Relative Effects of Premium Loading and Tax Deductions on the Demand for Insurance

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Abstract: This paper derives reduced-form equations for estimating the relative effects of premium loading and income tax deductions on the demand for insurance. In the absence of loading, tax deductions would not affect the equilibrium in the market for individually purchased health insurance. With loading, the proportion of uninsured medical losses due to tax deductibility is equal to the tax rate, assuming constant absolute risk aversion; the proportion is between 40 and 86 percent in the casualty insurance market, and between 30 and 70 percent in the theft insurance market. The effects of tax deductions are greater under decreasing absolute risk aversion. [Key words: premium loading, taxation, health insurance, property insurance]

INTRODUCTION

In a competitive, zero-profit environment without transaction costs or taxes, risk-averse individuals would buy full insurance against potential losses, paying actuarially fair premiums for coverage. But it has long been understood, of course, that transaction costs, corporate profits, and other sources of premium "loading" reduce the demand for insurance below the level of full coverage, leaving the insured exposed to some risk (see, for example, Mossin, 1968). More recently it has become recognized that the demand for insurance is also reduced by the federal income tax deductions for uninsured medical expenses and property losses. Indeed,

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these tax deductions make the U.S. government a partner in risk sharing. By discouraging individuals from purchasing as much private insurance as they otherwise would, the tax deductions shift risk to the government and, indirectly, to taxpayers in general. Thus, the deductions are a form of social insurance, in which taxpayers are compelled to partially insure one another's privately uninsured losses.[1] Authors such as Kaplow (1992) and Butler and Kendall (1999) have debated the merits of such policies, but have generally overlooked an important distinction between deductions for medical (or dental) care and deductions for theft or casualty losses on property: the fact that health insurance premiums are also tax-deductible, while property insurance premiums are not deductible. Moreover, the extent of the underinsurance caused by tax deductibility, as opposed to the underinsurance caused by premium loading, has not previously been determined for either market.

This paper extends the literature by first separating health insurance from property insurance, and then deriving reduced-form equations to examine the relative magnitude of uninsured losses due to the tax deductibility provision in each market. In general, tax deductibility discourages both forms of private insurance, but the effect is more pronounced for property insurance. For itemizing taxpayers with constant absolute risk aversion (CARA), the proportion of uninsured medical losses attributable to tax deductibility is equal to the marginal tax rate. Thus, tax deductions account for some 15 to 40 percent of uninsured losses, and premium loading accounts for the remaining 60 to 85 percent. In contrast, when the property insurance model is calibrated at reasonable parameter values for the same group of taxpayers, the proportion of uninsured losses attributable to tax deductibility is between 40 and 86 percent in the casualty market and between 30 and 70 percent in the burglary and theft market. For utility functions exhibiting decreasing absolute risk aversion (DARA), the relative effects of tax deductions are even greater.

UNINSURED MEDICAL AND DENTAL EXPENSES

Consider first the case of medical and dental expenses. Under Section 213 of the Internal Revenue Code, any unreimbursed medical or dental expenses of the taxpayer, the taxpayer's spouse, or dependents, in excess of 7.5 percent of adjusted gross income (AGI), may be taken as an itemized income tax deduction for the year in which they were incurred.[2, 3] Importantly, medical and dental insurance premiums (and, within limits, long-term-care premiums) for oneself, one's spouse, and one's dependents also qualify for a federal income tax deduction along with any uninsured losses.

The self-employed may take a percentage (currently 60 percent) of health insurance premiums as a statutory deduction when calculating AGI, and all others can deduct such premiums as itemized medical and dental expenses as per Section 213 (IRS, 1999).[4]

The deductibility of both health insurance premiums and uninsured losses is modeled as follows. The representative individual in any risk class is assumed to have a concave utility function $U(X)$, such that $U'(X) > 0 > U''(X)$. The individual is endowed with a gross income of Y, and faces an income tax rate t. For simplicity, assume that only two states of nature are possible: a loss of health requiring medical care of fixed magnitude L occurs with probability p, and a state of no loss occurs with the complementary probability $1 - p$. The utility function is assumed to be independent of the state of nature, so that a loss of health does not by itself alter the utility derived from consuming net income. A loss does, however, require medical expenditures that, if not insured, reduce discretionary income and thus lower utility. An insurance policy with variable coverage V is available at a premium rate, or per-dollar cost of coverage, of m. The pure, or actuarially fair, premium rate is at $m = p$; but because of transaction costs and other administrative expenses, the premium rate inevitably reflects a loading factor such that $m/p = \lambda$, where $\lambda > 1$. The total premium, mV, is paid regardless of the state of nature that prevails.[5]

For the purpose of comparing a fiscal regime in which premiums (mV) and uninsured losses ($L - V$) are tax deductible with a fiscal regime of non-deductibility, let θ be a binary indicator of deductibility. The rate at which these costs are deductible is then θt; if $\theta = 0$, premiums and uninsured losses are not deductible, and if $\theta = 1$, premiums and uninsured losses are fully deductible at the prevailing tax rate. Of course, partial deductibility is also a possible tax structure, but that intermediate case is of less interest than the two polar extremes.

