

# The incidence of Medicare<sup>☆</sup>

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## Abstract

The Medicare program transfers nearly \$300 billion annually from taxpayers to beneficiaries. This paper considers the incidence of such transfers in the context of a life cycle model with uncertainty about future health care expenditures. We find the distributional consequences of the Medicare program are roughly neutral in dollar terms; households living in high income neighborhoods pay more in taxes, but they also receive more in benefits. These dollar flows, however, ignore the insurance value of the Medicare system. Given the incomplete insurance coverage of lower income elderly households prior to the Medicare program, the money-metric benefits to lower income groups exceed the dollar flows, suggesting that Medicare redistributes more than a simple accounting exercise would suggest. © 2005 Elsevier B.V. All rights reserved.

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## 1. Introduction

As the primary source of health insurance for the elderly, Medicare is a major component of social insurance in the United States. Overall spending in fiscal year 2004 was nearly \$300 billion and is projected to grow dramatically in the near term with expanded prescription drug benefits (Tierney, 2003) and in the long term (Lee and Miller, 2002). Indeed, Fuchs

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(1999) has suggested that for the elderly population in 2020, per capita Medicare spending will be equal in magnitude to *all* non-medical consumption expenditures.

Despite Medicare's growing importance, there is only sparse evidence on who benefits from it and who pays for it.<sup>1</sup> One reason for the limited attention may be the apparent simplicity of the question. The Medicare entitlement is essentially the same for all elderly: hospital insurance (Part A) financed by payroll taxes and supplemental insurance (Part B) financed largely by general tax revenues. Because high-income households tend to pay more in both payroll taxes and other taxes over their lifetimes, the Medicare program would appear to provide an important source of redistribution to lower income elderly households.

The answer is not so simple. We calculate lifetime expenditures for the elderly in Medicare by zip code income deciles using comprehensive Part A (hospital) and Part B (outpatient and physician) insurance claims data from a cohort of Medicare enrollees for the years 1987–2001. We then calculate lifetime payments into the system using the Panel Study of Income Dynamics (PSID), which allows us to track, for representative individuals, their entire accumulated Medicare payments since 1967, essentially the entire life of the Medicare system.

Not surprisingly, we find substantial levels of intergenerational transfers towards older generations, with an average projected transfer (in 1990 dollars) of \$26,273 for the 1922 cohort. We also find elevated Medicare expenditures among higher income households, largely because they are more likely to survive to age 65—thus becoming eligible for Medicare—and because conditional on reaching age 65 they can expect to collect Medicare expenditures longer. Of course, high-income wage-earners pay more in lifetime tax revenue. Based on zip-code-level income measures, we find that the highest income households received net benefits (i.e., lifetime expenditures less lifetime taxes) slightly *higher* than those in lower income groups. At least in dollar terms, Medicare appeared to transfer little or nothing from high to low income groups.

More importantly, dollar flows of money are not the appropriate way to judge the value of any social insurance program. A large part of Medicare's value is that it provided a health insurance option to the elderly, many of whom prior to 1965 were not covered by health insurance.<sup>2</sup> To estimate the insurance value of Medicare—and in particular, the *differential* insurance value between high and low income households, we develop a simple analytic model to measure the money-metric value of the ex ante benefits provided by the Medicare program. This valuation of Medicare exceeds the dollar flows for lower income households because it provides the “missing market” of health insurance to people who, prior to 1965, were largely uninsured.

## 2. An accounting framework for measuring redistribution in Medicare

Like Social Security, Medicare is financed largely on a “pay as you go” basis. Since its inception in 1966, Medicare Part A, insurance for hospital care and some alternatives to hospitalization, has been financed by a payroll tax on wages. The Part A payroll tax rate is 2.9%, half levied on the employee and half on the employer. Medicare Part B, insurance

<sup>1</sup> Vogel (1988) and more recently Bhattacharya and Lakdawalla (2005) are notable exceptions.

<sup>2</sup> For example, see Gruber and Gertler (2002) and Finkelstein and McKnight (2005).

for physician and outpatient services, is financed partly by beneficiary premiums that cover one-fourth of expenditures, but primarily by general Federal tax revenues. Because Medicare tax payments, especially payments for Part B, are related to an individual's income over his or her working life, an individuals' overall contribution to Medicare financing clearly increases with lifetime income.

However, lifetime payments by current beneficiaries have never come close to financing their lifetime expenditures. Individuals who were 65 or over in 1966 were clearly better off with the program, since they contributed no payroll taxes and relatively little general tax revenue and premiums to its financing. But the subsequent rapid growth in Medicare expenditures coupled with the largely "pay as you go" nature of its financing has led to substantial intergenerational transfers to all subsequent cohorts of beneficiaries (Vogel, 1988), and these intergenerational transfers are expected to persist (Gokhale and Smetters, 2003).

If lifetime Medicare expenditures were similar across income groups, measuring the incidence of Medicare would be straightforward. But considerable evidence indicates that health care expenditures are correlated with lifetime income.<sup>3</sup> Even under the National Health Service in Great Britain, expenditures per occurrence of an illness were 35% more among higher-income groups in England (LeGrand, 1982, p. 26), and higher income is associated with lower mortality (Menchik, 1993; Preston and Taubman, 1994; Smith and Egger, 1992; Pappas et al., 1993). In this section we develop an accounting approach to account for income-based differences in expenditures and taxes.

### 2.1. An accounting framework

Benefits are the sum of taxes paid plus intergenerational and intragenerational transfers:

$$\begin{aligned} \text{PV}(\text{Benefits})_{ik} = & \text{PV}(\text{Taxes paid})_{ik} + \text{PV}(\text{Within} - \text{Cohort Redistribution})_{ik} \\ & + \text{PV}(\text{Between} - \text{Cohort Redistribution})_{ik} \end{aligned}$$

for the  $k$ th beneficiary group within cohort  $i$ . By definition, within-cohort redistributions sum to zero across the  $k=1, \dots, K$  groups. Since the intergenerational transfer is a *constant dollar amount* for each person in the cohort, the within-cohort redistribution is the difference between the actual transfer and the average transfer to the cohort.

