Deadweight Loss in the Absence of Income Effects



induce socially efficient increases in medical expenditures."[6] As a consequence, "previous studies which attribute all the extra demand for medical care to moral hazard effects may overestimate the efficiency costs of health insurance" (*ibid*, p. 47).

To help visualize this idea, de Meza (1983) proposed the following thought experiment. Suppose that, rather than paying for (or reimbursing) medical care *per se*, health insurance was to provide an equivalently large lump-sum cash transfer to the insured in the event of an illness. Then, provided that utility is obtained from both medical care and other goods (such as food and shelter), the consumer would presumably spend at least some portion of the cash transfer on medical care and spend the remainder on other goods. The medical treatment purchased with cash would not be inefficient, since the consumer would be exhibiting a willingness to pay the

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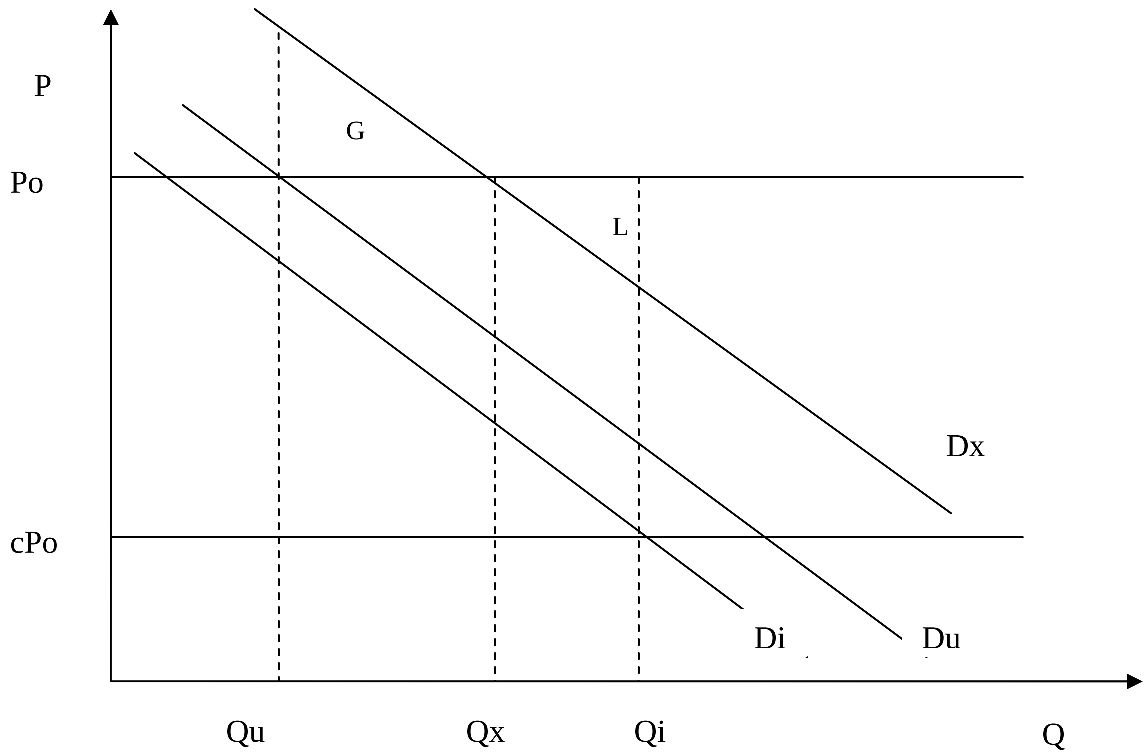
[6] Arrow (1963, p. 943) had earlier observed that "a transfer of purchasing power from the well to the ill will increase the demand for medical services."

market price for the care received. In practice, of course, health insurance (unlike some other forms of insurance) does not pay claims to policyholders in cash, but rather provides the claimant with an in-kind subsidy of medical treatment which effectively reduces the price of care to the consumer. Thus, the inefficiency of insurance arises from that portion of the in-kind transfer that the consumer would prefer to spend on goods and services other than medical care. In short, de Meza (1983) suggested that the total effect of the price reduction could be decomposed into an income effect and a substitution effect, such that only the latter represents inefficiency.

