MEDICAL EXPENDITURE RISK AND HOUSEHOLD PORTFOLIO CHOICE

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Abstract

As health care costs continue to rise, medical expenses have become an increasingly important contributor to financial risk, especially for the elderly. Economic theory suggests that when background risk rises individuals will reduce their exposure to avoidable risk in other areas.   This paper presents a test of this theory by examining the effect of medical expenditure risk on the willingness of older U.S. households to hold risky assets. We focus on individuals who are age 65 or older and who are enrolled in the Medicare program using data from the Health and Retirement Study. Because supplemental insurance such as Medigap, employer retiree health insurance, and HMOs offer greater protection against catastrophic out-of-pocket medical expenses than traditional Medicare, we measure exposure to out-of-pocket medical expenditure risk by whether an individual is covered by Medigap, employer supplemental insurance, or a Medicare HMO. One issue with this approach is that the choice of insurance may be endogenous. We account for endogeneity by using exogenous variation in county Medigap prices, and county-level HMO market penetration. We find that having Medigap or an employer policy increases risky asset holding by 6.7 percentage points relative to those enrolled in only Medicare Parts A and B. HMO participation increases risky asset holding by 4.3 percentage points, though this latter effect is not statistically significant in models that include endogenous wealth and income. Given that just 50 percent of our sample holds risky assets, these are economically sizable effects.

1. Introduction

As health care costs continue to rise, medical expenses have become an increasingly important contributor to financial risk, especially for the elderly. Although nearly all Americans age 65 and older have basic health insurance coverage through the Medicare program, they are still at-risk of large out-of-pocket medical expenses. Medicare does not cover prescription drugs (but will starting in 2006), requires 20 percent coinsurance on many services, and charges a deductible of $876 for a single hospital stay of up to 60 days.[1] In 2000, Medicare beneficiaries without additional coverage had a 5% chance that out-of-pocket expenses would exceed $6,367 and a 1% chance that they would exceed $31,751. Because of these potentially high costs, many individuals seek supplemental insurance, either through their former employers, a Medigap policy, or by enrolling in a Medicare HMO. These insurance arrangements offer different degrees of protection, but do not fully insure against the risk of large out-of-pocket medical expenses.[2]

Risks of this nature are known in the finance literature as background risks. The defining features of background risk are that it is not fully uninsurable and largely beyond the control of the individual. Economic theory suggests that when individuals face background risk, they should be less willing to bear other risks (Kimball, 1993). For example, theory would predict that an exogenous increase in uninsurable medical expense risk would cause an individual to reduce his exposure to other risks, such as rate-of-return risk.

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[1] For hospital stays of 61-90 days, Medicare beneficiaries are responsible for $219 per day (in 2004), and $438 per day for days 91-150. After 150 days, the beneficiary is responsible for all costs (CMS, 2003).

[2] Moral hazard is the most likely explanation for incomplete insurance (Arrow, 1963).

In this paper, we test the effects of background risk on portfolio allocations by examining the effect of exogenous variation in medical expenditure risk on the decision to hold risky assets. Variation in medical expenditure risk comes from the different supplemental insurance arrangements chosen by Medicare beneficiaries. Because supplemental insurance choices are potentially endogenous, we jointly estimate equations for ownership of risky assets, Medigap or employer insurance, and HMO participation, allowing for arbitrary correlation patterns in the unobserved heterogeneity across equations. Identification comes from county-level variation in Medigap prices, county-level variation in the number of Medigap carriers, and county-level Medicare HMO market penetration. We find that Medigap or employer supplemental insurance increases risky asset holding by 6.7 percentage points relative to those enrolled in only Medicare Parts A and B. HMO participation increases risky asset holding by 4.3 percentage points, though this latter effect is not statistically significant in models that include endogenous wealth and income. Given that just 50 percent of our sample holds risky assets, these represent economically sizable effects in percentage terms.

Beyond offering an opportunity to test economic theory, the case of portfolio allocation under uncertainty about future medical expenditures raises important policy issues. The elderly hold a disproportionate share of wealth in the U.S. (Rosen and Wu, 2003), yet are known to invest relatively conservatively. If changes in medical expenditure risk affect their willingness to hold wealth in risky assets, reforms to the Medicare system could have spillover effects on financial markets. For example, the new Medicare Modernization Act of 2003 will institute a prescription drug benefit into Medicare. The attendant reduction in medical expenditure risk could increase demand for riskier financial assets.

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2. Theory and Evidence of Background Risk

In practice, individuals make economic decisions in an environment characterized by multiple risks. It makes intuitive sense that an individual facing one risk should be less willing to bear another risk, even if the two risks are independent. Kimball (1993) formalized this intuition with the concept of *standard risk aversion*, building on Pratt and Zeckhauser's (1987) notion of *proper risk aversion*.[3] An implication of standard risk aversion is that any undesirable background risk lowers the absolute value of the optimal level of investment in any other (endogenous) risk (Kimball, 1993).[4] Whether an increase in background risk also causes precautionary saving to rise is theoretically ambiguous: the direct effect of an increase in background risk both increases precautionary saving and reduces investment in the endogenous risk, but the induced reduction in the endogenous risk may in turn *reduce* precautionary saving (Elmendorf and Kimball, 2000). Empirically, researchers have found that precautionary saving is positively associated with income risk (Carroll and Samwick, 1998, Gourinchas and Parker, 2001, Guiso et al., 1992, Lusardi, 1998) and medical expenditure risk (Kotlikoff, 1986, Levin,

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[3] A utility function characterized by standard risk aversion is formally equivalent to one with the property of decreasing absolute prudence (DAP), which in turn implies the weaker condition of decreasing absolute risk aversion (DARA). DARA describes risk aversion that decreases as wealth rises, whereas DAP describes a precautionary saving motive that decreases as wealth rises. DARA says that a nonrandom reduction in wealth should increase an individual's sensitivity to risk, whereas DAP says that any undesirable risk should increase an individual's sensitivity to risk, whenever a nonrandom reduction in wealth would. In other words, undesirable risks effectively increase risk aversion just as reductions in wealth do. DAP and DARA describe many commonly used utility functions such as the class of CRRA utility functions. Standard risk aversion is closely related to proper risk aversion. Formally proper risk aversion states *every undesirable risk aggravates every statistically independent undesirable risk*, while standard risk aversion states *every loss-aggravating risk aggravates every statistically independent undesirable risk* (Kimball, 1993). In other words, standard risk aversion expands the class of risks that may aggravate an undesirable risk to include not only other undesirable risks but also the larger set of loss-aggravating risks.

[4] An exception would be if the background risk were negatively correlated with the endogenous risk (Elmendorf and Kimball, 2000).

1995, Palumbo, 1999).[5] We focus on portfolio allocation rather than saving behavior, since by age 65 many (though not all) households are *dissaving*, and precautionary saving appears to be negligible (Gourinchas and Parker, 2001).

The literature finds that background risk has at least a small effect on the willingness of individuals to bear avoidable risks, such as investing in risky assets. In a cross-sectional study of Italian households, Guiso, Japelli and Terlizzese (1996) found that households facing above-average subjective income risk held 2.4 percentage points more of their financial assets in risky assets. In a panel data analysis of Dutch households, Hochguertel (2003) found an economically small effect of moderate income uncertainty on the demand for risky assets, but surprisingly no effect of high income uncertainty. We focus on medical expenditure risk since for the elderly the most important background risk is arguably medical expenditure risk stemming from health and mortality risk. Indeed, labor income risk among individuals age 65 and older is relatively unimportant since most are retired.[6] We are not aware of any work that has investigated medical expenditure risk directly; however, two recent studies have examined the effect of health risk on demand for risky assets in older households. Rosen and Wu (2003) found that individuals in fair or poor health hold lower portfolio shares in risky assets and are less likely to own risky assets. Edwards (2002) calculated that a one standard deviation increase in subjective health risk reduced risky portfolio shares by anywhere between 5-25 percentage points.

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[5] An exception is Starr-McCluer (1996) who found that those facing greater medical expenditure risk (defined as those lacking health insurance coverage) had lower net worth in a simple bivariate selection model designed to control for the endogeneity of health insurance coverage.

[6] Fewer than 5 percent of respondents in our sample of HRS respondents age 65 and older are working full-time in 2000. Another 9 percent work part-time.

Health risk is an important determinant of medical expenditure risk, but consideration of health risk does not obviate the need to study the effect of medical expenditure risk. Medical expenditure risk is a function of not only health risk but also health insurance coverage. In models that included both health status and insurance coverage, Rosen and Wu (2003) found that both variables retained independent effects on the demand for risky assets. This suggests that health status and medical expenditure risk are related but potentially distinct sources of background risk. Suppose health risk has an indirect effect on portfolio behavior operating through medical expenditure risk, and a direct effect operating through the marginal utility of consumption or the rate of time preference (Edwards, 2002, Rosen and Wu, 2003).[7] The total effect of health risk on portfolio behavior will include both components, making it difficult to assess the role of medical expenditure risk itself. Even if we could isolate the indirect effect of health risk, it would not necessarily reveal an accurate picture of medical expenditure risk, since many individuals obtain health insurance to offset part of this risk.

This paper presents an analysis of medical expenditure risk by comparing the demand for risky assets among individuals with different forms of Medicare supplemental insurance. The next section describes in detail the different forms of supplemental insurance and how each serves to offset medical expenditure risk.

3. Medical Expenditure Risk and Health Insurance

Nearly all Americans age 65 and older (96 percent) receive health insurance coverage through the Medicare program. Although Medicare coverage is fairly comprehensive, it has some important gaps. Medicare does not cover prescription drugs (but will starting in 2006), has

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[7] Because health status may affect the marginal utility of consumption, Hurd (2002) describes health risk as "utility" risk.

been slow to offer coverage for preventive care, requires 20 percent coinsurance on many services, and charges a deductible of $840 for a single hospital stay of up to 60 days.