There are a variety of measures used to evaluate the distributional characteristics of government programs. The traditional measures of progressivity applied to tax policy relate to whether tax rates rise or fall as a percentage of income; for example see Coronado et al. (1999). By this approach, a government program providing \$400 in benefits to a household earning \$10,000 (4% of income), and \$7000 to a household earning \$200,000 (3.5%), would be deemed progressive.<sup>4</sup>

Other studies have compared relative rates of return across income groups from Social Security and Medicare tax payments (Hurd and Shoven, 1985; Bhattacharya and Lakdawalla, 2005). Internal rate of return calculations are typically avoided in cost–

<sup>3</sup> See Gornick et al., 1996; Davis and Reynolds, 1975; Link et al., 1982.

<sup>4</sup> This makes the Fullerton and Rogers (1993) study all the more remarkable, since they find little progressivity in the Social Security system. See also Mulligan and Philipson (2000).

benefit analysis for a variety of reasons (see Rosen, 2001), with the most serious concerns regarding the sometimes misleading results that occur when the timing of the costs and benefits differ between comparisons groups, and because they do not reflect the relative dollar gains or losses most important for utility-based policy evaluation. We avoid these pitfalls by following in the tradition of cost–benefit analysis by which a program is evaluated based on the dollar or money-metric *redistribution* across income groups.<sup>5</sup>

Considering a specific cohort  $i$ , the present value of benefits for income group  $k$  through 2017 is given by

$$PV(\text{Benefits})_k = \sum_{j=1965}^{2017} \omega_{jk} M_{jk} \left[ \prod_{s=1965}^j (1 + r_s)^{-1} \right] \lambda \quad (1)$$

where  $j$  denotes year,  $\omega_{jk}$  is the fraction of cohort members in group  $k$  surviving to year  $j$  based on age- and income-specific survival rates,  $M_{jk}$  is the level of Medicare expenditures for group  $k$  in year  $j$ , and  $r_s$  is the year-specific interest rate. The variable  $\lambda = \prod_{s=1965}^{1990} (1 + r_s)$  adjusts all dollar measures from 1965 up to 1990. Thus all measures of benefits (and taxes) are present value terms, but are scaled up to 1990 dollars.

Next, we consider the present value of taxes paid to finance Medicare. An individual's total allocated tax payments into the Medicare system are given by:

$$PV(\text{Taxes})_k = \sum_{j=1965}^{2017} \omega_{jk} [\min(E_{jk}, \text{MAX}_j) \tau_j^m + \psi_j T_{jk} + P_j] \left[ \prod_{s=1965}^j (1 + r_s)^{-1} \right] \lambda. \quad (2)$$

The first term in the first bracket measures the Medicare Part A component of the payroll tax, where  $\tau_j^m$  is the proportional Medicare payroll tax in year  $j$  and  $E_{jk}$  earnings in the  $k$ th income decile during year  $j$ . In earlier years, the payroll tax rate was only 0.7%, with modest caps on taxable earnings ( $\text{MAX}_j$ ), for example  $\text{MAX}_{1971} = \$7800$ , but since then the cap was expanded and in 1994 it was removed. The second term allocates total household Federal tax payments  $T_{jk}$  (exclusive of payroll taxes) into Medicare Part B, based on the fraction  $\psi_i$  of total Federal expenditures devoted to Medicare Part B in that year.<sup>6</sup> We also include the Part B premium  $P_j$  which is zero prior to age 65 and assumed constant at \$473 in real 1990 dollars.<sup>7</sup> Tax payments are adjusted by the probability that the individual survives to age  $j$  ( $\omega_{kj}$ ) and are normalized to 1990 dollars using the adjustment factor  $\lambda$  as before. These life-table probabilities  $\omega_{kj}$  are specific to age and income groups and are based upon published data from the National Longitudinal Mortality Study (Sorlie et al., 1995) and described in more detail in Appendix A.1. The interest rate prior to 1990 is the actual nominal rate of interest paid on U.S. government debt held by the Social Security Administration, while all discount calculations (for

<sup>5</sup> We are grateful to Richard Musgrave for suggesting this approach.

<sup>6</sup> Tax payments are included for those over age 65 by taking their imputed tax contributions from general revenue in 1990, and taking the present value, discounting by a 3% real interest rate and a 5% mortality rate.

<sup>7</sup> We use the 2001 Part B premium as an average of “future” premiums; since 1990 they have roughly kept pace with inflation. Recent legislation has called for substantially higher contributions by high income households; for example those with incomes of \$200,000 and over are legislated to pay 80% of their actuarial cost in 2011. We do not model these expected changes, both because of uncertainty about whether they will be enacted, and because they are still relatively small in present value terms for the 1922 cohort, who will be age 89 in 2011.

Medicare expenditures, primarily) use a real 3% interest rate. (As we show below, the results are not sensitive to this discount rate.).

### 3. Estimating income-based dollar transfers in Medicare

In an ideal world, we would follow all individuals alive in 1965 forward to compile their actual income, lifetime taxes, and lifetime Medicare expenditures. In this imperfect world, we first estimate lifetime Medicare expenditures based on administrative claims data, matched to income deciles using data on their zip code of residence. Second, tax estimates are built up from individual-level longitudinal data based on the PSID. Finally, the tax estimates are converted from individual measures to zip-code-based deciles, thus allowing the tax data to be merged with the expenditures data. Each step is considered in turn.

#### 3.1. Medicare expenditures by zip-code decile

The Medicare data includes expenditures on services covered by Medicare (inpatient, outpatient, and physician) for a random 5% sample of elderly Medicare beneficiaries alive in 1987, approximately 1.3 million individuals. We matched these data by residential zip code to 1990 Census data on average zip code income for households aged 55–64 compiled from the CensusCD database.<sup>8</sup> (The choice of income for the 55–64 age group is discussed below.) We then divided the sample of Medicare beneficiaries aged 65–69 in 1987 into income deciles, and calculated the present value of sex-specific Medicare expenditures during 1987–2001, as in Eq. (1), based on the survival probabilities and Medicare expenditures available in the claims data.