The income and substitution effects are depicted in Figure 2. When an uninsured consumer falls ill, (s)he exhibits the demand curve for medical care labeled D_u, and facing the market price P_0, (s)he purchases Q_u units of medical care (just as in Figure 1). Alternatively, if the individual has purchased health insurance (either in the private market or through taxation) at a premium of π, then his or her income has been reduced by π. To the extent that there is a positive income-elasticity of demand for medical care, the premium payment causes the demand curve to shift inward, to D_i. Despite this inward shift of the demand curve, the consumption of care increases because the price is effectively reduced for the patient: with a coinsurance rate of $c < 1$, the insured consumer purchases Q_i units of treatment. But hypothetically, if the value of the insurance claims were paid to the patient as cash, there would have been a net income transfer to the insured and an outward shift of the demand curve for medical care to D_x, so Q_x units of treatment would have been utilized at the market price. The effective price reduction (from P_0 to cP_0) caused by insurance therefore has a total impact on consumption equal to $Q_i - Q_u$, which can be decomposed into an efficient income effect ($Q_x - Q_u$) and an inefficient substitution effect ($Q_i - Q_x$).

Figure 2. Deadweight Loss and Gain in the Presence of Income Effects



In response to de Meza (1983), Pauly (1983) acknowledged that income effects might be present, especially for seriously ill patients, but argued that the magnitude of the income effects would likely be fairly small in most cases.[7]

2.1 A Measure of Net Inefficiency

Because the deadweight loss that Pauly (1968) described as area *abd* in Figure 1 fails to account for any income effects which might be present, it is useful to modify the deadweight loss by allowing for the income-elasticity of demand. In Figure 2, only the $Q_i - Q_x$ units of treatment are under-valued; consequently, the deadweight loss adjusted for income effects is represented

[7] The argument that income effects matter most for the seriously ill has been supported in theoretical work by Eisenhauer (2006) and empirical work by Koc (2005).

by the area labeled *L*. Writing the inverse demand curve (D_X) as *P* = *P*(*Q*), the adjusted deadweight loss (*L*) is measured by the definite integral

$$L = \int_{Q_x}^{Q_i} [P_0 - P(Q)]dQ \ . \tag{1}$$

As Figure 2 makes clear, however, there is also a deadweight *gain* (area *G*) associated with the efficient portion of moral hazard. This welfare gain arises because the initial units of extra care are worth more to the insured than they cost to produce. This area is measured by the definite integral

$$G = \int_{Q_u}^{Q_X} [P(Q) - P_0]dQ \ . \tag{2}$$

For evaluative purposes, both *L* and *G* can be compared to the magnitude of the subsidy, or the net transfer of funds to the ill consumer. The insured has paid a premium of π for coverage, of which $\pi *$ goes into the insurance pool and $\pi - \pi *$ pays administrative expenses; when ill, (s)he files claims with a monetary value of $(1-c)P_0Q_i$. Thus, the net subsidy of medical treatment is

$$X = (1-c)P_0Q_i - \pi * \ . \tag{3}$$

Taking the difference, *L* – *G*, as a proportion of *X*, inefficiency can be evaluated by what we shall designate as the *net efficiency loss (NEL)*,

$$NEL = (L - G)/X \, . \qquad (4)$$

Both private and public forms of insurance could potentially be evaluated by this criterion.[8] In the latter case, because it measures inefficiency as a proportion of the public transfer, the subsidy-inefficiency criterion readily allows public health insurance coverage to be compared to alternative uses of public funds.