Because Medicare beneficiaries are at risk of large out-of-pocket medical expenditures, many choose to purchase supplemental insurance policies known as Medigap plans. As the name suggests, Medigap plans are designed to fill the gaps in Medicare coverage. Since 1992, the federal government has required standardization of Medigap policies in 10 different plans ranging from Plan A, which covers coinsurance payments (but not deductibles), to Plan J, which covers coinsurance payments, deductibles, prescription drugs and some kinds of preventive care.[8] Despite standardization, prices of Medigap policies vary widely across local markets, and even within local markets. In 2001, the annual premium for Plan A in Texas ranged from $300 to $1683 and the annual premium for Plan J ranged from $2059 to $5658 (GAO, 2001). Medicare beneficiaries are guaranteed access to Medigap policies during a 6-month open enrollment period, which begins when the individual enrolls in Medicare Part B, usually at age 65.[9] During this period, policies are community-rated and insurers are prohibited from either denying coverage or charging higher prices to those with pre-existing conditions. Once the open enrollment period has passed, insurers may take the individual's health history into account in determining whether to offer coverage and at what price.[10]

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[8] Three states are exempt from the national standards because they had standardized plans prior to 1992: Massachusetts, Minnesota, and Wisconsin.

[9] If an individual delays enrollment in Part B past his 65th birthday (perhaps because he has health insurance coverage through his current employer), the beginning of the open enrollment period is also delayed.

[10] Exceptions are made for those whose former employers terminate retiree health benefits, those who voluntarily leave a Medicare HMO within one year of becoming eligible for Medicare, and those whose Medicare HMO has withdrawn from their service area.

Another source of supplemental insurance comes through employers in the form of retiree health insurance. Employer supplemental policies generally offer more coverage at less cost than Medigap. For example, annual premiums averaged $600 in 2001, and virtually all retiree health plans offered by employers had prescription drug coverage (Kaiser, 2001).

Medicare HMOs offer a third way of filling the gaps in traditional fee-for-service Medicare. Whereas Medigap and employer-provided retiree health insurance act as secondary insurance, Medicare HMOs are an alternative to the traditional fee-for-service Medicare program. They provide the basic services of traditional Medicare as well as supplemental benefits such as lower copayments, unlimited hospitalization, prescription drugs, some preventive care, vision, and dental. Most HMO's require little or no premium over and above the premium for Medicare Part B. In exchange, individuals must obtain medical services from within the HMO's network. HMOs eliminate the need for a Medigap policy, and insurers are generally prohibited from selling Medigap policies to Medicare HMO enrollees. Finally, Medicaid provides supplemental insurance coverage for indigent Medicare beneficiaries who meet Medicaid's strict asset and income limitations.

Table 1 shows supplemental insurance coverage rates in 2000 for Medicare beneficiaries in the Health and Retirement Study (HRS).[11] The table shows that 14.8 percent of Medicare beneficiaries had no supplemental coverage of any kind (i.e., they had only Medicare Parts A and B), 16.2 percent were enrolled in a Medicare HMO, 32.6 percent had supplemental coverage through their employer, 28.5 percent had a Medigap policy, and 8.0 percent received supplemental coverage through Medicaid. From here on we drop Medicaid recipients from our

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[11] Our sample includes individuals aged 65 and older in 1998, drawing from the HRS, AHEAD, and CODA birth cohorts, and constitutes a nationally representative sample of the U.S. population age 65+ in 1998.

analysis since they do not generally invest in risky financial assets owing to the program's strict asset limitations. Table 2 shows a number of interesting differences across the supplemental insurance status groups. Those without any supplemental coverage tend to be somewhat older, have markedly less education (10.6 years), are much more likely to be Black and unmarried, and have lower income and net worth. Nearly 95 percent of those with Medigap coverage are white, and Medigap enrollees have the highest net worth ($467,611) followed by those with employer coverage ($400,515). Surprisingly those without any supplemental coverage are no more likely to have ever been diagnosed with a major health condition (defined as cancer, lung disease, heart disease, or stroke) and the groups show similar probabilities of having experienced a major health shock over the last two years.[12] Nevertheless, those without supplemental coverage are much more likely than the other groups to report themselves in fair or poor health. Notably, reported rates of diabetes are somewhat higher in this group and suggest an elevated risk of diabetes-related complications.[13]

Table 3 shows the distribution of annual out-of-pocket expenses by supplemental insurance status tabulated from pooled cross-sections of the 1999 and 2000 Medicare Current Beneficiary Survey (MCBS).[14] Mean annual expenses are highest for those without any supplemental insurance ($2,066), and lowest for those enrolled in a Medicare HMO ($942). Those with Medigap pay on average $1,544 per year, while those with supplemental insurance from their employer pay on average $1,217. Examining different points of the distribution's

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[12] Our classification of major health conditions follows Smith (2003).

[13] Diabetes ranks as the fourth most common cause of death among blacks in the U.S., following heart disease, cancer, and stroke (Sahyoun et al., 2001).

[14] For data on out-of-pocket medical expenses, the MCBS is preferable to the HRS. The MCBS asks very detailed questions about service use and reconciles respondent reports with claims data.

right tail, we note that at those without any supplemental insurance always incur the most out-of-pocket expenses, reaching \$31,751 at the 99th percentile. In contrast, the 99th percentile of expenses ranges from \$9,750 for those with Medigap to \$8,548 for those with employer insurance to \$7,778 for those enrolled in a Medicare HMO. Figure 1 shows the density of log out-of-pocket expenses across the four insurance groups. Compared to those without supplemental insurance (A&B Only), the distribution of out-of-pocket expenses has noticeably less spread, and also less mass in the right tail. Although the distribution for Medicare HMO enrollees has more spread than the distributions for Medigap and employer insurance, the center of the distribution is noticeably lower. Although these descriptive statistics do not control for the effects of other variables (such as race), they make the basic point that individuals without any supplemental insurance are at significantly greater risk of large out-of-pocket medical expenses than are those with supplemental insurance.[15] Even among those with supplemental insurance, there is some variation across coverage types: HMO enrollees appear to be most protected, followed by those with employer insurance, and lastly those with Medigap policies.[16]

Another way to assess the degree of risk households face is to compare average annual out-of-pocket expenses to wealth. Median net worth in HRS 2000 is \$148,000, with an interquartile range of \$46,300 to \$362,000. The 95th percentile of expenses for someone without supplemental coverage is four percent of median wealth and 13 percent of 25th-percentile wealth. The 99th percentile of expenses for someone without supplemental coverage is 21 percent of

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[15] Goldman and Zissimopoulos (2003) reach a similar conclusion based on models that control for covariates.

[16] Another explanation for the lower out-of-pocket costs experienced by HMO enrollees is the possibility that HMO's either deliberately encourage or tend to attract enrollments by healthier individuals. In a comparison of HMO enrollees with traditional fee-for-service enrollees, Riley et al. (1989) found that new enrollees at three HMO's were healthier than their fee-for-service counterparts, and in one HMO experienced a slower rate of decay in health status over time.

median wealth and 69 percent of 25th-percentile wealth. These figures suggest medical expenditure risk is sizeable, especially considering that wealth is a stock, and medical expenses are a flow likely to be correlated over time.

4. Household Portfolios of Older Americans

We next turn to an overview of the portfolio holdings of older Americans. We restrict our analysis to liquid financial assets since illiquid assets (such a primary home or business) are by their very nature less readily adjustable to changes in background risk. We divide liquid assets into two categories: safe and risky assets.[17] Safe assets are checking, saving, and money market accounts, certificates of deposit, government savings bonds, and treasury bills. Risky assets are stocks, bonds, and IRA and Keogh accounts.[18]

Demand for risky assets can be analyzed on the intensive margin—the share of assets held in risky assets—or the extensive margin—whether the individual owns any risky assets at all. Our analysis concentrates on the extensive margin of asset ownership. The reason for this is that even within the category of risky portfolios, the true riskiness of any particular portfolio is unknowable in the survey data and may vary substantially. For example, one portfolio might be invested in less risky income producing mutual funds, whereas another might be more heavily invested in aggressive growth stocks. Focusing on the extensive margin avoids this problem

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[17] The justification for considering just two asset categories comes from a two-fund separation theorem that states all individuals with mean-variance preferences will hold the same proportionate mixture of risky assets regardless of the overall fraction of their wealth held in risky assets. Although mean-variance preferences imply the absence of a precautionary saving motive (which is defined by a positive third derivative of utility), the literature continues to follow this convention.

[18] It is common to also include defined contribution plans in the definition of risky assets, but analysis of the HRS self-reported pension data reveals that only a handful of observations in our 65+ sample have a defined contribution plan in 1998. A natural explanation is that such plans were not common among older cohorts (our HRS sample includes individuals born between 1896-1934 making up the AHEAD, CODA, and part of the original HRS cohorts). It is also possible that some plans were rolled over into IRA's or cashed out at retirement.

since it is less ambiguous to conclude that someone who owns risky assets is exposed to more financial risk than someone who does not. In addition, the extensive margin is inherently interesting since it relates to one of the more persistent puzzles in empirical finance: why do so many households fail to hold risky assets at all? Known as the equity allocation (or stock-holding) puzzle, this is the microeconomic analog of the equity premium puzzle, and is viewed as the key issue in portfolio analysis (Gollier, 2002, Miniaci and Weber, 2002). Yet another reason why the extensive margin is of such interest is that ownership represents actual behavior, whereas asset shares at any point in time are a composite of behavior and exogenous price changes.

Table 4 describes the household portfolios of HRS respondents in 2000 by supplemental insurance status. The left panel considers asset ownership, while the right panel shows portfolio shares. Generally, asset ownership of any type is lowest among the group without supplemental coverage and highest among those with supplemental coverage through their employer. This pattern holds even among safe assets, where more than one-quarter of those without supplemental insurance do not own a checking, saving or money market account, compared to just seven percent of those with employer coverage. The stock-holding puzzle is readily apparent: just 50.4 percent of the sample participates in the stock market. About one-third own stocks directly, whereas another one-third own stocks through an IRA. Bond ownership is relatively low, even among those with employer coverage. Turning to portfolio shares conditional on ownership, we note that checking, saving and money market accounts are the dominant liquid financial asset in all groups. Among those with no supplemental coverage, checking accounts comprise 60 percent of liquid assets, while for those with employer coverage they amount to 40 percent of liquid assets. Not only are those with employer coverage more

likely to own risky assets, but they also invest the largest portfolio share in such assets (45.9 percent), followed by those with Medigap (42 percent), HMO enrollees (38 percent), and those without supplemental coverage (26 percent).