By 2001, the initial cohort was just age 79–83. To capture expenditures at a later age, we therefore examined the parallel pattern of survival and Medicare expenditures for the cohort aged 80–84 in 1987, followed through to 2001 when they were 94–98. These expenditures in turn were “chained” to the original, adjusted by the probability of reaching age 80–84, the growth rate in real Medicare expenditures during 1987–2001 (3.0%) and the discount rate, as in Eq. (1). Strictly speaking, this analysis makes inferences about high and low income neighborhoods rather than high or low income households, an issue to which we return below.

#### 3.2. Lifetime Medicare taxes by income decile

We use the Panel Study of Income Dynamics to estimate differences in lifetime Medicare taxes across income groups. In calculating lifetime taxes for the cohort age 65 in 1987 (those born in 1922) we restrict the sample to households (married or single) aged 60–69 in 1990 and who had remained intact since 1982. To accumulate total taxes paid since program implementation in 1966, we include both the husband and wife’s earnings

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<sup>8</sup> Average income was calculated using midpoints of income intervals.

back to 1967.<sup>9</sup> Federal taxes paid by the head and spouse are reported (since 1970) in the PSID; these are used to impute federal taxes paid into the Medicare system.<sup>10</sup> We use average money income between 1984–88 as our measure of “permanent income” for the purpose of creating income deciles, with all values expressed in 1990 dollars.<sup>11</sup> At the individual level, taxes accumulated up to 1987 are somewhat progressive, but when the present value of Part B premiums are included, the tax becomes regressive, as shown in Appendix Table A.

### 3.3. Converting individual income tax payments to zip-code-based deciles

Note that when we compare taxes paid to expenditures received, we must convert the PSID-level income deciles, based on individual income, to the neighborhood zip code level income deciles. Because PSID income is based on lagged income (1984–88) earned at a younger age, we match this measure to zip code income from the Census data for ages 55–64. The income distributions for the PSID and the Census data are quite similar, although the PSID income distribution is more compressed, with fewer households in the lowest (<\$15,000) and highest (>\$75,000) income categories.<sup>12</sup> This is not unexpected, the PSID uses a 5-year average rather than annual income as in the Census.

The PSID data are used to create synthetic “neighborhood” lifetime tax payments for each of the zip code income deciles. This is done by estimating from the PSID average lifetime taxes for the income categories <\$15,000, \$15–25,000, \$25–50,000, \$50–75,000, and \$75,000+, these can be designated as  $PVT_h$ ,  $h = 1, \dots, 5$ . For each zip code decile, we calculate from Census data the probability distribution of these 5 income intervals  $z_{hk}$ . Tax payments for zip code decile  $k$  is therefore a weighted average,  $\sum_h z_{hk} PVT_h$ . Not surprisingly, the weights vary widely across the zip code income deciles; there are just 2.2% of households reporting incomes of \$75,000 or more in decile 1, in contrast to 38.4% in decile 10.

### 3.4. Medicare expenditures and taxes

Fig. 1 shows the income-mortality gradient by zip code decile as the simple fraction of men and women age 65–69 in 1987 who are still alive in 2001. There is a pronounced income gradient in mortality; 54% of the bottom income decile and 41%

<sup>9</sup> Family structure is allowed to change prior to 1982; if we had restricted the sample to one in which there had been no change, it would have been highly unrepresentative. For single female households, we counted earnings as spousal earnings if the household had been married prior to 1982, for single male households, we counted just head's earnings.

<sup>10</sup> The 1970 taxes paid are used to impute previous years' federal taxes paid.

<sup>11</sup> Observations are excluded if household income is less than \$1000 in any of the years 1984–88 and if there was a change in marital status during this period. See Dynan et al. (2004) for details on the construction of this measure.

<sup>12</sup> The distributions were created using cutpoints of \$15,000, \$25,000, \$50,000, \$75,000, and above \$75,000. According to the Census data for households age 55–64, 23.2% had income less than \$15,000, and 12.2% had incomes above \$75,000. The corresponding values for the PSID data were 17.2% under \$15,000 and 8.1% over \$75,000.

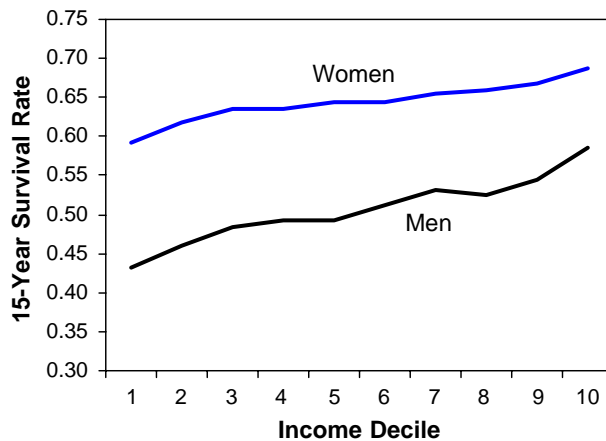


Fig. 1. 15-year survival rates among Medicare enrollees age 65–69 in 1987.

of the top income decile had died by 2001. For women in the same age group, 40% in the bottom income decile and 31% in the top income decile died during the 15-year period.

There are also income-based differences in spending conditional on being alive. Fig. 2a (for men) and b (for women) shows Medicare expenditures in 1987, 1992, 1997, and 2001, using 75–79 as the age reference group. (The income gradient is flatter or more negative at earlier ages, more positive at later ages.) Looking at 1987, there is a generally flat or positive correlation between income and Medicare spending, particularly for men. These results are more consistent with the earlier literature; for example Davis and Reynolds (1975) found expenditures among high income enrollees twice the expenditures for low income enrollees. By the mid-1990s the gradient had changed, as can be seen in Fig. 2a and b for the 1997 data (see also Lee et al., 1999 and Skinner and Zhou, 2004). The dramatic increase in expenditures among the lowest income deciles was in part an explosion in home health care expenditures, scaled back only partially by the Balanced Budget Act of 1997. Another factor was the Disproportionate Share Hospitals (DSH) program targeted to hospitals in low income neighborhoods. Some part of this rapid increase in expenditures is likely to have benefitted the providers of care, although here we have attributed all the benefits to low income enrollees (see Havemann, 1997; Dugan, 2000; Baicker and Staiger, in press).