It is important to note the possibility that *NEL* < 0, implying a net efficiency gain, even where some portion of the moral hazard is inefficient. The reason is twofold. First, there is the welfare gain, or increase in consumer surplus, on the initial units of care received through insurance (from Q_u to Q_x). Second, although (s)he undervalues the other $Q_i - Q_x$ units of care relative to their production cost, the consumer would have been willing to pay *some* price for each of these units, so even these units are not entirely inefficient in monetary terms.

Imagine, for example, that units of care are measured discretely and an uninsured individual buys a single unit of medical care at a price of $5000 when ill. If the same individual had paid a $2000 premium (of which $400 covers administrative expenses) for health insurance with a coinsurance rate of 10 percent, she might have utilized 6 units of treatment when ill, 5 of which represent moral hazard. (Note that the 6 units of care cost $30,000 to produce, of which the insured contributes $4600 in pooled premiums and copayments, so the net transfer is $25,400). Suppose further that if claims were paid in cash, thereby shifting the demand curve for medical care outward via the income effect, the consumer's willingness to pay for the 5 extra units of care would have been $5500, $5300, $5100, $4900, and $4700, respectively. In that

[8] As Zweifel and Manning (2000, p. 411) point out, "consumer incentives matter regardless of whether health care is financed by insurance premiums, payroll contributions, or taxes."

case, 3 of the 5 extra units of treatment would have been purchased at the market price and 2 would not. Thus, 3/5 or 60 percent of the moral hazard would be deemed efficient, and 2/5 or 40 percent would be deemed inefficient. However, the 5 extra units of care utilized as a result of the insurance are collectively worth $25,500 to the individual, or $500 more than they cost to produce; thus there is a *net welfare gain* from the insurance. As a percentage of the net transfer of funds to the policyholder, *NEL* = (400 – 900)/25,400 = -0.0197; the net efficiency gain is approximately 2 percent of the subsidy.

The next section presents and estimates a more formal model in which care is measured as a continuous, rather than discrete, variable.

3. Model and Estimation[9]

Consider a simple model in which the demand for medical care in a state of illness is loglinear, such that, in its general form,

$$Q = I^{\varepsilon} P^{\eta} \tag{5}$$

where I is income, ε is the income-elasticity of the demand for medical care, P is the per-unit price of care, and η is the price-elasticity of demand. If uninsured, the consumer has an initial income of Y and confronts a market price of $P = P_0$, so the quantity of treatment purchased is

$$Q_u = Y^{\varepsilon} P_0^{\eta}. \tag{6}$$

[9] For an alternative model of moral hazard with income effects, see Vera-Hernandez (2003).

If, instead of being uninsured, the individual pays an income tax of $\pi = tY$ in exchange for public insurance coverage, (s)he then faces an effective price per unit equal to $P = cP_0$ (where c is the coinsurance rate), and the quantity of care demanded by the insured (when ill) is

$$Q_i = (Y - \pi)^{\varepsilon} (cP_0)^{\eta} \ . \tag{7}$$

A portion, t^*Y, of the tax payment represents an actuarially fair insurance premium—i.e., it is pooled to pay for medical care; but because of administrative expenses and the insurer's uncertainty regarding the precise magnitude of claims in any particular period, the premium is loaded, such that $t = \lambda t^*$, or equivalently, $\pi = \lambda \pi^*$, where the loading factor is $\lambda > 1$.

Finally, if health insurance claims were paid in cash rather than in-kind, income in a state of illness would be increased by the net transfer X, yielding the inverse demand curve

$$P(Q) = Q^{1/\eta} (Y + X)^{-\varepsilon/\eta} \, . \tag{8}$$

Because the insured would face the full market price of care, (s)he would purchase a quantity of treatment equal to

$$Q_x = (Y + X)^{\varepsilon} P_0^{\eta} \, . \tag{9}$$

Substituting (8) into (1) and integrating gives the adjusted deadweight loss as

$$L = \int_{Q_x}^{Q_i} [P_0 - Q^{1/\eta}(Y+X)^{-\varepsilon/\eta}]dQ = P_0 Q - \left(\frac{\eta}{1+\eta}\right) Q^{\frac{\eta+1}{\eta}} (Y+X)^{-\varepsilon/\eta} \Bigg|_{Q_x}^{Q_i} . \qquad (10)$$