Our earlier analysis of out-of-pocket expenses showed that those without supplemental insurance are at most risk of realizing large out-of-pocket medical expenses. Those without supplemental insurance are also least likely to own risky assets, and conditional on ownership, hold the smallest share of their portfolios in risky assets. This is consistent with standard risk aversion—that those facing greater background risk reduce their exposure to avoidable risks. However, if we look within categories of supplemental insurance, we note that HMO's appear to offer the most protection, followed by employer insurance and Medigap policies. By the logic of standard risk aversion, those in HMO's should have the highest stock market participation rates, and the largest portfolio shares invested in risky assets. Instead, the descriptive statistics show that while HMO participants are notably more likely to hold risky assets, they are *less* likely than the two other groups to hold risky assets. The same pattern holds for portfolio shares. On the other hand, those with employer insurance have more protection against medical expenditure risk than those with Medigap coverage, and they also hold more risky assets.

5. Research Design

As the descriptive analyses of the previous sections suggest, supplemental insurance status is correlated with a number of observable characteristics, and is especially likely to be correlated with unobservable characteristics such as risk aversion. To address the endogeneity of supplemental insurance status, we jointly estimate equations for ownership of risky assets and supplemental insurance, allowing for arbitrary correlation patterns in the unobserved

heterogeneity across equations. Identification comes from county-level variation in HMO market penetration and Medigap prices.

Our research design is cross-sectional. Since the HRS is a panel data set, it would seem to be more natural to take advantage of this aspect of the data; however, several data limitations make panel data methods less desirable in our context. The main drawback is that the data show very little movement in and out of risky asset ownership between 1998 and 2000. Only 5.3 percent of households transition from holding no risky assets in 1998 to holding any risky assets in 2000, and 6.0 percent move from holding any risky assets to holding no risky assets. In total, just 11.3 percent of households transition in or out of risky assets during the two-year period between waves.[19] One way to increase the number of transitions observed in the data would be to use additional survey waves. The earlier waves are not so useful since not until 1998 was the AHEAD cohort (which previously had a distinct survey) merged with the original HRS cohort, a key new cohort added (the Children of the Depression or CODA cohort), and prior to 1998, nearly the entire HRS cohort was not yet eligible for Medicare (though some spouses were). Furthermore, not until 1998 did the survey become nationally representative of the population age 65 and older. There do exist two prior waves of data for the AHEAD cohort, but the youngest member of this cohort is age 70 at the first wave in 1993, and our sample size would be reduced by about 50 percent. The best alternative would be to incorporate future waves as they become available.

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[19] Two-year transition rates in and out of HMOs or supplemental coverage are also low. Only 9.5 percent either join or leave an HMO, and 16.5 percent either newly obtain or cancel a Medigap policy. This is not surprising since individuals are guaranteed community-rated prices only during their open enrollment period, which begins when they first enroll in Medicare Part B, or under special circumstances such as if their employer terminates retiree health benefits or their Medicare HMO withdraws from their service area.

In contrast to asset ownership, there is much more movement in asset shares across the 1998 and 2000 waves, but the use of asset shares over time is perhaps even more problematic. First, much of observed changes over time in portfolio shares are passive changes due to changes in stock and bond prices, not active investor behavior. In the HRS, it is not possible to know how much of an observed change in risky assets is due to active portfolio rebalancing. Second, as noted earlier, we have no information about the true riskiness of a given investment portfolio, and any active reallocations made within class (i.e., reallocations made among subcategories of risky assets) would be impossible to identify even if we could distinguish the behavioral component of the change. Third, exacerbating the usual measurement error problem with wealth data is the fact that the wealth data in the HRS are heavily imputed, and all imputations are done on a cross-sectional basis, not over time. We calculate that in both 1998 and 2000 fully 32.8 percent of observations have an imputed value on at least one of the variables used to compute portfolio shares.[20] It is well known that differencing two variables measured with error exacerbates the measurement error present in each alone. An alternative would be to exclude the imputed observations, but this is rarely a satisfactory approach given non-random item non-response.

We identify the effects of health insurance on portfolio decisions using information on the price and availability of Medigap supplemental insurance and Medicare HMO market penetration at the county level. We use restricted versions of the HRS data files that include county identifiers. Given the low rates of geographic mobility of the elderly, it is reasonable to assume that the price of a standardized Medigap plan and the presence of Medicare HMOs in the

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[20] In contrast, asset ownership is generally measured with less error and many fewer observations have been imputed. Just six percent of observations have an imputed value on any one of our liquid asset ownership items.

county of residence affect insurance decisions but not portfolio decisions (except through insurance). We obtained county-level prices for Medigap plans as of January 1, 2000 from Weiss Ratings, Inc. Insurance companies voluntarily report their current market prices to Weiss, and approximately 90 percent of the market is represented in their data.[21] The Weiss data reveal that there is a single market leader—United Healthcare—with fully 19 percent of the market nationwide (as measured by premium volume).[22] The second-ranked insurer, Mutual of Omaha Plaza, has just 5 percent of the market. We use as our instrumental variable the countywide price of United Healthcare's Medigap Plan F for 65-year old males as of January 1, 2000.[23] In the handful cases in which United Healthcare sells Plan F at a different price in different zip codes within the same county, we use the county average price. Medigap Plan F is the most popular of the 10 standardized plans, purchased by 37 percent of Medigap buyers (GAO, 2001).[24] We also use the total number of plans available in the county (counting plans available through all insurers). We obtained county-level HMO market penetration in 2000 from the

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[21] For our purposes, the Weiss data are superior to data produced by the National Association of Insurance Commissioners, which includes total premium volume and number of covered lives, but not actual market prices at specific points in time.

[22] United Healthcare underwrites Medigap policies sold through AARP.

[23] We experimented with using county average prices across all carriers as an instrument, but found this version of the instrument had little power; one explanation is that simple averaging does not account for market share. Indeed 88 percent of carriers have less than one percent of the national market.

[24] Medigap Plan F is a mid-level plan covering: Parts A and B coinsurance, skilled nursing coinsurance, Parts A and B deductibles, Part B balance billing, and foreign travel emergency. It does not cover home health care, prescription drugs, or preventive medical care. Massachusetts, Minnesota, and Wisconsin are omitted from the national standards on account of already having their own standardization schemes prior to 1990. For counties in these states, we calculate the price for the plan nearest in coverage to Plan F.

Centers for Medicare and Medicaid Services (CMS). Market penetration is defined as the percent of Medicare beneficiaries enrolled in a Medicare+Choice HMO.[25]

Figure 2 presents the first stage relationship between county variation in supplemental insurance holding and the price of United Healthcare Medigap Plan F. As expected, price and supplemental insurance holding are strongly negatively correlated. The slope of the regression line is significantly different from zero (t=-9.9) implying that a $100 increase in price is associated with a 3 percentage point decline in supplemental insurance. The regression is weighted by the number of HRS observations in the county, with the largest counties denoted by the largest circles. Figure 3 shows the relationship between supplemental insurance holding and HMO market penetration (the cross-price effect). The weighted regression coefficient is highly significant suggesting that a 10 percent increase in HMO market share reduces supplemental insurance holding by 5 percentage points (t=-9.3). Figure 4 shows the relationship between HMO enrollment and HMO market share. A 10 percent increase in county market share is associated with an 8 percentage point increase in HMO enrollment in the HRS (t=29.3). Finally Figure 5 shows the cross-price effect of Medigap prices on HMO enrollment. A $100 increase in price relates to a 2.4 percentage point increase in HMO enrollment (t=8.2). In sum, the pictures suggest a very robust first stage.

In Figures 6 and 7, we present the reduced form relationships between county-level ownership of risky assets and our instruments. The fraction holding any risky asset in the county is negatively related to the price of United Healthcare's Plan F, and positively related to the

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[25] The Medicare+Choice program was established by the Balanced Budget act of 1997, and was designed to offer Medicare beneficiaries a variety of healthcare delivery models, including coordinated care plans such as HMOs, preferred provider organizations, provider sponsored organizations, Medical Savings Accounts, and private fee-for-service Medicare.

HMO market share in the county. In both cases, the regression lines are significantly different from zero (t=2.01 for Medigap prices and t=3.40 for HMO market share). The graphs are consistent with the idea that lower Medigap prices and greater HMO market penetration increase supplemental insurance coverage and HMO enrollment, which reduces medical expenditure risk and increases risky asset holding. It is unlikely that this relationship would exist in the absence of an effect through supplemental insurance coverage.[26]

6. Estimation Strategy

In our model, we have three discrete endogenous variables: whether the individual owns any risky assets, whether the individual is enrolled in an HMO, and whether the individual has purchased a Medigap policy or holds supplemental insurance through an employer. We combine the Medigap and employer insurance choices since they are based on the same insurance delivery model (unlike HMOs), and offer a similar degree of protection against risk. We employ a mixture maximum likelihood technique in which the distribution of the error terms are decomposed into correlated and uncorrelated components. The uncorrelated components are assumed to be independently normally distributed. A discrete factor approximation for the correlated component enables identification of clustering in the unobserved components. Kiefer and Wolfowitz (1956) prove the consistency of this estimator. Monte Carlo experiments in a simultaneous equation setting demonstrate that these estimators compare favorably to maximum likelihood estimators when the likelihood function is correctly specified, and outperform maximum likelihood when the model is misspecified (Mroz and Guilkey, 1999). Using data from self-selected and randomly assigned populations, Goldman, Leibowitz and Buchanan

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[26] One alternative story for the existence of this relationship is that county differences in urbanicity could account for both greater insurance options (and hence lower prices) and more investment brokers and financial sophistication. In our estimation models, we control for urbanicity.

(1998) show that such estimates can effectively recover the structural parameters of the underlying models.

Similar methods have been used to study patterns of unemployment duration (Heckman and Singer, 1984) and the effects of training on employment (Card and Sullivan, 1988, Gritz, 1993). In an application very similar in spirit to this research, Bhattacharya, Goldman, and Sood (2003) use this approach to estimate the impact of private and public insurance on mortality in an HIV-infected population.

Let R_i^* represent an index function that measures the propensity to hold risky assets for beneficiary i. Then we write:

$$(1) \qquad R_i^* = c_1 + \gamma_1 \beta supp_i + \gamma_2 \cdot hmo_i + \beta_1' X_i + \rho_{risky,i} - \varepsilon_{risky,i}$$

The vector X_i represents observed exogenous covariates that determine asset holdings, such as age, gender, and education. Asset holdings are also affected by insurance status, where $supp_i$ represents whether the beneficiary was covered by Medigap or employer supplemental insurance, and hmo_i represents whether the beneficiary was covered by HMO insurance. Asset holdings are also assumed to depend on an unobservable heterogeneity component $\rho_{risky,i}$ that will also relate to insurance choices. It is useful to think of this as unobserved financial sophistication or attitudes towards risk, and it is assumed to be orthogonal to the covariates X_i. There is also a random error $\varepsilon_{risky,i}$ that is uncorrelated with X_i and insurance status. We want to consistently estimate the parameters c_1, β_1, γ_1 and γ_2, after accounting for the heterogeneity.