Taxes at the zip code level are shown in Fig. 3. Accumulated taxes paid ranged from \$9826 (38% of annual incomes) in Decile 1 to \$15,509 (32% of annual income) in Decile 10. The Medicare component of the tax is regressive largely because of the expected value of the Part B premium, which comprises more than half of the overall tax burden for the lowest income group.<sup>13</sup>

<sup>13</sup> In practice, Medicaid will often pay for the Part B premium. This issue of interaction effects between Medicare and other social insurance programs is addressed below.

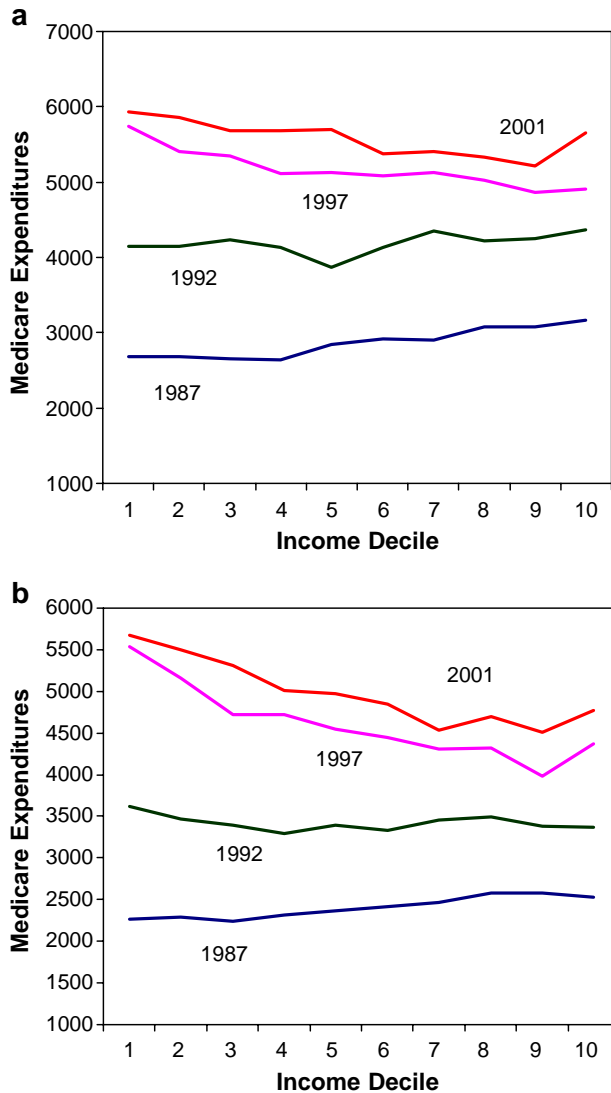


Fig. 2. a: Average Medicare expenditures by zip code income decile for men age 75–79. b: Average Medicare expenditure by zip code income decile for women age 75–79. Note: all expenditures in 1990 dollars.

### 3.5. Intergenerational and intragenerational transfers

The present value of expenditures, taxes, and the resulting net transfers are reported in Table 1 with an assumed discount rate of 3%. Results are averaged across men and women. In all deciles, taxes are considerably less than lifetime expenditures, with generational transfers of \$26,273 per person. Aside from the lowest income decile, Medicare effects a modest redistribution from lower income to higher income households



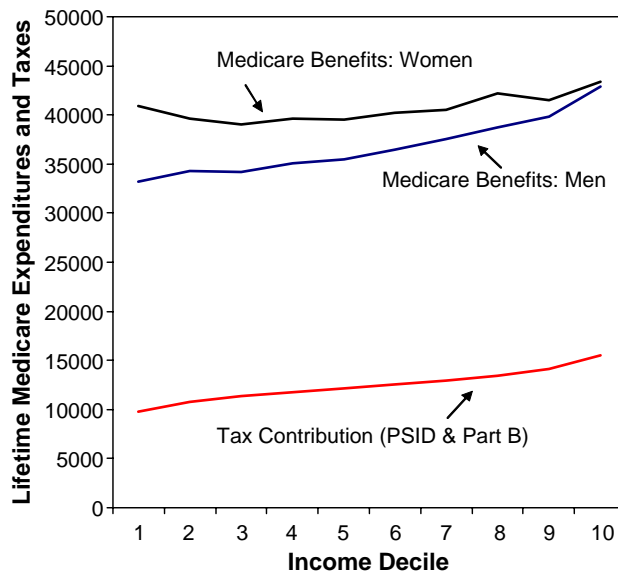


Fig. 3. Medicare lifetime expenditures and tax contribution by zip code income decile: the 1922 cohort.

(Column 3, and Fig. 4). The lowest income decile is estimated to receive a net transfer of \$978 (for a total generational transfer of \$27,251), the 3rd decile within-cohort redistribution is  $-\$1,017$  (total transfer of \$25,256), while the highest income decile nets \$1381 (total transfer of \$27,654).

As sensitivity analysis, we also consider discount rates of 1% and 5%, also shown in Table 1. A higher discount rate tends to increase redistribution, this is because the future Medicare benefits for long-lived high income individuals are discounted more heavily. However, dollar transfers are modest whether at a 1% or a 5% discount rate.

Table 1  
Medicare taxes, benefits, and net transfers for the 1922 cohort

Decile	Lifetime taxes paid (000)	Benefits (000)	Net Medicare transfers (\$ 000)				
			Base scenario	1% discount	5% discount	1990 tax rates	Utility-adjusted
1	9.8	37.1	1.0	0.7	1.1	2.8	7.6
2	10.8	36.9	-0.1	-0.2	0.6	1.0	3.5
3	11.3	36.6	-1.0	-1.4	-0.4	-0.3	1.0
4	11.7	37.3	-0.7	-0.9	-0.2	0.4	0.4
5	12.1	37.5	-0.9	-1.1	-0.5	-0.7	-0.8
6	12.6	38.4	-0.5	-0.4	-0.2	-0.6	-1.3
7	12.9	39.0	-0.2	-0.2	-0.2	-0.6	-1.6
8	13.4	40.5	0.8	1.2	0.4	0.0	-1.5
9	14.1	40.7	0.3	0.4	-0.5	-1.0	-3.6
10	15.5	43.2	1.4	1.8	-0.1	-1.0	-3.7
Avg. intergenerational transfer			26.3	29.8	17.0	19.2	37.8

All numbers are on a per capita basis. In the base case, the discount rate is 3% and the time period of analysis for the Medicare claims data is 1987–2001.