The individual's expected utility under these conditions is[6]

$$E[U] = (1-p)U(Y(1-t) - mV + \theta tmV) + \\ pU(Y(1-t) - mV - L + V + \theta t(L - V + mV)) . \tag{1}$$

The individual chooses the optimal level of insurance coverage to maximize (1). The result is given by the first-order condition

$$m(1-p)U'_N = p(1-m)U'_L \tag{2}$$

where the subscripts L and N denote states of loss and no-loss, respectively, and the arguments of the utility function have been dropped for notational simplicity.[7] Equation (2) provides the first important result. In contrast to Kaplow's (1992) analysis, at actuarially fair prices ($m = p$), full medical insurance is optimal, regardless of the income tax rate or deductibility. While the deductibility of uninsured losses discourages coverage, the deductibility of premiums encourages coverage, and at a fair premium rate the latter just offsets the former. It is only when the premium is loaded ($m > p$) that partial coverage prevails, and the income tax deductibility affects the optimal level of coverage.

Indeed, the effect of the tax rate can be seen more clearly by considering the following approximation, the details of which are provided in the appendix. The expected net income during the period in question is

$$E[I] = Y(1-t) - mV^* + \theta tmV^* - p(1-\theta t)(L-V^*) \tag{3}$$

where V^* denotes the optimal level of coverage as implicitly defined by (2). Naturally, $E[I]$ is higher when $\theta = 1$ than otherwise. A first-order Taylor series expansion of (2) around (3) yields

$$\begin{aligned} &m(1-p)U'(E[I]) + m(1-p)p(1-\theta t)(L-V^*)U''(E[I]) = \\ &p(1-m)U'(E[I]) - p(1-m)(1-p)(1-\theta t)(L-V^*)U''(E[I]). \end{aligned} \tag{4}$$

Using the definition of λ and rearranging (4) to solve for the optimal level of uninsured loss ($L - V^*$) gives

$$L - V^* = \frac{\lambda - 1}{(1-p)(1-\theta t)R_A(E[I])} \tag{5}$$

where $R_A(E[I]) = -U''(E[I])/U'(E[I])$ is the Pratt-Arrow measure of absolute risk aversion, evaluated at the expected income.[8] Equation (5) again shows that for an actuarially fair premium ($\lambda = 1$), full coverage is optimal, regardless of tax deductibility. However, it is now clear that for any loaded premium ($\lambda > 1$), partial coverage (or, in the extreme, zero coverage) is optimal. Empirically, taxpayers itemized \$29 billion in unreimbursed medical and dental expenses in 1997 (Campbell and Parisi, 1999). Up to one-half of this figure may have been health insurance premiums, the remainder having been uninsured losses; the Consumer Expenditure Survey shows that across the income distribution, roughly one-half of household expenditures on health are spent on health insurance.

It is also clear from (5) that if the premium is loaded, the level of uninsured loss ($L - V^*$) is greater with tax deductibility ($\theta = 1$) than without deductibility ($\theta = 0$). Indeed, contrasting these two fiscal regimes is a simple comparative static exercise. With full deductibility, uninsured losses are

$$(L - V^*)\big|(\theta = 1) = \frac{\lambda - 1}{(1-p)(1-t)R_A(E[I])} \tag{6a}$$

whereas, in the absence of deductibility, uninsured losses are

$$(L - V^*)\big|(\theta = 0) = \frac{\lambda - 1}{(1-p)R_A(E[I])}\ . \tag{6b}$$

For constant absolute risk aversion (CARA), equations (6a) and (6b) differ only by virtue of the tax rate. Expressing their difference as a percentage of the former gives

$$\frac{\langle(L - V^*)|(\theta = 1)\rangle - \langle(L - V^*)|(\theta = 0)\rangle}{(L - V^*)\big|\theta = 1} = t\,; \tag{7}$$