We define R_i as an indicator variable that represents whether beneficiary i holds any risky assets:

$$(2) \quad R_i = \begin{cases} 1 & \text{if } R_i^* > 0 \\ 0 & \text{if } R_i^* \leq 0 \end{cases}$$

We assume $\varepsilon_{risky,i}$ is distributed normally with zero mean and unit variance. This assumption implies a probit model for R_i, where the probability of holding risky assets, conditional on observed characteristics $\{supp_i, hmo_i, X_i\}$ and unobserved characteristics ρ_{risky} is:

$$(3) \quad P[R_i = 1 \mid \{supp_i, hmo_i, X_i\}, \rho_{risky,i}] \quad \Phi(c_1 + {}_1 \cdot supp_i + \gamma_2 \cdot hmo_i + \beta_1 ' X_i + \rho_{risky,i})$$

Here $\Phi(.)$ is the cumulative distribution function for the standard normal distribution.

We model insurance choices using the standard random indirect utility approach. Beneficiaries choose among supplemental status $j = \{supplemental, hmo, none\}$ on the basis of a random indirect utility function:

$$(4) \quad V_{j,i}^* = c_j \quad \beta_j ' Z_{j,i} + \rho_{j,i} + \varepsilon_{j,i}$$

Here $Z_{j,i}$ represents variables that determine insurance status including our set of instrumental variables (that is, variables that belong in each insurance equation, but not in the asset equation); and $\rho_{j,i}$ is a beneficiary-specific random intercept that reflects the beneficiaries' propensity for insurance status j that is unobserved by the researcher. The parameters c_j and β_j are additional parameters to be estimated; and $\varepsilon_{j,i}$ represents the orthogonal error term.

Beneficiaries choose the insurance status that maximizes their indirect utility. We assume that $\varepsilon_{j,i}$ are independently and identically distributed according to the Type II extreme value distribution. This distributional assumption and normalizing $\{c_{none}, \beta_{none}, {}_{none,i}\}$ to zero yields a multinomial logit model for insurance choice.

$$(5) \qquad \Pr\left[supp_i = 1 \mid Z_{j,i}, \rho_{supp}, \rho_{hmo}\right] \quad \frac{\exp\left(c_{supp} + \beta_{supp}'Z_{j,i} + \rho_{supp,i}\right)}{1 + \sum_{j \neq none} \exp\left(c_j + \beta_j'Z_{j,i} + \rho_{j,i}\right)}$$

$$(6) \qquad \Pr\left[hmo_i = 1 \mid Z_{j,i}, \rho_{supp}, \rho_{hmo}\right] \quad \frac{\exp\left(c_{hmo} + \beta_{hmo}'Z_{j,i} + \rho_{hmo,i}\right)}{1 + \sum_{j \neq none} \exp\left(c_j + \beta_j'Z_{j,i} + \rho_{j,i}\right)}$$

To complete the model and allow for correlation between asset holdings and insurance choices, we need to assume a joint distribution for the unobserved heterogeneity vector $\rho = \left(\rho_{risky}, \rho_{supp}, \rho_{hmo}\right)$. Our approach is semi parametric. We allow the unobserved heterogeneity in each equation to take one of three values—intuitively, there are three types of people that occur with probabilities p_1, p_2, and $1 - p_1 - p_2$. The effect of being a certain type has different effects on each outcome: $\left(\rho_{risky}^1, \rho_{risky}^2, \rho_{risky}^3\right)$ for asset holdings, $\left(\rho_{supp}^1, \rho_{supp}^2, \rho_{supp}^3\right)$ for supplemental insurance, and $\left(\rho_{hmo}^1, \rho_{hmo}^2, \rho_{hmo}^3\right)$ for Medicare HMOs. For example, there is a p_1 probability that a person will be of the first type, which would imply realizations of ρ_{risky}^1 for the propensity to hold risky assets, ρ_{supp}^1 for the propensity to have supplemental insurance, and ρ_{hmo}^1 for the propensity to be in a Medicare HMO.

This discrete factor distributional approach has several advantages over specifying a continuous parametric density for the unobserved heterogeneity vector. First, an incorrect specification of the parametric density function might lead to biased parameter estimates. The discrete factor density allows us to approximate any underlying distribution of heterogeneity. In fact, Monte Carlo studies show that discrete factor distributions with two to four points of support adequately model many distributions (Heckman, 2001, Mroz 1999). Second, discrete

factor models are computationally simpler than parametric models as they avoid multiple numerical integration in the construction of the likelihood function.

Since all three outcome equations—asset holdings, supplemental insurance, Medicare HMO—have intercept terms, we normalize the mean of each heterogeneity component to be zero. This implies that the third point of support in each equation is not "free." Thus our distributional assumption on the unobserved heterogeneity adds eight additional parameters: two points of support in the asset holdings equation $(\rho^k_{risky}, {}^2_{risky})$, two points of support in the supplemental insurance equation $(\rho^k_{supp}, {}^2_{supp})$, two points of support in the HMO equation $(\rho^k_{hmo}, {}^2_{hmo})$, and two probabilities (p^1, p^2). The resulting variance-covariance matrix for the unobserved heterogeneity may be written as:

$$(7) \qquad Var\left(\rho_{risky}, {}_{supp}, \rho_{hmo}\right) = \begin{bmatrix} \sum_k \sum_k \left(\rho^k_{risky}\right)^2 & p_k \; {}^k_{risky}\rho^k_{supp} & \sum_k p_k\rho^k_{risky}\rho^k_{hmo} \\ & \sum_k p_k \left(\rho^k_{supp}\right)^2 & \sum_k p_k\rho^k_{supp}\rho^k_{hmo} \\ & & \sum_k p_k \left(\rho^k_{hmo}\right)^2 \end{bmatrix}$$

This model not only allows non-zero covariance across asset holdings and insurance propensities but also allows non-zero covariance between the propensities to have supplemental and HMO insurance. Thus our model relaxes the independence of irrelevant alternatives assumption of the standard multinomial logit model and allows a more general variance-covariance matrix. The key correlations in our model may thus be written as:

$$(8) \qquad Corr\left(\rho_{hmo}, {}_{risky}\right) = \frac{\sum_{k=1}^{3} p_k \rho^k_{hmo} \; {}^k_{risky}}{\sqrt{\sum_{k=1}^{3}\sum_k \left(\rho^k_{hmo}\right)^2 \; \sum_{k}^{3} p_k\left({}^k_{risky}\right)^2}}$$

$$
(9) \qquad Corr\left(\rho_{supp}, \rho_{risky}\right) = \frac{\sum_{k=1}^{3} p_k \rho_{supp}^{k} \rho_{risky}^{k}}{\sqrt{\sum_{k=1}^{3} p_k \left(\rho_{supp}^{k}\right)^2 \sum_{k=1}^{3} p_k \left(\rho_{risky}^{k}\right)^2}}
$$

$$
(10) \qquad Corr\left(\rho_{supp}, \rho_{hmo}\right) = \frac{\sum_{k=1}^{3} p_k \rho_{supp}^{k} \rho_{hmo}^{k}}{\sqrt{\sum_{k=1}^{3} p_k \left(\rho_{supp}^{k}\right)^2 \sum_{k=1}^{3} p_k \left(\rho_{hmo}^{k}\right)^2}}
$$

The model is estimated using maximum likelihood. We have six possible outcomes for the dependent variables: a person can either hold or not hold risky assets, denoted by R_i, while being in one of three insurance states (none, supp, hmo). ("None" refers to the case where the beneficiary is covered by Medicare Parts A and B only and is denoted by (1-*supp*)(1-*hmo*)). To construct the contribution to the likelihood function for each beneficiary, we first obtain the likelihood of observing that value of the dependent variables conditional on a realization k of the unobserved heterogeneity $\rho^k = \left(\rho_{risky}^{k}, \rho_{supp}^{k}, \rho_{hmo}^{k}\right)$. We then sum over all the possible realizations to obtain the contribution of beneficiary i to the likelihood function:

$$
\begin{aligned}
l_i = \sum_{k=1}^{3} p_k & \left(Pr\left[R_i = 1 \mid \rho_{risky}^{k}\right]^{R_i}\right) \times \left(1 - Pr\left[R_i = 1 \mid \rho_{risky}^{k}\right]^{1-R_i}\right) \times \\
(11) \quad & \left(Pr\left[supp_i = 1 \mid \rho_{supp}^{k}, \rho_{hmo}^{k}\right]^{supp_i}\right) \left(Pr\left[hmo_i = 1 \mid \rho_{supp}^{k}, \rho_{hmo}^{k}\right]^{hmo_i}\right) \times \\
& \left(1 - Pr\left[supp_i = 1 \mid \rho_{supp}^{k}, \rho_{hmo}^{k}\right] - Pr\left[hmo_i = 1 \mid \rho_{supp}^{k}, \rho_{hmo}^{k}\right]\right)^{(1-supp_i)(1-hmo_i)}
\end{aligned}
$$

Finally we obtain the weighted log-likelihood function by summing the log-likelihood across individuals:

$$
(12) \qquad \ln(L) = \sum_{i=1}^{N} w_i \ln\left(l_i\right)
$$

Γ is the vector of model parameters; w_i are the analytic sample weights and N is the sample size. Because it is difficult to interpret the magnitude of the parameter estimates directly, we also report the average predicted values if the entire sample had supplemental insurance, Medicare HMO, or neither.

7. Estimation Results

We start with a simple probit model of ownership of risky assets in 2000 in which we do not account for the endogeneity of insurance status. The first column of Table 5 shows our base specification. The dummies for supplemental insurance (Medigap or employer coverage) and HMO participation are both positively related to ownership of risky assets and highly significant. The model also includes a number of controls for demographic characteristics, health status, and county characteristics. Those with more education (high school/GED, some college, college) are significantly more likely to hold risky assets than those without a high school degree, and minorities (black, Hispanic, other) are less likely than whites to hold risky assets. Compared to married respondents, those who are divorced, widowed, or never married are less likely to hold risky assets. Conditional on marital status, household size is negatively related to ownership of risky assets. Interestingly, the coefficients on female gender and age are not significant once we control for health and other demographic characteristics.