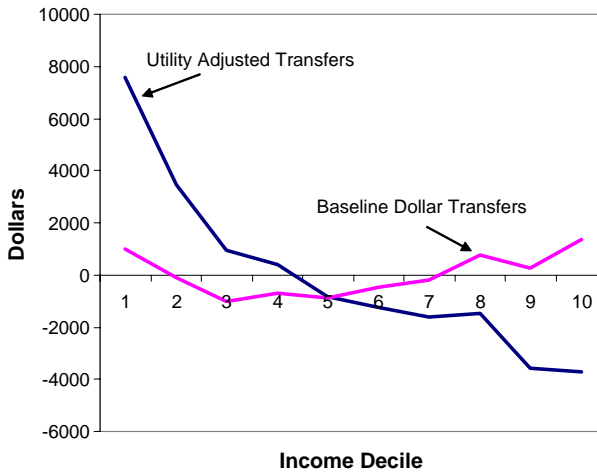


Fig. 4. Net Medicare transfers by income decile: utility adjusted and baseline dollar flows.

Perhaps results derived for a transition generation do not hold when the tax system is more fully phased in. We therefore consider the counterfactual case where the then current (1990) federal and payroll tax rates, absent any maximum caps on taxes, are imposed on all earnings since 1967. Not surprisingly, lifetime tax revenue is substantially larger, ranging from \$15,067 at the lowest decile to \$24,953 to the highest. This in turn leads to a modest degree of redistribution, \$2813 to the lowest income decile and –\$988 for the highest income, with a correspondingly smaller degree of intergenerational redistribution (\$19,198). Even in this case, the extent of redistribution is remarkably modest, given that lower income households tend to experience more illness.

#### 4. A utility-based approach to valuing Medicare benefits

Even accounting measures of dollar flows will not capture an important part of the net value of Medicare as a social insurance program to different income groups. As [Bernheim \(1987\)](#) has argued, dollar benefits paid ex post do not reflect the ex ante value of a social insurance program such as Social Security because the ex post measures ignore the value of providing insurance against living too long, or equivalently against high medical expenditures, even among those who never need it. This general point—that adverse selection and missing private markets affect the valuation of the government transfers—holds as well for Social Security Disability Insurance ([Bound et al., 2004](#)) and unemployment insurance ([Engen and Gruber, 2001](#)).

Evidence of wide gaps in insurance coverage prior to Medicare is shown in [Table 2](#). In 1962, fewer than 40% of elderly households in the bottom third of the income distribution held any health insurance, compared to three-fourths of households in the upper third of the income distribution. Nor were they particularly generous: most of them capped not only the dollar amount of coverage provided per hospital day (as little

Table 2  
Shares of elderly households with health insurance, 1962

Income tercile	Couples	Single males	Single females
Lowest	42%	15%	31%
Middle	66%	31%	42%
Highest	80%	64%	66%

Source: Appendix G, “Services for Senior Citizens,” Special Committee on Aging, Hearings, U.S. Senate 1631 (88th Congress), 1964.

as \$10) or per physician visit, but also the total days and number of visits (Epstein and Murray, 1967).

There are other explanations as well for the minimal coverage levels among the low-income elderly. A universal insurance program forces lower-income beneficiaries who probably have lower demands for insurance to pool with individuals who have higher demands. Health care spending resulting from generous insurance could be worth much less than its costs to low income recipients. In Congressional testimony during 1964, Edwin Daily, MD, of the Group Health Association of America noted

We have many enrollees who upon attainment of age 65 become ineligible to continue under group enrollment and no longer have part or all of their premiums paid by an employer or welfare fund. We urge every one of these people to keep their insurance, that this is the time they need it most. Yet at this time, when they need it most, two out of three of these people drop their health insurance. They simply cannot afford to go on at a time when their income is reduced, to pick up the full cost of health insurance which previously had been paid for all or in part by the employer. This really is tragic (U.S. Congress, 1964, p. 182).

What is perhaps most surprising is that the policies offered to the elderly retirees were community rated across *all* age groups; thus for the elderly, the annual insurance premium, \$55, was below the actuarial cost. It is possible that even with this preferential pricing of the policies, community rating led to more insurance than the low-income elderly wanted.<sup>14</sup>

To capture these ideas in a simple model, suppose there are two periods, e.g., a period of old age with uncertain health status, and a current period in which health insurance and savings decisions are made. Expected utility is

$$U = U(C_1, M_1) + \frac{\pi_b U^b(C_{2b}, M_{2b}) + \pi_g U^g(C_{2g}, M_{2g})}{1 + \delta} \quad (3)$$

where  $C_i$  denotes consumption in period  $i$ ,  $M_{ik}$  measures total medical spending in period  $i$  with health state  $k=g$  (good) or  $k=b$  (bad). There are three possible health outcomes in period 2; death with probability  $\pi_d$ , bad health with probability  $\pi_b$ , and good health with probability  $\pi_g$ . The rate of time preference is given by  $\delta$ . The utility function in period 2,  $U^k$ ,

<sup>14</sup> Or the statement may reflect biases in beliefs that the individuals will encounter serious illness. The Kerr–Mills program provided some medical assistance for the elderly prior to Medicare but its availability was modest. In February 1964, just 369 elderly people in Florida received any assistance (Merriam, 1964). Hospitals also provided some charitable care for the impoverished elderly, but Dr. Daly also testified that such programs were limited in scope and sometimes unavailable.

may be specific to health status; in particular, the value of a given level of  $M$  is greater in the bad health state than in the good health state. To simplify the problem, we assume that medical expenditures in period 1,  $M_1$ , are predetermined and hence can be dropped from separate consideration in the model, although  $C_1$  and hence savings will be a choice variable.