After dividing by *X* and rearranging algebraically, this becomes

$$\frac{L}{X} = \frac{1 - [\gamma^{\varepsilon} c^{-\eta} /(1+\eta)] - [c\eta\gamma^{-\varepsilon/\eta} /(1+\eta)]}{1 - c - (t^*/\omega)} \qquad (11)$$

where

$$\gamma = \frac{Y+X}{Y-\pi} = \frac{1+(1-c)\omega - t^*}{1-t} \qquad (12)$$

and

$$\omega = P_0 Q_i / Y . \qquad (13)$$

The γ term defined by (12) represents the ratio of an insured's post-claim income to pre-claim income for the hypothetical case of cash claims, and the ω term defined in (13) denotes the total cost of medical care utilized by the insured when ill, expressed as a fraction of initial income.

Likewise, substituting (8) into (2) and integrating gives the deadweight gain as

$$G = \int_{Q_U}^{Q_X} [Q^{1/\eta}(Y+X)^{-\varepsilon/\eta} - P_0]dQ = \left(\frac{\eta}{1+\eta}\right) Q^{\frac{\eta+1}{\eta}} (Y+X)^{-\varepsilon/\eta} - P_0 Q \Bigg|_{Q_U}^{Q_X} \qquad (14)$$

and dividing by the subsidy gives

$$\frac{G}{X}=\frac{\left[\left(\frac{1}{1-t}\right)^{\varepsilon}-\gamma^{\varepsilon}\right]+\left(\frac{\eta}{1+\eta}\right)\left[\gamma^{\varepsilon}-\left(\frac{1}{1+(1-c)\omega-t*}\right)^{\varepsilon/\eta}\left(\frac{1}{1-t}\right)^{\varepsilon}\right]}{(1-c-(t*/\omega))(c^{\eta})} \quad . \tag{15}$$

The inefficiency measure in (4), the net efficiency loss, can then be computed directly from (11) and (15).

The five parameters needed to estimate the model are the price-elasticity of demand for medical care, the income-income elasticity of demand, the coinsurance rate, the production cost of care received relative to initial income, and the tax rate. The first two are behavioral parameters for which we will rely on previous empirical estimation. The coinsurance rate and tax rate are policy variables determined by the public insurer subject to a budget or solvency constraint. And to estimate ω from national income data, it is necessary to make some assumptions regarding the probability of illness and the distribution of income, as follows.

As a rule, those who are not covered by insurance have lower incomes than those who are covered. Indeed, they are often described as the "working poor" because they neither qualify for Medicaid nor do they receive health insurance as a fringe benefit of employment. As above, let Y denote the income of an uninsured individual, let Y^* denote the income of an insured individual, and let $Y^* = kY$ indicate their relative magnitudes. Let N denote the population size and let u denote the proportion of the population that is uninsured. If the population is thus segmented into the insured and the uninsured, gross domestic product (GDP) can be written as

$$GDP = N[uY + (1-u)Y^*] = N[u + k - uk]Y \ . \tag{16}$$

Total medical expenditures in the economy are denoted by *M*. However, only a fraction (α) of the population is ill and using medical care at any time; the rest of the population is consuming no medical treatment.[10] Thus, the expenditures on the medical treatment utilized by the insured and the uninsured sum to

$$M = \alpha N[uP_0Q_u + (1-u)P_0Q_i] \ . \tag{17}$$

For a sufficiently low tax rate *t*, equations (6) and (7) imply $Q_u \approx Q_i/(c^{\eta})$, so total medical expenditures as a fraction of gross domestic product can be written as

$$\frac{M}{GDP} = \frac{\alpha\omega[1-u+(u/c^{\eta})]}{u+k-uk} \ . \tag{18}$$

Equivalently, this can be rearranged as

$$\omega = \left(\frac{M}{GDP}\right)\left(\frac{u+k-uk}{1-u+(u/c^{\eta})}\right)\left(\frac{1}{\alpha}\right) \ , \tag{19}$$

so that ω can be estimated from data on national income accounts and the related parameters.