We model health status by including indicators for having ever been diagnosed with a chronic disease (i.e., high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, psychiatric problems, or arthritis), as well as an indicator for self-reported fair or poor health. To account for any potential endogeneity of health status, we use 1998 values of the health variables (two-year lags). We also include an indicator for having had a serious health shock since 1998, which we define as onset of cancer, lung disease, heart disease, or stroke. Most serious health

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conditions are significant and negatively related to ownership of risky assets, which is consistent with the notion that elevated background health risk should reduce exposure to avoidable risks. An exception is cancer, which is positively related to ownership of risky assets and highly significant. This result is surprising, but may reflect a survivor bias. The coefficient on high blood pressure ("the silent killer") is insignificant, suggesting people may not fully internalize future health risk, but then again the coefficient on heart disease is also insignificantly different from zero. Surprisingly, the health shock coefficient is small and statistically insignificant. This could reflect measurement problems or may indicate that people take time to adjust their portfolios in response to changes in background health risk. Our measure for overall health status—the indicator for fair or poor health—is highly significant. The specification also includes controls for geographic characteristics such as county urbanicity, county population, the state unemployment rate in 2000, and average Medicare expenditure in the county in 2000 (Parts A and B).[27] Only the coefficients on urbanicity and state unemployment rate are significantly different from zero, suggesting that ownership of risky assets is more likely in urban counties, but less likely in states with high unemployment rates.

The specification in column two of Table 5 is similar except we add dummies for quartiles of net worth and non-capital income. Wealth and income are important determinants of portfolio allocation, but are also in part *determined by* portfolio allocation. We use their lagged values to mitigate simultaneity bias, but we note that this is likely inadequate given the substantial inertia in risky asset ownership over time. The coefficients in column 2 show that wealth and income are positively related to ownership of risky assets and highly significant. The

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[27] County urbanicity comes from the restricted HRS geographic data files, state unemployment rates are from the Bureau of Labor Statistics, average Medicare expenditures are from the Centers for Medicare and Medicaid Services, and county population is from the 2003 Area Resource File.

coefficients on supplemental insurance and HMO participation fall in magnitude, and the HMO coefficient loses statistical significance. Notably, most of the other coefficients in the model fall in magnitude as well, suggesting that the exogenous variables absorbed the effect of omitted wealth and income in column 1.

In Table 8, we show the predicted probabilities from the probit model with and without wealth (lines 2 and 5). The probit model without wealth predicts that those with supplemental insurance are 15.8 percentage points more likely to hold risky assets than those with just Medicare Parts A and B. Those in a Medicare HMO are 5.9 percentage points more likely to own risky assets. With the inclusion of wealth and income in the model, these effects drop to 8.0 and 2.8 percentage points respectively. With or without wealth, these effects are much smaller than what we observe in the raw sample means, suggesting demographic characteristics and health account for much of the raw differences in risky asset ownership across insurance groups.

Table 6 shows results from our three-equation discrete factor model accounting for the endogeneity of insurance status, and excluding wealth and income. In the risky asset ownership equation (column 1), both supplemental insurance and HMO participation are highly significant, and close in magnitude. The model includes the same set of covariates as the probit model in Table 5, and the coefficients on the exogenous variables are qualitatively similar. In the supplemental insurance equation (column 2), the county price of United Healthcare Plan F and the number of Plan F carriers in the county are both highly significant and take the expected sign. The "cross-price" effect, HMO county market share, is not statistically significant once we control for Plan F prices and number of carriers. In the HMO participation equation (column 3), HMO market share is highly significant, as is the cross-price effect of United Healthcare Plan F,

but the number of Plan F carriers in the county is not statistically significant once we control for HMO market share.

The pattern of coefficients on the other exogenous variables in columns 2 and 3 tells a story similar to Table 2. Individuals who are married, white and have higher education are more likely to choose supplemental insurance over no insurance, whereas individuals enrolled in HMOs are demographically similar to those with no supplemental insurance. There are also some interesting differences by disease status; for example, individuals with cancer, heart disease, or arthritis are more likely to choose supplemental insurance over no insurance whereas those with lung disease or stroke are less likely to choose supplemental insurance. Those with diabetes are significantly more likely to choose an HMO over no insurance. Consistent with Table 2, those who say they are in fair or poor health are less likely to by covered by either supplemental insurance or an HMO even after controlling for other covariates.

Table 7 presents a comparison of the results from the three-equation discrete factor models with and without wealth and income. As in the probit specification, the inclusion of these potentially endogenous variables causes the coefficients on supplemental insurance and HMO participation to fall in magnitude. The coefficient on supplemental insurance retains statistical significance, but the coefficient on HMO participation does not. The coefficients on the instruments do not change much with the addition of wealth and income. As in the simple probit specification, the coefficients on the exogenous covariates fall in magnitude with the addition of wealth and income, especially for those variables that are highly correlated with wealth and income such as education.

Lines 3 and 6 of Table 8 present the predicted probabilities of risky asset ownership for each insurance category for the different model specifications summarized in Table 7. Implied

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marginal effects are shown in columns 4 and 5. The discrete factor model without wealth predicts that those with supplemental insurance are 13.8 percentage points more likely to hold risky assets than those with just Medicare Parts A and B. Those in a Medicare HMO are 12.3 percentage points more likely to own risky assets. With the inclusion of wealth and income in the model, these effects drop to 6.7 and 4.3 percentage points respectively. Because our HRS data include both spouses in married couples, we re-estimate the discrete factor models on a sample limited to a single member per household.[28] In married couple households, we select a random spouse. Our results are very similar to those based on the full sample and are shown in Appendix Table 1. Table 8 shows that the effects of supplemental insurance and HMO participation on risky asset ownership in the restricted sample are very close to the effects implied by the full model.

Although not shown, our results are robust to the inclusion of variables for home ownership, life insurance, employer pension, labor force status, as well as interactions between insurance status and health. They are also robust to inclusion of log wealth and log income instead of wealth and income quartile dummies. Adding controls for the size of the local financial industry in order to approximate local area financial sophistication also did not affect the results.

Finally, as noted in equations 8-10, the discrete factor model has three implied correlations between the unobserved heterogeneity components in each equation.   The

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[28] In the HRS data, household wealth and its components are measured at the household level, implying that husbands and wives have the same values on the dependent variable. They do not, however, have identical values on the insurance status variables or on the demographic (except marital status) and health variables, though of course these items are correlated. In the model results based on the full sample, standard errors are not adjusted to account for correlation in the errors of individuals in the same household. However, the standard errors in the models based on the restricted sample do not require adjustment, and though somewhat larger, are not large enough to change inference.

correlation in unobservables for risky asset ownership and supplemental insurance is small and positive at 0.07, suggesting that the implied marginal effect of supplemental insurance from the simple probit model is biased upward by an unobserved factor that is positively correlated with both risky asset ownership and the propensity to hold supplemental insurance. This is readily apparent from comparison of the lines 5 and 6 of column 4 in Table 8. One plausible candidate might be financial sophistication or awareness, such that financially sophisticated individuals are more likely to both invest in risky assets and hold insurance. On the other hand, the correlation in unobservables for risky asset ownership and HMO participation is larger and negative at -0.23, suggesting that the HMO effect implied by the probit model is biased downward by an unobserved factor that is negatively correlated with risky asset ownership but positively correlated with HMO participation. This too is evident from the implied marginal effects reported in column 5 of Table 8. A likely candidate might be risk aversion, such that risk averse individuals are less likely to invest in risky assets, but more likely to hold insurance. There is little evidence of correlation between the unobservables in the supplemental insurance and HMO equations. The implied correlations from the restricted model with one observation per household are similar.

8. Conclusion

Our results are consistent with the theory of background risk. We find evidence that individuals who obtain greater protection against out-of-pocket medical costs by enrolling in an HMO or obtaining supplemental insurance through Medigap or an employer are more likely to hold risky assets. Implied marginal effects for supplemental insurance are larger than the effects for HMO participation, and the coefficient on HMO participation loses statistical significance once we introduce controls for lagged wealth and income. Nevertheless, the economic

significance of the effects of both supplemental insurance and HMO participation is notable. We find that supplemental insurance increases risky asset holding by 6.7 percentage points relative to those enrolled in only Medicare Parts A and B. HMO participation increases risky asset holding by 4.3 percentage points. Given that just 50 percent of our sample holds risky assets, these represent sizable effects in percentage terms. We identify the effects of supplemental insurance and HMO participation using exogenous variation in Medigap prices and HMO market penetration. Our results suggest that simple probit estimates that do not account for the endogeneity of insurance choices are biased by factors such as unobserved risk aversion and unobserved financial sophistication. Finally, our results suggest that reforms to the Medicare system that appreciably change the degree of medical expenditure risk elderly households face have the potential to affect demand for risky assets in the economy. However, we caution that our results are based on cross-sectional variation in risky asset ownership, and note that the data show significant inertia in risky asset ownership by the elderly over time.

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Figure 1. Densities of Out-of-Pocket Medical Expenses by Supplementary Insurance Status
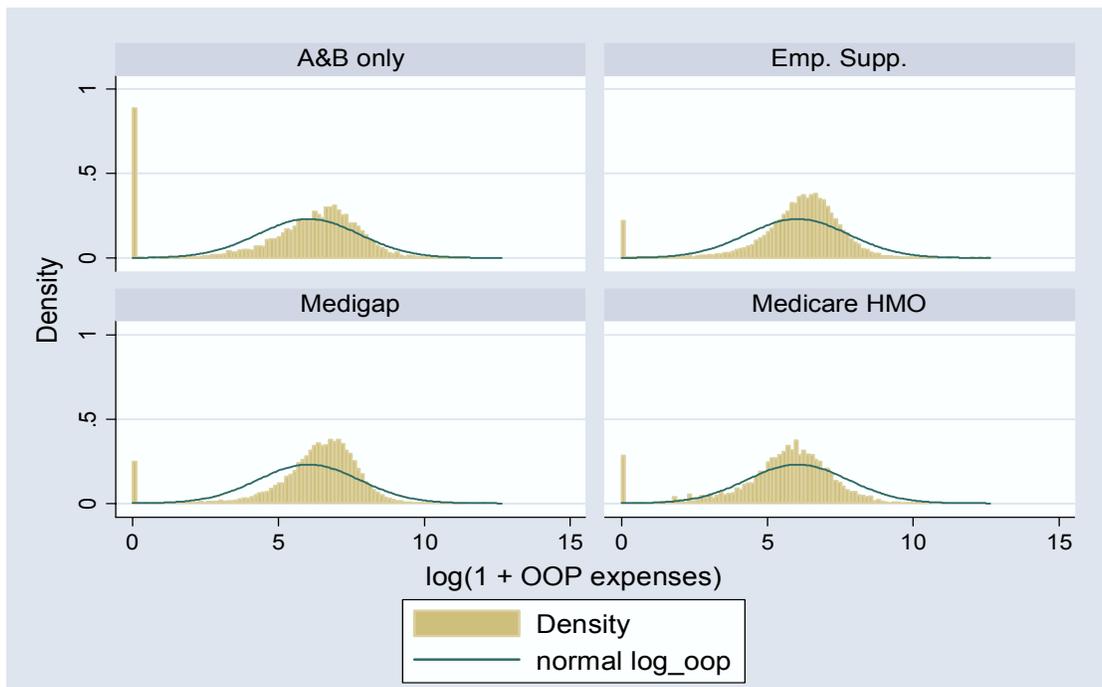
Notes: Data are from the 1999 and 2000 MCBS Cost and Use files and are in 2000 dollars. Spending in 1999 is inflated to 2000 dollars using the consumer price index for medical care. Expenditures for inpatient services, outpatient services, home health care, medical equipment, prescription drugs, dental services, hospice care, skilled nursing facilities, and institutional care are included.