the proportion of uninsured medical and dental loss attributable to tax deductibility is equal to the marginal tax rate, regardless of how heavily loaded the premium is. Thus, for example, among itemizers at a marginal tax rate of 28 percent, 28 percent of uninsured medical expenses may be attributed to the income tax provision, while the remaining 72 percent is attributable to premium loading.[9] Indeed, if we treat the 28 percent tax bracket as applying to the typical itemizer, then about $4 billion in medical losses went uninsured in 1997 as a result of income tax deductibility—or rather, were covered by a form of social insurance operated through the tax code—while about $10.5 billion in losses went uninsured because of premium loading. And since the highest marginal tax rate is under 40 percent, premium loading accounts for at least 60 percent of uninsured losses in any given year.

Two caveats are of importance here. First, this result somewhat underestimates the effect of the tax deduction, since state income tax provisions have not been incorporated. The state income tax deductions generally follow those of the federal tax code, so that the federal deduction for uninsured losses triggers state deductions as well. Thus, for any federal income tax rate, the effective overall rate at which losses are deductible is several percentage points higher, depending upon the state tax rate.[10]

Second, because expected income is higher when losses are deductible, both the absolute difference between (6a) and (6b) and the percentage difference in (7) are somewhat larger under decreasing absolute risk aversion (DARA) than under CARA. Under DARA, the tax deduction not only substitutes for insurance, but makes the individual less risk averse, further reducing the demand for insurance. Conversely, under increasing absolute risk aversion (IARA), the impact of the tax deductibility on the market for insurance is diminished. For practical purposes, the CARA assumption is at least a reasonable first approximation, given the mixed empirical results on this question.[11] Thus, even with these caveats, the result of equation (7), that the proportion of uninsured health care expenses due to income tax deductibility is equal to the marginal tax rate, seems to be fairly robust.

UNINSURED PROPERTY LOSSES

Like uninsured medical expenses, uninsured property losses in excess of an income threshold (10 percent of AGI) are tax deductible under Section 165 of the Internal Revenue Code. These include losses that are due to storms, fires, automobile accidents, shipwrecks, vandalism, and other casualties, as well as losses resulting from burglaries, robberies, and other forms of theft.[12] Unlike medical and dental premiums, however, there is no provision in the federal income tax code for deductibility of property insurance premiums. This difference in the tax code requires a modification of the model as follows. For an individual contemplating casualty and/or theft insurance, expected utility is given by

$$E[U] = (1-p)U(Y(1-t)-mV) + pU(Y(1-t)-mV-L+V+t\theta(L-V)). \tag{8}$$

As with medical insurance, the individual chooses the optimal level of property coverage to maximize expected utility. This results in the first-order condition

$$m(1-p)U'_N = p(1-m-\theta t)U'_L \tag{9}$$

and expected income is then given by

$$E[I] = Y(1-t)-mV^*-pL+pV^*+pt\theta(L-V^*). \tag{10}$$

Note from (9) that for property insurance, full coverage is optimal only in the case of actuarially fair insurance ($m = p$) *and* non-deductibility of uninsured losses ($\theta = 0$). By contrast, for $m > p$ *and/or* $\theta = 1$, $V^* < L$. Thus, even without premium loading, a tax deduction for uninsured losses induces partial coverage.[13]

A first-order Taylor series expansion of (9) around expected income (10) yields the following approximation:

$$m(1-p)U'(E[I]) + m(1-p)p(L-V^*)(1-\theta t)U''(E[I]) =$$
$$p(1-m-\theta t)U'(E[I]) + p(1-m-\theta t)(1-p)(L-V^*)(\theta t-1)U''(E[I]). \quad (11)$$

Again using λ and rearranging equation (11) gives the level of uninsured property loss as

$$L - V^* = \frac{\lambda - 1 + \theta t}{(1-p)(1-\theta t)^2 R_A(E[I])}. \quad (12)$$

While it is impossible to determine the precise empirical magnitude of uninsured losses, recent IRS data show that taxpayers who itemized wrote off \$2.88 billion in uninsured casualty and theft losses in 1996, and \$1 billion in 1997 (Campbell and Parisi, 1999).