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[10] This is, of course, a simplification; in practice, utilization of medical care is not dichotomous but rather depends on the severity of illness.

If the system is to have (long run) solvency, then the tax revenue devoted to public insurance must be sufficient to pay the administrative costs of the public insurance agency as well as the public share of the medical bills for those without other health insurance coverage when they become ill. Each such individual now receives a *net* transfer equal to *X* when ill; in the aggregate, this amounts to $\alpha uN[(1-c)P_0Q_i - t^*Y]$. The pooled premiums of those who are otherwise insured total $t^*(1-u)NkY$ and the pooled premiums of those who are not otherwise insured but not currently ill amount to $t^*N[u(1-\alpha)Y]$.[11] Thus, solvency requires that on average,

$$u\alpha[(1-c)P_0Q_i - tY] = t^*[u(1-\alpha)+(1-u)k]Y \tag{20}$$

or equivalently,

$$t^* = \frac{\alpha u(1-c)\omega}{u+k-uk} \ . \tag{21}$$

As an adjustment for risk and administrative expenses, a fifty percent loading is added to the tax rate in the numerical estimates used below, so that the effective tax rate is $t = 1.5t^*$.[12] Because it measures the cost to taxpayers for providing public insurance to the uninsured, the magnitude of this tax rate is itself an important policy consideration.

[11] Pooled premiums refer to the fair premium portion of the tax payment—i.e., excluding the portion that pays the administrative expenses of the insurer. This formulation assumes that the tax *rate*, *t*, is independent of income.

[12] Health insurance policies sold in the private market generally have somewhat smaller loadings than this; a loss ratio of 70 percent, for example, implies a loading factor of 1/0.7 = 1.429. Insurance regulations, however, typically allow loss ratios in the neighborhood of 65 percent, implying a loading factor near 1.5. Woolhandler *et al.* (2004) estimated overhead expenses to be 11.7 percent of the premiums collected by private health insurers in 1999; the remainder of the loading factor is an adjustment for risk. As mentioned in footnote 1, insuring a greater number of homogeneous individuals reduces the insurer's insolvency risk and thereby reduces the required loading factor.

3.1 Estimates

In the U.S. at present, $u = .16$ and $M/GDP = .153$ (OECD, 2006). Estimates of the price elasticity of demand for medical care vary widely, though one often cited estimate from the RAND Health Insurance Experiment (HIE) is $\eta = -0.22$ (Manning, *et al.*, 1987).[13] A reasonable value for k might be 2, implying that on average those with insurance have twice the income of those without insurance.[14] The probability of illness is assumed to be 12.5 percent, implying that one out of every eight individuals is receiving medical care at any point in time.[15] If the coinsurance rate is then set at 30 percent, the income tax rate required to provide public insurance to those who are presently uninsured would be about 2.67 percent, after allowing for administrative expenses.[16]

To evaluate the relative efficiency of the public insurance program, it is also necessary to know the income-elasticity of the demand for medical care. Using the HIE study, Manning *et al*. (1987, p. 269) report, "Income elasticities estimated from the experimental data…are at most 0.2". Combining this estimate with the parameter values above, the first row of Table 1 indicates that there would be a *net efficiency gain* of 12.36 percent.

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[13] Designed and conducted by researchers from the RAND Corporation in the 1970s, the HIE was a large-scale social experiment funded by the U.S. Department of Health, Education, and Welfare. The HIE randomly assigned 2,750 families from six locations in the U.S. to health insurance plans with several different cost-sharing arrangements, to observe how differences in cost-sharing affect the utilization of medical care.