Figure 2. County-Level First-Stage Relationship between Supplemental Insurance and Medigap Prices
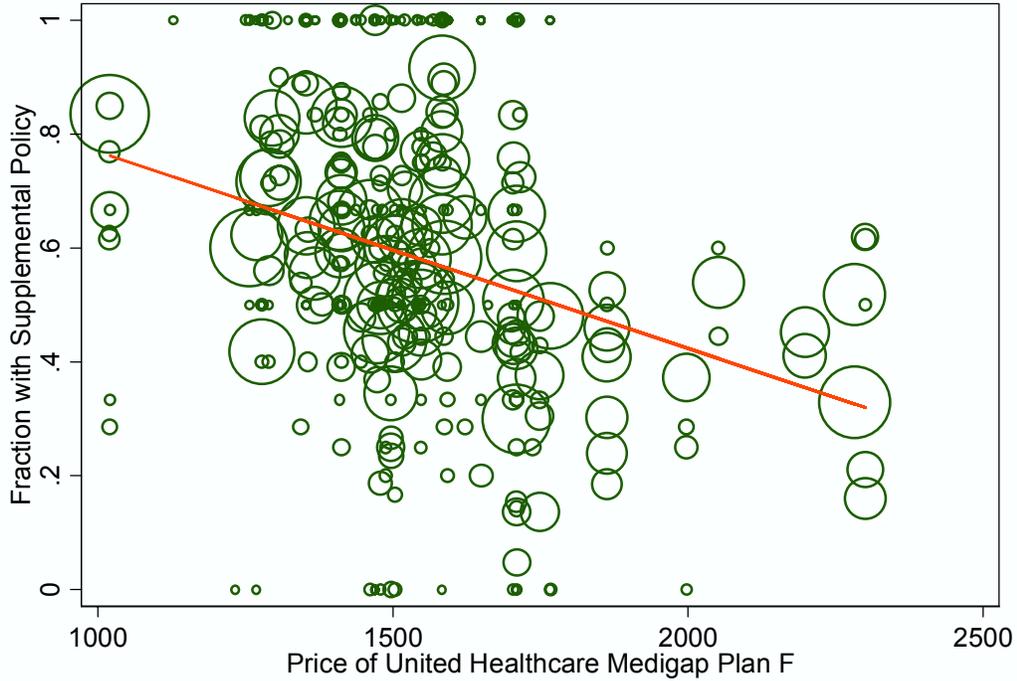
Note: Weighted by no. of observations in the county.

Figure 3. County-Level First-Stage Relationship between Supplemental Insurance HMO Market Penetration
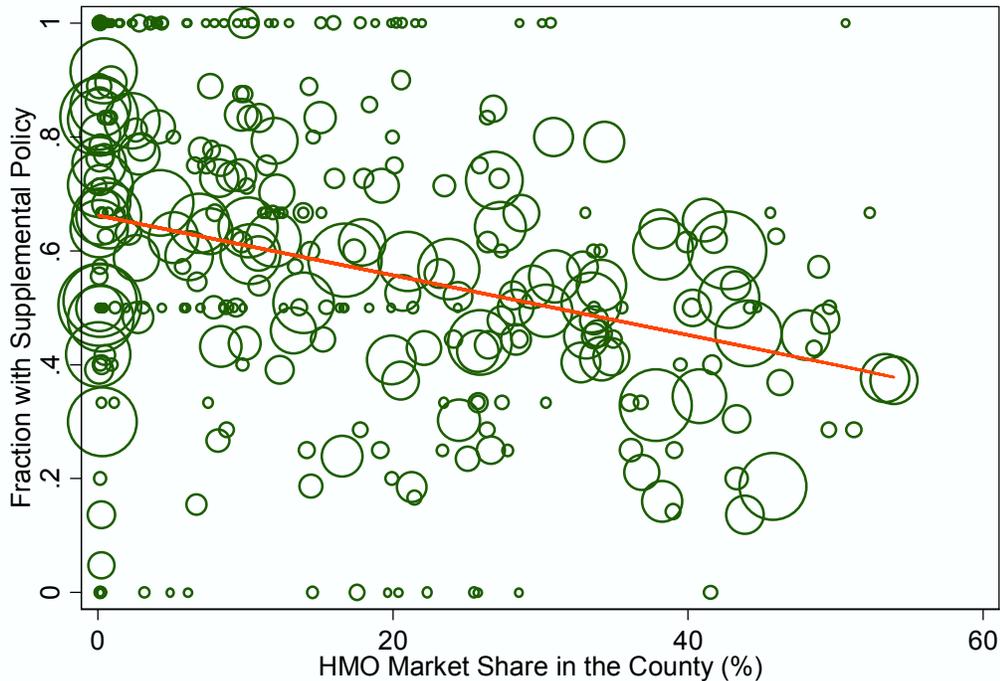
Note: Weighted by no. of observations in the county.

Figure 4. County-Level First-Stage Relationship between Medicare HMO Enrollment
and HMO Market Penetration

Note: Weighted by no. of observations in the county.
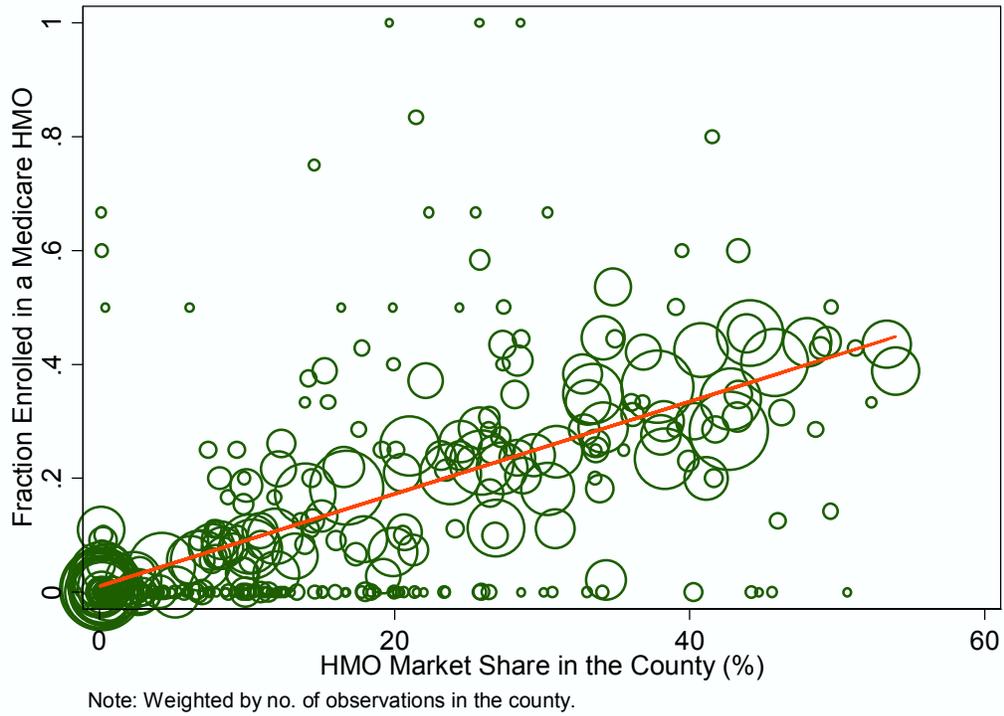
Figure 5. County-Level First-Stage Relationship between Medicare HMO Enrollment
and Medigap Prices

Note: Weighted by no. of observations in the county.
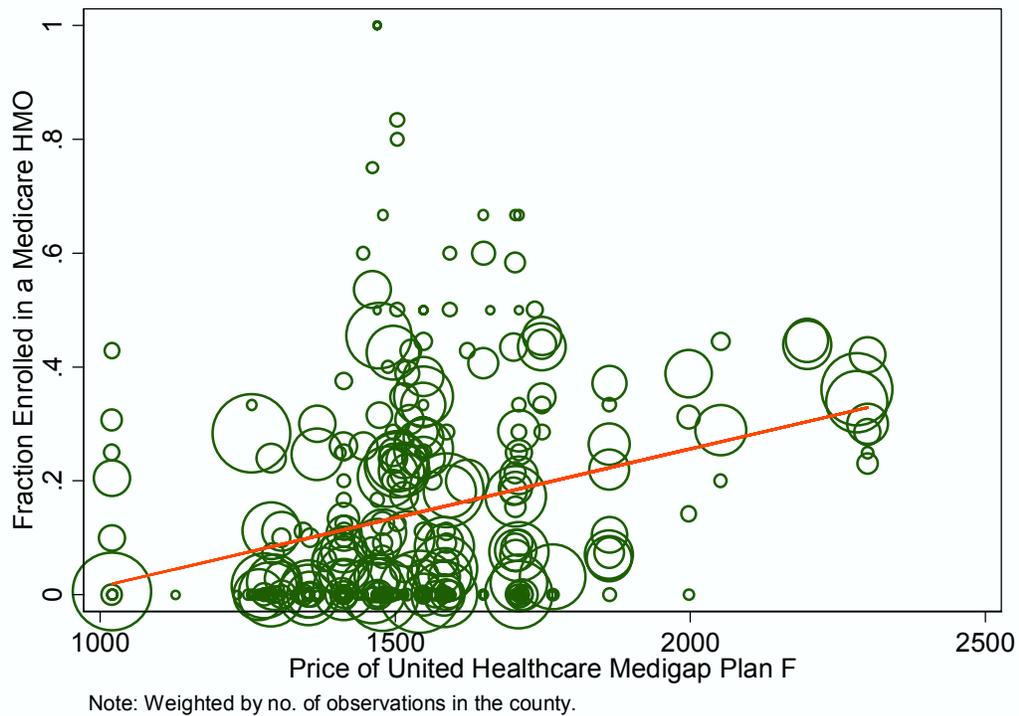
Figure 6. County-Level Reduced Form Relationship between Demand for Risky Assets and Medigap Prices