To compare the level of uninsured loss with and without the tax deduction, it is again necessary only to evaluate the approximate optimum (12) at $\theta = 1$ and $\theta = 0$. Thus, the uninsured property losses with tax deductibility are

$$(L - V^*)\big|(\theta = 1) = \frac{\lambda - 1 + t}{(1-p)(1-t)^2 R_A(E[I])} \quad (13a)$$

and uninsured losses without deductibility would be

$$(L - V^*)\big|(\theta = 0) = \frac{\lambda - 1}{(1-p)R_A(E[I])}. \quad (13b)$$

If we initially assume, as before, that the utility function exhibits CARA, the percentage of uninsured property losses attributable to the tax deductibility can be written as

$$\frac{\langle (L - V^*) | \theta = 1 \rangle - \langle (L - V^*) | \theta = 0 \rangle}{(L - V^*) | \theta = 1} = 1 - \frac{(\lambda - 1)(1 - t)^2}{\lambda - 1 + t}. \quad (14)$$

It is easily seen that this percentage increases with the tax rate (t) and decreases with the premium loading factor (λ). Trivially, of course, for actuarially fair property insurance ($\lambda = 1$), the proportion would simply be 100 percent: all uninsured losses would be attributable to tax deductibility. (Conversely, in the absence of deductibility, all uninsured losses would be due to premium loading.)

More realistically, it is necessary to evaluate (14) at reasonable loading factors. Assuming that the insurer's expectations are correct on average, the reciprocal of the insurer's loss ratio (losses divided by premiums) may be used as a measure of the loading factor (Bradford and Logue, 1998). For personal casualty policies including homeowners insurance and collision coverage on private passenger automobiles, loss ratios have tended to run from about .57 to .80 in recent years, with a weighted average of .67; this implies loading factors ranging between 1.25 and 1.75, with a mean of about 1.5.[14] The relevant fiscal parameter is the marginal tax rate on taxable income, which increases from 15 percent to 39.6 percent in four discrete jumps (IRS, 1999). Table 1 estimates equation (14) for casualty policies using various combinations of these parameter values.

Consider, for example, a marginal tax rate of 28 percent and a loading factor of 1.5, arguably the parameter values facing the representative individual. Assuming that the utility function exhibits CARA, about two-thirds, or $667.70 out of every $1,000, of uninsured casualty losses can be attributed to tax deductibility, with the remaining one-third or $332.30 attributable to premium loading. Naturally, the relative share of the under-insurance caused by the tax code rises with the tax rate and falls with the loading factor. Calibrated across the range of parameter values, Table 1 shows that the proportion of uninsured casualty losses attributable to tax deductibility ranges from a low of about 40 percent up to a high of roughly 86 percent. And remarkably, for all taxpayers at or above the 28 percent marginal tax rate, where itemizers are most likely to be located, the proportion is substantially greater than one-half. This indicates that for many insureds, the tax code plays a more important role than insurance premiums in determining optimal property insurance coverage. This result is in stark contrast to the case of medical insurance, where the proportion of the underinsurance caused by income tax deductibility equals the marginal tax rate, and is therefore less than fifty percent.[15]

For the smaller burglary and theft insurance market, however, loss ratios are commonly in the range of .2 to .33, implying loading factors

Table 1. The Percentage of Uninsured Casualty Losses Attributable to Tax Deductibility

	Tax Rate				
Loading factor	.15	.28	.31	.36	.396
1.25	.5484	.7555	.7875	.8321	.8588
1.30	.5183	.7319	.7659	.8138	.8428
1.35	.4943	.7120	.7475	.7981	.8288
1.40	.4745	.6951	.7318	.7844	.8167
1.45	.4581	.6804	.7181	.7724	.8059
1.50	.4442	.6677	.7061	.7619	.7964
1.55	.4323	.6565	.6955	.7524	.7879
1.60	.4220	.6465	.6861	.7440	.7802
1.65	.4130	.6377	.6776	.7364	.7733
1.70	.4050	.6297	.6700	.7295	.7670
1.75	.3979	.6225	.6631	.7232	.7612

ranging from 3 to 5. Yet Table 2 estimates that even for such coverage, the tax code accounts for some 30 to 70 percent of the underinsurance, and here again, for taxpayers facing marginal income tax rates of 28 percent or higher, tax deductibility is more important than premium loading in determining coverage. For example, at a marginal tax rate of 28 percent and a loading factor of 4.5, 52 percent of uninsured burglary and theft losses are due to income tax deductibility, while 48 percent of uninsured losses are due to premium loading.

Of course, by the same reasoning used above, the estimates in Tables 1 and 2 are somewhat conservative, inasmuch as the state income tax deductions, which are triggered by federal deductions, have been ignored. And here again, the estimates would be even higher under DARA (and somewhat lower under IARA), as demonstrated in the appendix. Either way, it seems clear that the relative impact of the tax deductibility is greater for property insurance than it is for health insurance.