[14] The Institute of Medicine (2002, p.66) reports, for example, "The median income for two parent families in which both parents are covered by insurance is $67,000 compared to $30,000 for two-parent families in which neither parent is covered."

[15] In practice, of course, there is a different probability for every possible injury or illness. As a single proxy for the overall percentage of the population considered unhealthy, we use the proportion whose self-reported health status is either poor or fair (as opposed to good, very good, or excellent). Several large-scale surveys have estimated this proportion to be near 12.5%. In particular, the Current Population Survey (CPS) estimated it to be 11.8% for 2001, the National Health Interview Survey (NHIS) estimated it to be 12.2% among adults in 2005, the Medical Expenditure Panel Survey (MEPS) estimated 12.25% in 2004, and the Behavioral Risk Factor Surveillance System (BRFSS) estimated it to be 14.6% in 2006. The true population proportion may be roughly constant over time if some individuals recover as an equal number of others fall ill.

[16] The 30 percent coinsurance rate corresponds roughly to the average coinsurance rate (31 percent) in the HIE. It is, however, a policy variable. Thus, if policymakers were to offer coverage with a higher (lower) coinsurance rate, the corresponding tax rate required for solvency would be concomitantly lower (higher).

Table 1. Numerical Estimates*

Care	Sources for elasticities	Price elasticity	Income elasticity	Tax rate	Net efficiency loss
All	Manning et al.	-0.22	0.20	.02670	-.1236
Outpatient		-0.31	0.20	.02705	-.0254
Acute		-0.32	0.20	.02709	-.0163
Chronic		-0.23	0.20	.02674	-.1106
Preventive		-0.43	0.20	.02748	.0711
Hospital		-0.14	0.00	.02636	.0959
All	Eichner/ Newhouse	-0.6151	0.20	.02805	.1880
		-0.6151	0.40	.02805	-.0307
Drugs	Alexander et al.	-2.80	1.79	.03040	.2099
All	Karatzas	-1.287	0.616	.02941	.2012
		-1.347	0.616	.02949	.2314
		-1.273	0.616	.02939	.1939
All	Adrangi & Raffiee	-2.39	1.0300	.03028	.4033
		-1.57	1.0100	.02974	.0596
		-1.58	1.0000	.02975	.0735
		-0.97	0.9800	.02889	-.4573

*Estimates assume an insurance loading factor of 1.5, a coinsurance rate of 30 percent, and a probability of illness of 12.5 percent.

Manning *et al*. (1987) also distinguish between inpatient and outpatient care, and further subdivide the latter into acute, chronic, and preventive care. The reported price-elasticities for each type of care, and an income-elasticity of 20 percent for all except inpatient care (where results were statistically insignificant), are given in Table 1.[17] For chronic, acute, and all outpatient care, public insurance yields a net efficiency gain in monetary terms. For inpatient care, the lack of an income effect implies that all extra treatment received as a consequence of

[17] Manning *et al*. (1987, p. 262) note, "income has a moderately significant (at p < .10) and positive partial effect on use in all but the inpatient expenditure equation".

being insured is undervalued; monetarily, however, it is only undervalued by about 9.59 percent, roughly the same as Pauly's (1969) estimate.

Other estimates of price- and income-elasticities derived from micro data in the U.S. are larger but on the same order of magnitude as those from the HIE. Eichner (1998), for example, obtains price-elasticity estimates around -0.6151, and Newhouse (1992) notes that most cross-sectional studies using micro data report income-elasticities between 0.2 and 0.4, implying that medical care is a necessity. Combining these elasticities yields results ranging from a 19 percent efficiency loss to a 3 percent efficiency gain.