Note: Weighted by no. of observations in the county.
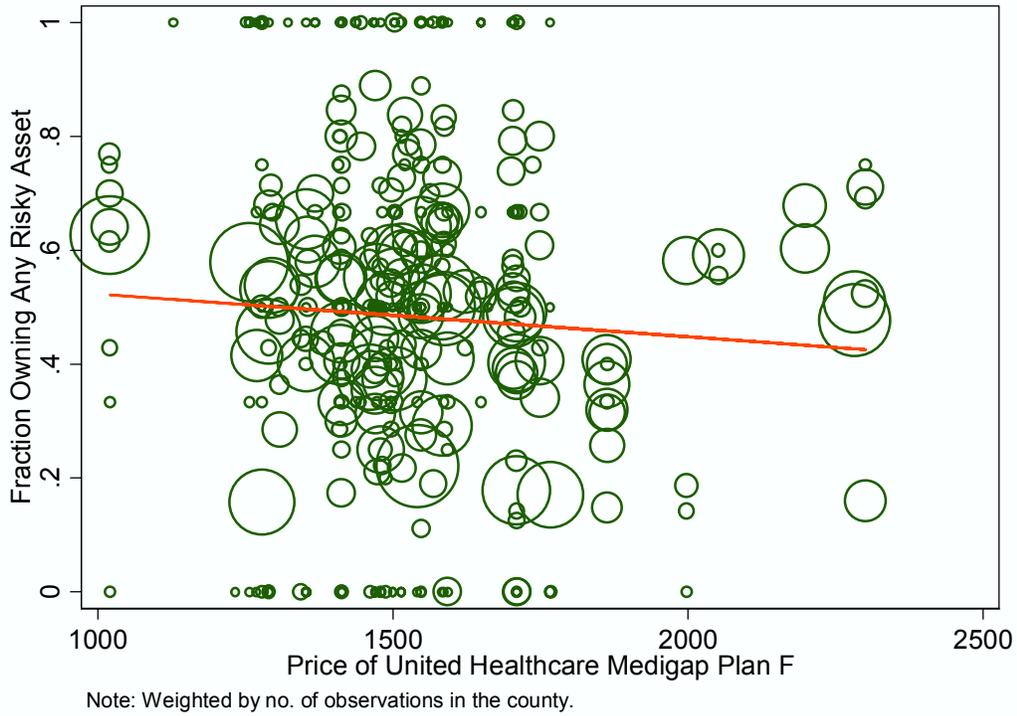
Figure 7. County-Level Reduced Form Relationship between Demand for Risky Assets and HMO Market Penetration

Note: Weighted by no. of observations in the county.
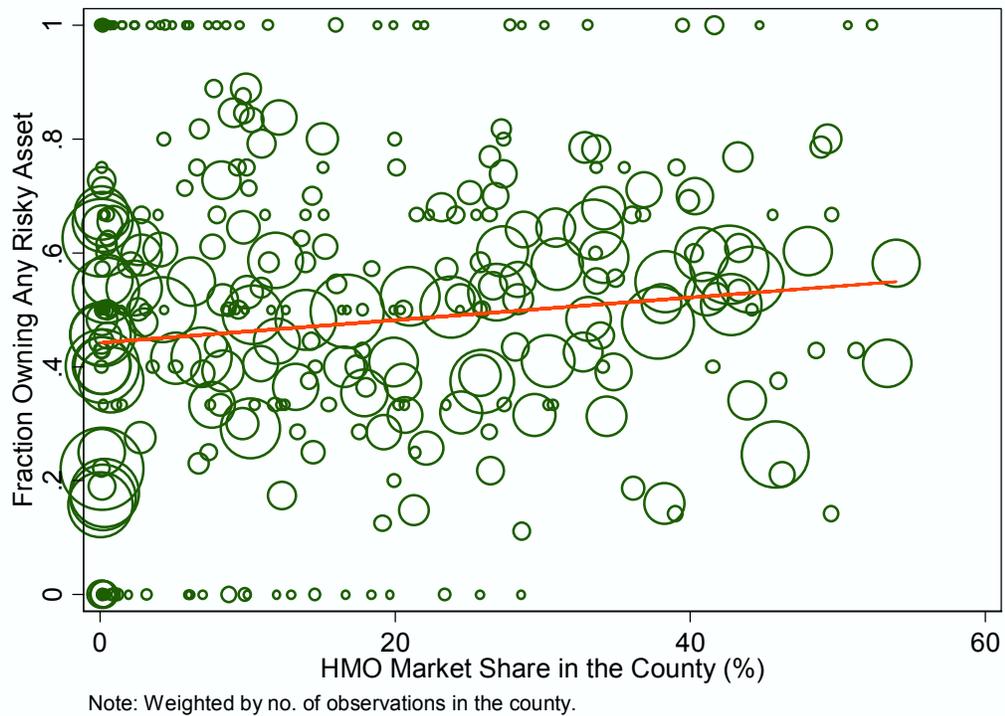
Table 1. Health Insurance Coverage of Medicare Beneficiaries, HRS 2000

Medicare A & B Only	14.8
Medicare HMO	16.2
Medicare + Individual Medigap Policy	28.5
Medicare + Employer Insurance	32.6
Medicare + Medicaid	8.0

Notes: Sample includes respondents in the 2000 wave of the HRS who were age 65 or older in 1998. N=8522

Table 2. Sample Means by Insurance Status, HRS 2000

	All	Medicare A&B Only	Medicare HMO	Medicare + Medigap	Medicare + Employer
Age	75.7	77.3	75.0	76.4	74.8
Male	42.3	39.8	40.6	40.5	45.9
Years of Education	12.1	10.6	12.0	12.2	12.8
White	88.6	74.0	84.8	94.9	91.6
Black	6.9	17.4	7.4	2.8	5.5
Hispanic	3.1	6.5	6.2	1.5	1.5
Married	57.1	44.4	57.2	55.2	64.5
Completely Retired	84.1	85.9	83.7	81.6	85.7
Income	$37,860	$27,204	$31,549	$39,085	$44,756
Net Worth	$376,100	$220,591	$307,848	$467,611	$400,515
Ever Diagnosed with High Blood Pressure	55.4	54.1	55.2	54.4	56.9
Ever Diagnosed with Diabetes	15.4	17.0	16.8	14.0	15.2
Ever Diagnosed with Major Health Condition	51.6	49.8	50.2	53.2	51.7
Major Health Shock in Last 2 Yrs	11.9	11.8	12.0	12.8	11.1
Fair or Poor Health	28.2	37.5	28.3	27.1	24.7
No. of Observations	7774	1324	1375	2324	2751

Notes: Sample includes respondents in the 2000 wave of the HRS who were age 65 or older in 1998. Major health conditions are cancer, lung disease, heart disease, and stroke. Major health shock refers to onset of a major health condition. Completely Retired respondents include those who report themselves as completely retired and not working for pay, those who say they are "not in the labor force," and those who report themselves as disabled.

Table 3. Distribution of Out-of-Pocket Medical Expenses by Supplementary Insurance Status

	Mean	Percentile of OOP Expenses			
		50th	90th	95th	99th
Medicare A & B Only	$2,066	$705	$3,869	$6,367	$31,751
Medicare HMO	$942	$423	$1,883	$3,067	$7,778
Medicare + Individual Medigap Policy	$1,544	$973	$3,221	$4,657	$9,750
Medicare + Employer Insurance	$1,217	$682	$2,575	$3,948	$8,548

Notes: Data are from the 1999 and 2000 MCBS Cost and Use files and are in 2000 dollars. Spending in 1999 is inflated to 2000 dollars using the consumer price index for medical care. Expenditures for inpatient services, outpatient services, home health care, medical equipment, prescription drugs, dental services, hospice care, skilled nursing facilities, and institutional care are included.

Table 4. Household Financial Portfolios in Liquid Assets, HRS 2000

	Ownership					Portfolio Shares				
	All	Medicare A&B Only	Medicare HMO	Medicare + Medigap	Medicare + Employer	All	Medicare A&B Only	Medicare HMO	Medicare + Medigap	Medicare + Employer
Safe Assets										
Checking	84.7	73.6	87.5	89.1	93.6	46.7	60.8	49.0	40.0	40.2
CDs/T-bills	32.1	21.6	31.1	39.2	39.1	14.2	13.2	12.9	18.0	13.9
Risky Assets										
Stocks	34.1	19.3	32.3	38.5	46.1	18.3	12.6	16.8	19.7	22.0
Bonds	9.6	5.3	8.0	11.9	12.8	2.2	1.6	1.8	2.9	2.4
IRA/Keogh Plans	34.5	16.9	35.6	39.2	45.2	18.6	11.7	19.4	19.5	21.6
Any Risky Assets	50.4	30.2	49.7	57.1	65.4	39.1	26.0	38.0	42.0	45.9

Notes: Sample includes respondents in the 2000 wave of the HRS who were age 65 or older in 1998. The category denoted "Checking" also includes saving and money market accounts. Portfolio shares are computed conditional on ownership.