CONCLUSION

In an insurance market without either premium loading or tax deductibility of losses, the first-best outcome is that every risk-averse individual fully insures against risk. But the demand for insurance can be substantially reduced by both premium loading and income tax deductions for unin-

Table 2. The Percentage of Uninsured Burglary and Theft Losses Attributable to Tax Deductibility

	Tax Rate				
Loading factor	.15	.28	.31	.36	.396
3.00	.3279	.5453	.5878	.6529	.6955
3.25	.3227	.5390	.5816	.6469	.6898
3.50	.3184	.5338	.5764	.6420	.6851
3.75	.3149	.5295	.5721	.6378	.6811
4.00	.3119	.5259	.5685	.6343	.6777
4.25	.3094	.5227	.5654	.6312	.6748
4.50	.3072	.5200	.5626	.6286	.6723
4.75	.3053	.5176	.5603	.6263	.6700
5.00	.3036	.5155	.5581	.6242	.6680

sured losses. This paper has found that in the absence of premium loading, the income tax deductions for medical premiums and uninsured losses would precisely offset each other, and thus would not alter the equilibrium in the health insurance market. But given that premiums are inevitably loaded, the proportion of medical and dental losses that remain uninsured because of tax deductibility is approximately equal to the marginal tax rate among taxpayers who itemize their returns. The tax-induced reduction in coverage is relatively greater in the property insurance markets, where premiums are not deductible. Specifically, some 40 to 86 percent of uninsured casualty losses and 30 to 70 percent of uninsured burglary and theft losses are due to the federal income tax code, and the remainder is attributable to premium loading. Indeed, because taxpayers who itemize deductions on their returns are commonly in the higher tax brackets, income tax deductibility is often a more important factor than premium loading in determining the optimal amount of property coverage.

These estimates of the relative effect of the tax code are somewhat conservative, inasmuch as they are based only on the federal tax rates, but many insureds face similar income tax deductibility provisions at the state level. And if the utility functions of the insureds exhibit decreasing absolute risk aversion, the effects of the federal income tax code on the insurance markets are even greater than these estimates suggest.

As noted at the outset, the tax deductions for uninsured losses are a form of social insurance. This paper shows that the primary beneficiaries of these provisions are property owners and high-income taxpayers who itemize on their returns—arguably, those who are best able to afford private coverage. Indeed, many of these same individuals receive health insurance as a tax-exempt fringe benefit from employers, and are thus doubly blessed. Sheils and Hogan (1999) estimate that in 1998, federal subsidies for health care (in the form of forgone tax revenue) averaged $71 per family for those with annual incomes below $15,000 but averaged $2,357 per family for those with incomes of $100,000 or more. Such a policy seems to run counter to the notion of income tax progressivity, and appears to have done little to reduce the number of medically uninsured low-income households. One potentially revenue-neutral alternative with more progressive distributional consequences might be to reduce or eliminate the deductions for uninsured losses and further subsidize the purchase of private insurance by those who are least able to afford it.

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APPENDIX

This appendix provides further details on the derivations of the Taylor series expansions, examines the approximation errors associated with these models, and compares the results for CARA and DARA utility functions.

For convenience, recall the first-order condition for the health insurance model

$$m(1-p)U_N' = p(1-m)U_L' \tag{2}$$

which implicitly contains V^*, the optimal level of insurance. Income in the no-loss state, income in the loss state, and expected income may be written respectively as

$$I_N = Y(1-t) - (1-\theta t)mV^*$$

$$I_L = Y(1-t) - (1-\theta t)mV^* - (1-\theta t)(L - V^*)$$

$$E[I] = Y(1-t) - (1-\theta t)mV^* - p(1-\theta t)(L - V^*) .$$

A Taylor series expansion on each side of (2) is made using the deviations of state-dependent income from expected income. If utility is thrice-differentiable, this is

$$m(1-p)U'(E[I]) + m(1-p)(I_N - E[I])U''(E[I]) +$$
$$.5m(1-p)(I_N - E[I])^2 U'''(E[I]) = p(1-m)U'(E[I]) +$$
$$p(1-m)(I_L - E[I])U''(E[I]) + .5p(1-m)(I_L - E[I])^2 U'''(E[I]).$$