Elasticity estimates derived from aggregate data tend to be substantially larger (in absolute value) than those calculated from micro data. Indeed, country-level data tend to produce income elasticities in the neighborhood of unity or higher, raising the possibility that medical care may be a luxury (Parkin, *et al.*, 1987; Blomqvist and Carter, 1997; Gerdtham and Jonsson, 2000). However, the higher income-elasticities calculated with such data are largely offset by greater price-sensitivity (Milne and Molana, 1991). For example, Alexander *et al.* (1994) pool aggregate data on prescription drug use from the U.S. and six other developed countries and find the income-elasticity of demand to be 1.79 and the price-elasticity to be -2.80. Inserting these values into the model above yields a net efficiency loss of 21 percent.

Karatzas (2000) uses aggregate time-series data on the real per capital private health care expenditure in the U.S. and finds an income-elasticity of 0.616 and several price-elasticity estimates in the neighborhood of -1.3.[18] In the present model, these parameter values also yield a net efficiency loss of about 20 percent.

[18] Karatzas (2000) uses the natural logarithm of health care *expenditure* (ln *PQ*) as the dependent variable, and the natural log of the health care price index (ln *P*) as an independent variable. To obtain the price-elasticity of demand for care from his regression results, it is necessary to subtract 1 from the coefficient of the log of price.

Adrangi and Raffiee (1997) use quarterly data from the U.S. national income and product accounts for 1963-1989. Four different specifications of the almost ideal demand system (AIDS) yield the elasticity estimates shown in Table 1. While the income-elasticity is near unity in each specification, the price-elasticity ranges between -0.97 and -2.39, yielding extremely different estimates of inefficiency. The estimates from one specification indicate a net inefficiency of 40 percent; in two others, the inefficiency is only about 6 or 7 percent, and in the fourth, there is a net efficiency gain equal to 45.7 percent of the subsidy.

Table 1 also calculates the additional cost to taxpayers from expanding public insurance. *Ceteris paribus*, greater price-sensitivity results in greater moral hazard and inefficiency, implying a higher tax burden to be shared among all the members of society. Yet despite the wide range of price-elasticity estimates employed here, the tax rate required for solvency (after allowing a 50 percent loading rate for administrative expenses) lies in a remarkably narrow interval from 2.64 percent to 3.04 percent. Thus, one fairly robust finding of the present study is that providing public health insurance to those currently without coverage in the U.S. would add about 3 percentage points to current income tax rates. This compares to a wage tax rate of 2.9 percent, divided between employees and employers, which finances the existing Medicare program covering approximately 42 million elderly and disabled individuals.

The efficiency estimates differ noticeably depending upon whether microeconomic or macroeconomic data are used to obtain the behavioral parameters. In general, the estimates obtained from micro data are perhaps more reliable, in that they avoid the potential problem of aggregation bias to which the macro estimates may be subject. Regardless of which data set is used to estimate the behavioral parameters, however, a second conclusion is that in monetary terms there is little or no inefficiency, and possibly an efficiency gain, due to the subsidization of health insurance. This outcome results from the fact that, although much of the treatment financed by insurance may be somewhat undervalued relative to its cost of production, diminishing marginal utility implies that the first few units may be valued well above their cost of production, and the last few units may be only slightly undervalued.

4. Conclusion

It is widely understood that public health insurance increases tax rates and induces *ex post* moral hazard—the utilization of extra medical treatment. The present paper examines two important aspects of extending public health insurance to those without coverage: the magnitude of the additional tax burden, and how those covered under such a program would value the extra care relative to its cost of production. With regard to the first issue, the results suggest that extending coverage to the 16 percent of the U.S. population that is currently uninsured would add approximately three percentage points to current income tax rates.

With regard to the efficiency question, the expansion of public health insurance to those currently without coverage may be substantially less inefficient than previous models suggest. In particular, although some of the extra medical treatment would be undervalued, the rest would be valued above market cost by patients, and the net result may be an overall efficiency improvement attributable to the insurance mechanism.

Further refinements of the estimates undertaken here are needed to clarify the precise magnitude of the efficiency effects. In particular, updated estimates of the parameter values, including price- and income-elasticities of the demand for medical care derived from individual- or household-level data would facilitate more policy-relevant conclusions.

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