Table 5. Probit Model of Ownership of Risky Assets

	(1)	(2)
Supplemental Insurance	0.486	0.294
	(0.047)	(0.051)
HMO Participation	0.180	0.102
	(0.058)	(0.062)
Age	0.036	0.002
	(0.050)	(0.055)
Age Squared/1000	-0.348	-0.143
	(0.322)	(0.351)
Female	-0.055	0.006
	(0.035)	(0.037)
HS Grad/GED	0.412	0.241
	(0.041)	(0.044)
Some College	0.678	0.365
	(0.048)	(0.053)
College or More	1.020	0.541
	(0.053)	(0.060)
Black	-0.931	-0.601
	(0.075)	(0.081)
Hispanic	-0.698	-0.469
	(0.108)	(0.118)
Other Races	-0.421	-0.181
	(0.136)	(0.148)
Divorced	-0.647	-0.078
	(0.069)	(0.076)
Widowed	-0.585	-0.190
	(0.043)	(0.049)
Never Married	-0.351	0.093
	(0.103)	(0.113)
Household Size	-0.135	-0.109
	(0.020)	(0.022)
Non-Capital Income Quartile 2 1998	--	0.209
		(0.053)
Non-Capital Income Quartile 3 1998	--	0.257
		(0.056)
Non-Capital Income Quartile 4 1998	--	0.393
		(0.061)
Net Worth Quartile 2 1998	--	0.542
		(0.054)
Net Worth Quartile 3 1998	--	1.270
		(0.055)
Net Worth Quartile 4 1998	--	1.772
		(0.061)
High Blood Pressure 1998	-0.015	0.035
	(0.034)	(0.037)
Diabetes 1998	-0.118	-0.090
	(0.041)	(0.044)
Cancer 1998	0.133	0.106
	(0.040)	(0.043)
Lung Disease 1998	-0.305	-0.217
	(0.048)	(0.051)
Heart Disease 1998	0.000	0.030
	(0.034)	(0.037)
Stroke 1998	-0.137	-0.118
	(0.049)	(0.053)
Psychiatric Problems 1998	-0.172	-0.055
	(0.046)	(0.050)
Arthritis 1998	-0.033	0.001
	(0.036)	(0.038)
Health Shock Since 1998	-0.067	-0.018
	(0.042)	(0.045)
Fair or Poor Health	-0.254	-0.187
	(0.037)	(0.040)
N=7621		

Notes: Sample includes respondents in the 2000 wave of the HRS who were age 65 or older in 1998. Specification also includes a constant, a dummy for urban county, county population, average county Medicare expenditure on Parts A and B, and state unemployment rate.

Table 6. Discrete Factor Model of Ownership of Risky Assets, Excluding Wealth and Income

	Ownership	Supp. Insurance	HMO Participation
Supplemental Insurance	0.471	--	--
	(0.085)		
HMO Participation	0.420	--	--
	(0.141)		
County Price of United Plan F	--	-0.0010	0.0016
		(0.0002)	(0.0006)
Number of Plan F Carriers in County	--	0.007	-0.005
		(0.002)	(0.004)
HMO Market Share in County	--	0.009	0.145
		(0.006)	(0.013)
Age	0.044	0.060	0.039
	(0.057)	(0.099)	(0.226)
Age Squared/1000	-0.411	-0.589	-0.663
	(0.369)	(0.627)	(1.449)
Female	-0.060	-0.027	0.212
	(0.038)	(0.077)	(0.167)
HS Grad/GED	0.482	0.639	-0.070
	(0.053)	(0.086)	(0.197)
Some College	0.767	0.705	0.126
	(0.064)	(0.108)	(0.243)
College or More	1.138	1.075	-0.501
	(0.073)	(0.130)	(0.272)
Black	-1.134	-1.364	-0.207
	(0.122)	(0.122)	(0.321)
Hispanic	-0.806	-1.396	-0.317
	(0.139)	(0.186)	(0.427)
Other Races	-0.473	-0.977	-0.787
	(0.155)	(0.255)	(0.667)
Divorced	-0.752	-0.513	0.063
	(0.086)	(0.145)	(0.316)
Widowed	-0.650	-0.311	-0.521
	(0.054)	(0.091)	(0.208)
Never Married	-0.370	-0.336	-0.874
	(0.114)	(0.208)	(0.500)
Household Size	-0.165	-0.075	0.088
	(0.027)	(0.038)	(0.089)
High Blood Pressure 1998	-0.012	0.141	0.189
	(0.038)	(0.074)	(0.166)
Diabetes 1998	-0.140	0.021	0.728
	(0.046)	(0.094)	(0.203)
Cancer 1998	0.149	0.376	0.260
	(0.044)	(0.095)	(0.199)
Lung Disease 1998	-0.335	-0.184	-0.569
	(0.055)	(0.102)	(0.250)
Heart Disease 1998	0.010	0.246	0.024
	(0.038)	(0.077)	(0.171)
Stroke 1998	-0.163	-0.273	-0.231
	(0.056)	(0.101)	(0.226)
Psychiatric Problems 1998	-0.187	-0.017	-0.237
	(0.052)	(0.102)	(0.247)
Arthritis 1998	-0.031	0.229	0.546
	(0.039)	(0.076)	(0.171)
Health Shock Since 1998	-0.080	0.118	0.041
	(0.046)	(0.095)	(0.201)
Fair or Poor Health	-0.287	-0.329	-0.439
	(0.045)	(0.079)	(0.187)

N=7621

Notes: Sample includes respondents in the 2000 wave of the HRS who were age 65 or older in 1998. Specification also includes a constant, a dummy for urban county, county population, average county Medicare expenditure on Parts A and B, and state unemployment rate.

Table 7. Comparison of Discrete Factor Models With and Without Wealth and Income

	No Wealth/Income (Table 6)			With Wealth/Income		
	Ownership	Supp. Insurance	HMO Participation	Ownership	Supp. Insurance	HMO Participation
Supplemental Insurance	0.471 (0.085)	--	--	0.280 (0.107)	--	--
HMO Participation	0.420 (0.141)	--	--	0.178 (0.138)	--	--
County Price of United Plan F	--	-0.0010 (0.0002)	0.0016 (0.0006)	--	-0.0010 (0.0002)	0.0010 (0.0049)
Number of Plan F Carriers in County	--	0.007 (0.002)	-0.005 (0.004)	--	0.008 (0.002)	-0.005 (0.004)
HMO Market Share in County	--	0.009 (0.006)	0.145 (0.013)	--	0.003 (0.006)	0.153 (0.014)
HS Grad/GED	0.482 (0.053)	0.639 (0.086)	-0.070 (0.197)	0.303 (0.054)	0.437 (0.090)	-0.008 (0.191)
Some College	0.767 (0.064)	0.705 (0.108)	0.126 (0.243)	0.437 (0.064)	0.305 (0.114)	0.074 (0.233)
College or More	1.138 (0.073)	1.075 (0.130)	-0.501 (0.272)	0.617 (0.070)	0.462 (0.137)	-0.478 (0.275)
Non-Capital Income Quartile 2 1998	--	--	--	0.260 (0.063)	0.349 (0.098)	-0.135 (0.235)
Non-Capital Income Quartile 3 1998	--	--	--	0.321 (0.067)	0.858 (0.119)	-0.129 (0.241)
Non-Capital Income Quartile 4 1998	--	--	--	0.461 (0.072)	1.273 (0.145)	-0.150 (0.273)
Net Worth Quartile 2 1998	--	--	--	0.695 (0.084)	0.688 (0.101)	-0.020 (0.224)
Net Worth Quartile 3 1998	--	--	--	1.513 (0.105)	0.916 (0.116)	-0.215 (0.249)
Net Worth Quartile 4 1998	--	--	--	2.039 (0.116)	1.246 (0.138)	-0.295 (0.274)

N=7621

Notes: Select coefficients shown. Specification is same as in Table 6 with the addition of wealth and income variables in right-hand panel.

Table 8. Comparison of Predicted Probabilities of Risky Asset Ownership across Different Model Specifications

Model	Supp. Insurance	HMO	None	Diff Supp-None	Diff HMO-None
Raw Means	61.6	50.0	30.7	30.9	19.2
No Wealth					
Simple Probit	58.7	48.8	42.9	15.8	5.9
DF Model	56.9	55.4	43.1	13.8	12.3
DF Model, One Obs per HH	53.8	53.5	41.6	12.2	12.0
With Wealth					
Simple Probit	56.8	51.6	48.8	8.0	2.8
DF Model	56.1	53.7	49.4	6.7	4.3
DF Model, One Obs per HH	53.2	51.2	47.0	6.3	4.2

Appendix Table 1. Comparison of Discrete Factor Models With and Without Wealth and Income, One Obs per Household

	No Wealth/Income			With Wealth/Income		
	Ownership	Supp. Insurance	HMO Participation	Ownership	Supp. Insurance	HMO Participation
Supplemental Insurance	0.443 (0.099)	--	--	0.271 (0.123)	--	--
HMO Participation	0.434 (0.171)	--	--	0.183 (0.164)	--	--
County Price of United Plan F	--	-0.0009 (0.0002)	0.0015 (0.0006)	--	-0.0009 (0.0002)	0.0011 (0.0006)
Number of Plan F Carriers in County	--	0.006 (0.002)	-0.009 (0.004)	--	0.007 (0.002)	-0.0080 (0.004)
HMO Market Share in County	--	0.007 (0.006)	0.142 (0.015)	--	0.002 (0.007)	0.144 (0.015)
HS Grad/GED	0.516 (0.066)	0.700 (0.097)	-0.010 (0.220)	0.316 (0.065)	0.496 (0.102)	0.029 (0.212)
Some College	0.802 (0.078)	0.734 (0.120)	0.042 (0.270)	0.449 (0.076)	0.339 (0.126)	0.041 (0.259)
College or More	1.280 (0.093)	1.161 (0.153)	-0.635 (0.312)	0.725 (0.087)	0.544 (0.162)	-0.653 (0.311)
Non-Capital Income Quartile 2 1998	--	--	--	0.276 (0.070)	0.373 (0.106)	-0.104 (0.251)
Non-Capital Income Quartile 3 1998	--	--	--	0.308 (0.076)	0.840 (0.133)	0.109 (0.259)
Non-Capital Income Quartile 4 1998	--	--	--	0.426 (0.082)	1.253 (0.167)	0.030 (0.301)
Net Worth Quartile 2 1998	--	--	--	0.732 (0.100)	0.689 (0.113)	0.035 (0.252)
Net Worth Quartile 3 1998	--	--	--	1.521 (0.127)	0.875 (0.132)	-0.221 (0.283)
Net Worth Quartile 4 1998	--	--	--	2.059 (0.140)	1.199 (0.160)	-0.208 (0.308)

N=5770

Notes: Sample includes one observation per household. In married couple households, a random spouse was selected. Select coefficients shown. Specification is same as in Table 6 with the addition of wealth and income variables in right-hand panel.