Notice that the $U'''(E[I])$ terms on either side of the equation represent remainders, or approximation errors, which have been ignored in the text. However, these terms are of the same order of magnitude and cancel out completely in some cases. To see this, note that after substituting for the income terms and rearranging algebraically, we get

$$-.5p(1-p)(1-m-p)(1-\theta t)^2 U'''(E[I])(L-V^*)^2 +$$
$$p(1-p)(1-\theta t)U''(E[I])(L-V^*) + (m-p)U'(E[I]) = 0$$

Equivalently, after dividing by $U''(E[I])$, we get

$$.5p(1-p)(1-m-p)(1-\theta t)^2 \eta(L-V^*)^2 +$$
$$p(1-p)(1-\theta t)(L-V^*) - (m-p)(1/R_A) = 0$$

where $\eta = -(U'''(E[I])/U'')(E[I])$ is the coefficient of absolute prudence (Kimball, 1990). The quadratic formula can now be applied to solve for (L – V^*). For full deductibility,

$$(L-V^*)|(\theta = 1) = \qquad \text{(A1)}$$
$$\frac{-p(1-p) \pm \sqrt{p^2(1-p)^2 + 2p(1-p)(1-m-p)(\eta/R_A)(m-p)}}{p(1-p)(1-m-p)(1-t)\eta}$$

Whereas, without deductibility, if η and R_A are constant,

$$(L-V^*)|(\theta = 0) = \qquad \text{(A2)}$$
$$\frac{-p(1-p) \pm \sqrt{p^2(1-p)^2 + 2p(1-p)(1-m-p)(\eta/R_A)(m-p)}}{p(1-p)(1-m-p)\eta}$$

Utilizing these expressions to estimate uninsured losses will give slightly different estimates than using equations (6a) and (6b), respectively. However, expressing the difference between (A1) and (A2) as a percentage of the former gives the proportion of uninsured medical losses attributable to the tax deductions as

$$\frac{\langle (L-V^*)|\theta=1\rangle - \langle (L-V^*)|\theta=0\rangle}{(L-V^*)|\theta=1} = \frac{[1/(1-t)]-1}{[1/(1-t)]} = t.$$

This is identical to equation (7), which was obtained from the linear approximation.

The same technique can be applied to the property insurance model, but because of the asymmetric tax treatment of premiums and uninsured property losses, the U''' terms will not cancel out completely. The difference between first-order and second-order Taylor series expansions can, however, be illustrated by evaluating each numerically. A second-order expansion of the property insurance model yields

$$.5p(1-p)(1-\theta t)^2[(1-p)(1-\theta t)-m]\eta(L-V^*)^2 +$$
$$p(1-p)(1-\theta t)^2(L-V^*)-[(m-p+p\theta t)/R_A] = 0$$

Solving this equation for uninsured losses by applying the quadratic formula for $\theta = 1$ and $\theta = 0$ requires numerical values for η and R_A as well as for t, m, and p. Most of the literature on risk preferences has estimated relative risk aversion rather than absolute risk aversion, but the latter may be recovered from the former. For illustration purposes, let relative risk aversion be $R_R = E[I]R_A = 3$, and let the individual be endowed with $60,000 in expected income; then absolute risk aversion is $R_A = .00005$. If, as assumed above, the individual exhibits constant absolute risk aversion, then absolute prudence and absolute risk aversion are equal, so $\eta = .00005$ as well. Consider next a loss probability of .10, a premium rate of .15, and an income tax rate of .28. Under these conditions, the individual leaves $25,402.43 of property value uninsured if losses are deductible, and leaves $9,440.17 uninsured if losses are not deductible. The fraction of uninsured property losses due to tax deductibility is then 62.8%, only slightly less than the 66.8% estimated in Table 1 using the more convenient linear approximation.

To illustrate the outcome under decreasing absolute risk aversion, note that DARA implies that $\eta > R_A$ and that R_A declines as $E[I]$ rises with a tax deduction. Suppose, therefore, that without a tax deduction, $\eta = .00006$ and $R_A = .00005$; but with a tax deduction, $R_A = .00004$ while prudence and other parameters are constant. Then the proportion of uninsured losses attributable to tax deductibility rises to 68.4% in the quadratic estimation and 73.4% in the linear estimation. Conversely, it is easily demonstrated that the percentages decline under IARA.

Similar comparisons can be made for the estimates in Table 2. For example, assuming CARA with $\eta = R_A = .00005$, $t = .28$, $p = .10$, and $m = .40$ (for a loading factor of 4), the proportion of uninsured theft losses due to tax deductibility is estimated from the quadratic to be 52.0%, just slightly less than the 52.6% given in Table 2. Other assumptions regarding the parameter values yield similar results. Thus, the estimates in Tables 1 and 2 appear to be fairly robust with regard to the expansion.