The budget constraint is

$$C_{2g} = (Y - P(Y) - C_1)(1 + r) - \alpha M_{2g} - P_2$$

$$C_{2b} = (Y - P(Y) - C_1)(1 + r) - \alpha M_{2b} - P_2 \quad (4)$$

where  $Y$  is the present value of labor earnings and retirement income less medical care costs in the first period, that is,

$$Y = Y_1 + \frac{Y_2}{1 + r} - M_1. \quad (5)$$

The model also assumes a single-dimensional measure of the generosity of insurance, given by a coinsurance rate  $\alpha$ . The insurance premium paid in the first period is given by  $P(Y)$ . Under Medicare, the insurance “premium” paid through payroll and general taxes is related to income. Medicare Part B premiums  $P_2$  are paid in period 2 conditional on surviving. The interest rate, accumulated over the length of a period, is given by  $r$ . In Eq. (3) through Eq. (5), we have suppressed income subscripts for clarity.

We assume a displaced CRRA utility function to substitute in Eq. (3):

$$U = C_1^{1-\gamma} + \frac{\left[ \pi_b \left( C_{2b}^{1-\gamma} + \mu_b (M_{2b} - \Gamma_b)^{1-\gamma} \right) + \pi_g \left( C_{2g}^{1-\gamma} + \mu_g (M_{2g} - \Gamma_g)^{1-\gamma} \right) \right]}{1 + \delta} \quad (6)$$

where  $\mu_k$  reflects the relative value of medical spending in health state  $k$ ,  $\Gamma_k$  is the “necessary” medical spending for state  $k$ , and  $\gamma$  is the Arrow–Pratt measure of relative risk aversion.

The endogenous variables in the optimization problem are consumption in period 1, and second-period consumption and health care expenditures in the good and bad states of health. By reducing the coinsurance rate  $\alpha$ , an insurance program can increase expected utility by reducing the consumption uncertainty associated with the bad state in period 2. Because  $M$  is a choice variable, however, the lower coinsurance rate may also lead to moral hazard which attenuates the utility-based measures of insurance. Finally, by allowing for differences in health status and life expectancy across income groups, the model can also capture the notion that high income households experience greater demand for an annuity program such as Medicare because of their risk of living longer and their higher demand for medical care if ill.<sup>15</sup>

<sup>15</sup> There are some limitations of the model. We do not solve explicitly for the degree of adverse selection and moral hazard, but instead take the extent of the non-Medicare insurance market as given and consider its value based on plausible parameter assumptions. Nor do we allow for heterogeneity among individuals; for example assuming everyone has 30% insurance coverage will not have the same impact on demand as if half the population had 60% coverage and the other half were uncovered.

Utility-based calculations of the costs and benefits of Medicare are presented for three income terciles: low, middle, and high. Parameters are drawn from a Social Security Administration survey conducted in 1963 (Epstein and Murray, 1967), and a survey by the National Center for Health Statistics fielded in the second half of 1962 (NCHS, 1964a,b) and are described in more detail in Appendix A.2. These studies suggest that for pre-Medicare medical expenditures, 26% of health expenditures among low income households was paid by insurance, compared to 55% for high income households.

All simulations were done in an actuarially balanced framework, so that any improvement in utility is solely the consequence of changes in the insurance value of the pooled Medicare program. In the simulation model, coverage rates were raised to 85% to replicate the characteristics of Medicare, with results presented in Table 3. The simulated income elasticities of Medicare spending are somewhat higher than actual income elasticities, but the price elasticity of about .2 is consistent with empirical estimates for people with less than full coverage (e.g., Manning et al., 1987).

The dollar-equivalent utility measures were expressed as a percentage of total benefits. In the highest income tercile, the net effect of the increased moral hazard induces more excess burden than the reduction in risk, so that the utility-metric valuation of Medicare coverage is 93 cents per dollar of expenditures. For middle income households, the money-metric improvement in utility was an additional 17% of Medicare benefits, while for the lowest income group, the gain in utility was an additional 88% per dollar benefit. The results are sensitive to raising or lowering the

Table 3  
Simulation model of health care expenditures and utility

	Low income	Middle income	High income
Income <sup>a</sup>	1052	2126	5534
% covered by insurance <sup>b</sup>	35	54	73
% paid by insurance <sup>c</sup>	26	40	55
Pre–Medicare expenditures: good health [actual amounts in brackets]	654 [640]	953 [778]	2059 [1052]
Pre–Medicare expenditures: poor health [actual amounts in brackets]	5757 [5865]	6292 [6368]	8195 [7386]
Post–Medicare expenditures: good health	799	1270	2775
Post–Medicare expenditures: poor health	6173	6972	9527
Utility value of insurance (baseline)	0.88	0.17	–0.07
<i>Sensitivity analysis: utility value of insurance</i>			
Less risk averse ( $\gamma=1.01$ )	0.41	0.14	0.04
More risk averse ( $\gamma=5$ )	1.52	0.37	–0.03
High value of health care ( $\mu_b=0.00050$ )	0.90	0.18	–0.07
Greater chance of bad health ( $\pi_b=0.24$ )	1.20	0.31	–0.04

See Appendix A.2.

<sup>a</sup>Epstein and Murray (1967), p. 294; income while young ( $Y_1$ ) assumed to be double retirement income.

<sup>b</sup>Table 1, weights from Epstein and Murray (1967) p. 294.

<sup>c</sup>Previous column multiplied by .75. At best, insurance policies covered 75% of hospital costs, see Epstein and Murray (1967).

degree of risk aversion, but are less sensitive to changes in the relative valuation of medical care or the likelihood of illness (Table 3). In sum, the greatest impact of Medicare is to smooth second-period *consumption* across health events; in other words, Medicare reduces the financial risk from catastrophic health care costs.<sup>16</sup>

To assign these values to the zip-code-based income deciles, we weight the average money-metric adjustment by the fraction of high, medium, and low income households in each decile. As shown in Table 1, the average valuation of the Medicare program rises from \$26,273 to \$37,829, so in this sense, every zip code decile benefits, in money-metric terms, from the insurance value of Medicare. Fig. 4 shows that the lowest income groups benefit the most from the imputed value of Medicare; once again removing the mean intergenerational transfer (in this case, \$41,254) the intragenerational transfers are tilted toward lower income households. Net intragenerational benefits for the bottom income decile (\$8210) far exceed the net contributions of the highest decile (–\$4105).

## 5. Discussion

We have developed a general framework for assessing the redistributive impact of Medicare. We find that, on an accounting basis, the Medicare program transfers more dollars to high income neighborhoods. While higher income groups pay more in taxes, they also tend to receive more in dollar benefits. However, Medicare is more than just a flow of dollars; it also provides an insurance and annuity market for the elderly. A simple utility-based model suggests that Medicare is more redistributive than the simple accounting measures would suggest.

One objection to these results is raised by a simple thought experiment: Most studies of Social Security find, at a minimum, a neutral redistributive component (e.g., Liebman, 2001). Since Medicare provides a uniform health insurance benefit, while Social Security benefits are explicitly linked to payments, how could Medicare not be progressive?<sup>17</sup> The resolution of this puzzle is to note that for Medicare, there is a strong imbalance between future benefits and taxes paid into the program. Relatively modest *percentage* differences in expenditures across income groups (such as those caused by mortality differences) can easily swamp the *dollar* differences in taxes across income groups, simply because the expenditure base is so much larger. This held as well for Social Security when it was in a transition. As shown in Duggan et al. (1993), high income transitional generations born in 1895–1922 did receive nearly double the net dollar transfer from Social Security (\$111,665) as did lower income generations (\$61,855).

Over the past several decades, Social Security has matured to the point where the imbalance between expenditures and taxes has been largely erased, and as a consequence even the dollar net benefits for lower income households are now larger than the

<sup>16</sup> A recent paper by Finkelstein and McKnight (2005) using a different model has reached a similar conclusion; see also Gruber and Gertler (2002).

<sup>17</sup> We are grateful to Henry Aaron for pointing this out to us.

corresponding net benefits for higher income households (Smith et al., 2003–2004). However, most projections of the Medicare program predict a continuing long-term fiscal imbalance (Gokhale and Smetters, 2003; Lee and Miller, 2002), making it far more likely that the Medicare program will continue to effect little (dollar) redistribution from high income to low income households.

Bhattacharya and Lakdawalla (2005) have reexamined the incidence of Medicare using the Health and Retirement Survey, and find that low income and low education groups received a substantial (dollar) redistribution from high income or high education groups. Why are their results so different? One reason is their focus on Part A (hospital) benefits including Social Security Disability Insurance (SSDI) payments for enrollees under age 65. Since eligibility for SSDI is predicated on poor health and being out of the labor force, it is perhaps not surprising to find a negative income gradient for this population. Similarly, lower income households often seek care at hospitals rather than in physician offices, leading to a negative income gradient (at a point in time) for Part A expenditures alone.<sup>18</sup>

Second, their study encompasses a shorter time span, 1992–99, during which there was a sharp “twist” in Medicare spending towards low income neighborhoods, as noted above. Thus their results showing a negative association between income and Medicare expenditures cannot be generalized to the past (e.g., Davis and Reynolds, 1975; Link et al., 1982), nor is it clear how the distribution of Medicare expenditures will evolve in the future.

Third, and most importantly, they distinguish between individual income and zip code income, and suggest that this distinction explains most of the difference between our results and theirs. The consistency of zip-based average income measures for evaluating the association of income with use of medical care and mortality has been explored in previous studies (see Gornick et al., 1996; Geronimus et al., 1996). On the one hand, individual-level reports of current income are noisy measures of lifetime income due to reporting errors, transitory income, and inadequate measures of financial wealth, and zip code income may better reflect lifetime permanent income. On the other hand, neighborhood effects could lead to biased inferences about individual income elasticities when zip code income measures are used.<sup>19</sup>

Bhattacharya and Lakdawalla (2005) find that enrollees moving from low to high income neighborhoods experience an increase in Medicare expenditures, and conversely. They interpret these estimated effects as picking up neighborhood effects. An alternative

<sup>18</sup> Part B (physician) benefits are also considered in their appendix.

<sup>19</sup> Suppose that the true model is that  $M_{in} = aY_{in} + b_n$  where  $M_{in}$  is Medicare expenditures for person  $i$  in neighborhood  $n$ ,  $Y_{in}$  is the corresponding income, and  $b_n$  is a dummy variable reflecting neighborhood effects, which may be correlated with average  $Y_n$  in the neighborhood. The true association between  $M$  and  $Y$  is not just the coefficient  $a$ , assuming one could estimate  $a$  accurately using survey data (Dynan et al., 2004). If high income neighborhoods spend more on health, it is straightforward to show that the association between income and Medicare spending reflects as well the greater likelihood of higher income households to live in high income (and hence high expenditure) neighborhoods. It is also straightforward to show that in this case, the use of zip code income and zip code expenditures to infer the individual income elasticity of Medicare spending will be biased upward. The “true” parameter is likely to be bounded by the zip code estimates and the estimates using individual survey data.



explanation for this correlation is that positive shocks to permanent income encourage a move into a better neighborhoods *and* stimulate demand for more health care. More generally, other researchers (Smith, 2003) have shown that the causal path typically runs in the opposite direction, with poor health a strong predictor of low income near retirement in the Health and Retirement Survey (HRS).

Finally, their primary measure of lifetime income is education. While this sidesteps the reverse causation problem, a more serious shortcoming is that college graduates are healthier, conditional on income (Smith, 2003). Thus education is not a valid instrument for permanent income given that it exerts an independent influence on Medicare expenditures. A broader question is whether education, rather than income, *should* be the appropriate measure for the study of incidence analysis involving health outcomes. Traditionally, income has been the default choice for incidence analysis because income is so closely associated with tax payments, and was considered a sufficient statistic for the measurement of marginal utility (and hence utility). The argument for using income is not so clear in this case, given that education is more closely associated with the life-course of health. (Case and Deaton, 2003; Smith, 2003) If the social welfare function is more broadly defined to include both health and income, then Bhattacharya and Lakdawalla (2005) are right: Medicare does redistribute from healthier (high education) to less healthy (low education) households.

We neglect several issues related to the incidence of Medicare. First, we do not account for the presence of explicitly redistributive programs such as Medicaid for those over age 65, nor do we consider SSDI for the under-65 population. We focused on the pure Medicare program because it was designated and financed as a distinct social insurance program, and because it remains a template for expanding coverage, for example through the “Part D” prescription drug benefits.