Indeed, it is not obvious that the linear estimates are less accurate than the quadratic estimates. Although in principle the quadratic equations should be more precise because they include more utility terms, if our empirical knowledge of these preference parameters is uncertain, then in practice, inserting inaccurate data into the quadratic estimates may actually introduce more approximation error than the linear estimates.

NOTES

[1] For a discussion of the income tax itself as a form of social insurance, see Varian (1980).

[2] Deductible expenses include prescription medicines and insulin; the services of medical doctors, osteopaths, dentists, eye doctors, podiatrists, chiropractors, psychiatrists, psychologists, physical therapists, acupuncturists, and psychoanalysts; medical examinations, x-rays, and laboratory services; nursing help, hospital care, and qualified long-term care; medical aids, such as eyeglasses, contact lenses, hearing aids, braces, crutches, wheelchairs, and guide dogs; and ambulance services, as well as other travel and lodging expenses incurred to receive medical care.

[3] Moreover, the self-employed, along with wage and salary workers at small firms (those with 50 or fewer employees), may make contributions to a medical savings account (MSA) on a tax-deductible basis, and subsequently withdraw funds to pay for health care. Similarly, employees of firms that offer flexible spending accounts can contribute funds on a pre-tax basis to be used in the event that medical or dental expenses are incurred during the year. These exemptions represent additional avenues by which the federal income tax code reduces the demand for private health insurance.

[4] Of course, if no loss is incurred, the tax deduction for those who are not self-employed depends on the relative size of the premiums alone. While health insurance premiums are often less than 7.5 percent of AGI for young, healthy, single individuals with large incomes, private health and dental insurance premiums may well exceed the threshold for those with large families, older workers, and retirees with limited income and no employer-sponsored insurance. Data from the 1998 Consumer Expenditure Survey suggest that members of the lowest income quintile, for example, spend an average of more than 8 percent of their incomes on health insurance, and data from Wave I of the University of Michigan's Health and Retirement Study show that 23 percent of the households that purchase private health insurance spend 7.5 percent or more of their incomes on premiums. These are both conservative estimates, as they are based on total income, rather than AGI. On the other hand, not all of those with deductible expenses itemize their tax returns, as many take the standard deduction instead.

[5] This analysis, like Kaplow's (1992), deals only with insurance purchased individually by households. The effect of the income tax exclusion of employer-paid health insurance premiums has been studied separately and extensively; see, for example, Pauly (1986).

[6] For any given Y, the income threshold for a tax deduction (7.5 percent of AGI) is a constant, and therefore will not affect the insurance decision at the margin, so for simplicity this complication is omitted from the model; this simplification is again in keeping with Kaplow's (1992) analysis.

[7] The second-order condition is $m^2(1-p)U''_N + p(1-m)^2 U''_L < 0$, which guarantees that the level of insurance coverage implicit in (2) generates maximum expected utility.

[8] Note that because L is assumed to be fixed and the optimum coverage is determined before the state of nature is revealed, $(L - V^*)$ is the *ex ante* level of potentially uninsured loss; yet if an unfavorable state does occur, $(L - V^*)$ is also the *ex post* level of actual uninsured loss.

[9] Alternatively, of course, it is possible to express the difference between (6a) and (6b) as a percentage of (6b). In that case, the result is interpreted as the percentage by which uninsured losses are higher as a result of deductibility than they otherwise would be, and this is equal to $t/(1-t)$. Thus, at a 28 percent marginal tax rate, uninsured medical costs are about 39 percent greater than they would be in the absence of deductibility.

[10] The marginal income tax rate in New York State, for example, ranges from 4 percent to 6.85 percent; of course, a few states levy no income tax. At the same time, each of the 50 state governments assesses an excise tax ranging from 1 percent to 4 percent on insurance premiums, which further discourages the purchase of insurance (Eisenhauer, 1996).

[11] Szpiro (1983) found weak evidence of decreasing absolute risk aversion (DARA), as did Wolf and Pohlman (1983). The latter study found that for most small transactions, CARA could not be rejected; DARA was a statistically significant outcome only for large transactions. An experiment by Levy (1994) found strong evidence of DARA, but using life insurance data, Eisenhauer (1997) and Eisenhauer and Halek (1999) found households to exhibit a statistically significant but numerically slight tendency for increasing absolute risk aversion (IARA).