As well, we evaluate tax incidence from the standpoint of personal taxes paid only, and not the ultimate incidence on households of the federal tax system (Fullerton and Rogers, 1993). Most existing studies of incidence suggest that workers bear the burden of health insurance premiums (Gruber, 1994; Baicker and Chandra, 2005) and it would not be surprising to find a similar result for Medicare taxes. In addition, Medicare has important supply-side consequences for the distribution of income, particularly for highly-paid health care workers.

Finally, and most importantly, it is not entirely clear that the “recipients” of the Medicare benefits in the 1990s are necessarily the low income households in whose name Medicare was billed. Forty percent of home health care benefits in the mid-1990s were found to have been “inappropriate,” (Havemann, 1997). In California, the disproportionate share hospitals (DSH) payments in California flowed to the bank accounts of non-government hospitals located in low income neighborhoods (Dugan, 2000, although see Baicker and Staiger, *in press*). The right question is to what extent health outcomes were differentially improved for low income versus high income Medicare recipients.<sup>20</sup>

<sup>20</sup> There are just a few estimates of how Medicare has affected health outcomes. First, Skinner and Zhou (2004) found that, despite the rapid growth in Medicare expenditures for low income enrollees, effective care such as mammography continued to lag behind high income enrollees. Second, Card et al. (2004) and Decker (*in press*) show that in comparison to the under-65 population, Medicare is effective at improving the use of effective care such as mammography.



Ultimately, given the importance of Medicare in the overall income of the elderly, we would like to better understand the income distribution of secular improvements in effective health care.

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## Appendix A

Here we provide more detail on data analysis and calculations.

### *A.1. Income-Based Differential Mortality Prior to Age 65*

Sorlie et al. (1995) provide estimates from the National Longitudinal Mortality Study of relative mortality odds by age group (25–44, 45–64, and 65+) and sex, for 7 income categories (<\$5000, \$5000–9999, \$10,000–14,999, \$15,000–20,000, \$25,000–49,999, \$50,000+). We average these relative risk measures for men and women to simplify their use in the PSID data where the gender of the household head could change, for example because of widowhood. These are matched with corresponding data on the cumulative distribution of the income categories in a companion paper by Backlund et al. (1996).

Using these seven cut-points we then estimated a general log-linear relationship between mortality risk and the age-specific percentile of the income distribution. There was a very close fit between the natural log of the percentile and the relative risk of mortality for the relevant age groups (25–44 and 45–64), with adjusted  $R^2$  in excess of 0.98. (The adjusted  $R^2$  for age 65+ was 0.80.) From this model we were able to assign relative risk for the midpoint of each income decile. (That is, we predicted relative risk of mortality for the 5th percentile, 15th percentile, and so forth.) These relative risk measures were then normalized to ensure that they summed to one for each age group. For example, in the age group 45–65, the relative risk of mortality for decile 1 (the 5th percentile) was 1.79, while for decile 10 (95th percentile) the relative risk was 0.65.

We used mortality data, based on the Human Mortality Database ([www.mortality.org](http://www.mortality.org)) kindly supplied by Jay Bhattacharya to estimate age-specific mortality rates (men and women) for the 1922 cohort. Beginning at age 43 (in 1965) 67% of the original sample in the bottom income decile survived to age 65, while 86% survived in the top income decile.

## A.2. Specifications for the Simulation Model

Epstein and Murray (1967, Table 11.4) report that 12% of the elderly population reported themselves to be in poor health. We assume that those in the poorest health are those who spend the most money on health care, and calculate average spending by income group for those in poor health (the conditional mean of the 12%, or the cut-point closest to 12%, spending the most on health care) and for those in good health (the conditional mean for the remaining 88%). The greatest income elasticity was shown for spending in good health, which ranged from \$561 for the bottom income group to \$881 in the top income tercile. Spending in poor health was similar for the poorest and middle income groups (\$4908 and \$4882) but higher for the highest income group (\$6110).

Because the  $\Gamma$  parameters simultaneously determine price and income elasticity given  $\gamma$ , we cannot fit the observed data exactly. We set  $\Gamma_b = 5500$ ,  $\Gamma_g = 350$ ,  $\gamma$  (the Arrow–Pratt measure of relative risk aversion) equal to 3 and  $\mu_b = 0.00025$  so as to replicate as best as possible the observed spending among the low income pre-Medicare group. The simulated income elasticities of Medicare spending are somewhat higher than actual income elasticities, but the price elasticity of about 0.2 is consistent with empirical estimates for people with less than full coverage (e.g., Manning et al., 1987). Because of the homotheticity of the (discretionary) utility function, the implied income elasticity is higher than that suggested by the data.

Since  $M_2$  and  $C_2$  are chosen at the same time (given health status), the first-order condition for optimal health care expenditures is  $M_{2k} = C_{2k}[\mu_k/\alpha]^{1/\gamma} + \Gamma_k$ . This first-order condition allows one to substitute out  $M_{2k}$  in Eq. (2), which means that Eq. (4) can be used to express  $C_{2k}$  solely in terms of the choice variable  $C_1$ . The solution cannot be solved in closed form, so it is simulated using iterative methods where  $C_1$  is the choice variable over which utility is maximized.

Appendix Table A: Accumulated Medicare taxes paid, 1966–1990, based on individual income deciles in the panel study of income dynamics

Individual income decile	N of valid cases for tax calculations	After-tax average income (1984–88)	Accumulated tax payment	Accumulated tax payment+ part B premiums*
1	121	7795	964	5174
2	62	14,037	2818	7200
3	56	19,075	4285	8784
4	43	25,639	5912	10,490
5	37	31,030	7512	12,161
6	29	35,300	8230	12,970
7	36	41,908	10,566	15,363
8	28	49,926	10,453	15,326
9	28	61,968	13,953	18,959
10	28	95,959	17,896	23,131

Notes: \* Part B premiums are discounted for differences in life expectancy based on the zip-code income decile survival probabilities (and thus are identical to those used in Table 1). All dollar amounts in 1990\$. Deciles do not have equal numbers of households because the PSID oversamples low income households, all deciles are weighted using population weights from 1989. (That the three top deciles each include 28 observations is by chance and is not a misprint.).

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