[12] The extent of the loss is measured by the reduction in fair market value or the original price of the property (whichever is less), after subtracting $100 and any insurance reimbursement. Several examples are provided on the IRS website, www.irs.treas.gov.

[13] The second-order condition is $m^2(1-p)U''_N + p(1-m-\theta t)^2 U''_L < 0$, which ensures that (9) represents a maximum.

[14] These calculations are based on 1989–1998 figures from A. M. Best Company (1999); auto liability is excluded, since liability losses are not tax deductible. These figures are consistent with those reported by Born et al. (1998); see also the cross-section figures for 1997 presented by the National Association of Insurance Commissioners Staff (1998).

[15] Indeed, comparing (7) to (14) shows that $t < 1 - \frac{(\lambda-1)(1-t)^2}{\lambda-1+t}$ for all $0 < t < 1$; for any given tax rate, the relative effect of the tax deduction is always greater in the property insurance market, where premiums are not deductible.

REFERENCES

A. M. Best Company (1999) *Best's Aggregates and Averages: Property-Casualty.* Oldwick, NJ: A. M. Best Co.

Born, Patricia, William M. Gentry, W. Kip Viscusi, and Richard J. Zeckhauser (1998) "Organizational Form and Insurance Company Performance: Stocks versus

Mutuals," in *The Economics of Property-Casualty Insurance,* David F. Bradford, editor. Chicago: University of Chicago Press, pp. 167–192.

Bradford, David F. and Kyle D. Logue (1998) "The Effects of Tax Law Changes on Property-Casualty Insurance Prices," in *The Economics of Property-Casualty Insurance*, David F. Bradford, editor. Chicago: University of Chicago Press, pp. 29–80.

Butler, Stuart and David B. Kendall (1999) "Expanding Access and Choice for Health Care Consumers Through Tax Reform," *Health Affairs,* 18(6), November-December, pp. 45–57.

Campbell, David and Michael Parisi (1999) "Individual Income Tax Returns 1997," *Statistics of Income Bulletin,* 19(2), Fall, pp. 8–45.

Eisenhauer, Joseph G. (1996) "Insurance and Externalities: An Economic Analysis of Premium Taxes," *Journal of Insurance Issues,* 19, Spring, pp. 69–77.

Eisenhauer, Joseph G. (1997) "Risk Aversion, Wealth, and the DARA Hypothesis: A New Test," *International Advances in Economic Research*, 3, February, pp. 46–53.

Eisenhauer, Joseph G. and Martin Halek (1999) "Prudence, Risk Aversion, and the Demand for Life Insurance," *Applied Economics Letters,* 6, April, pp. 239–242.

Internal Revenue Service, U.S. Department of the Treasury (1999) *Forms and Instructions for Form 1040.* Washington, D.C.: U.S. Government Printing Office.

Kaplow, Louis (1992) "Income Tax Deductions for Losses as Insurance," *American Economic Review,* 82, September, pp. 1013–1017.

Kimball, Miles S. (1990) "Precautionary Saving in the Small and in the Large," *Econometrica*, 58(1), January, pp. 53–73.

Levy, Haim (1994) "Absolute and Relative Risk Aversion: An Experimental Study," *Journal of Risk and Uncertainty*, 8, pp. 289–307.

Mossin, Jan (1968) "Aspects of Rational Insurance Purchasing," *Journal of Political Economy,* 76, July/August, pp. 553–568.

National Association of Insurance Commissioners Staff (1998) "Aggregate Loss Ratios By Line By State," *NAIC Research Quarterly,* 4(2), April, pp. 28–42.

Pauly, Mark V. (1986) "Taxation, Health Insurance, and Market Failure in the Medical Economy," *Journal of Economic Literature* 24, June, pp. 629–675.

Sheils, John and Paul Hogan (1999) "Cost of Tax-Exempt Health Benefits in 1998," *Health Affairs*, 18(2), March–April, pp. 176–181.

Szpiro, George G. (1983) "The Hypotheses of Absolute and Relative Risk Aversion: An Empirical Study Using Cross-Section Data," *Geneva Papers on Risk and Insurance*, 8, October, pp. 336–349.

Varian, Hal R. (1980) "Redistributive Taxation as Social Insurance," *Journal of Public Economics,* 14, pp. 46–68.

Wolf, Charles and Larry Pohlman (1983) "The Recovery of Risk Preferences from Actual Choices," *Econometrica,* 51, May, pp. 843–850.