Health Shocks and Policy Evaluation[*]

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Abstract

The medical sector is a large and growing part of the US economy, and expenditures on medical care are funded in large part by the government. As a result, understanding the effects of the policies which finance medical expenditures is of critical importance. In order to understand the effects of these policies, such as Medicare and the recently passed health care act, it is critical to understand the nature and distribution of health shocks. The existing literature largely uses health expenditure shocks as a proxy for health shocks in order to abstract from modeling the medical decision, and this assumption has strong implications for the effects of policy. In this paper, I develop a structural model of the accumulation and depreciation of health capital over the life cycle. In this model, individuals accumulate health capital through medical consumption, and a health shock is a shock to the depreciation rate of health capital. To demonstrate the utility of this framework, I calibrate the model to be consistent with various features of the US economy, and evaluate a simple policy changes in which a reduction in the co-payment rate for medical care for sick individuals is financed by a lump-sum transfer. In this model, in contrast to a model with exogenous medical expenditures, I find that these policies reduce welfare.

1   Introduction

The medical sector is a large and growing part of the US economy. Since 1960, medical expenditures as a share of GDP have risen from five percent to over fifteen percent. Further,

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these expenditures are financed to a large extent by the government; in 2009, the government financed 44 percent of medical expenditures. An important question is, what are the aggregate implications of these policies for allocations and welfare?

A recent literature[1] attempts to answer this question in the context of the recently passed Affordable Health Care for America Act. These studies generally argue that the recent policy change increases welfare. One important limiation of these studies is that they generally take a reduced form approach to modeling health shocks. In particular, they model health shocks as shocks to medical expenditures rather than shocks to primitives which generate endogenous variation in medical expenditures across individuals with different health shocks. One implicit assumption associated with this modeling approach is that medical expenditures are invariant to policy. This runs counter to existing evidence, in particular the RAND Health Insurance Experiment,[2] that policy does affect medical expenditures. By evaluating policy in a framework in which policy does not affect medical decisions, these studies ignore a potentially important channel through which policy affects allocations and welfare.

This paper proposes a new framework for health policy evaluation. Specifically, this paper develops a model of the accumulation and depreciation of health capital over the life cycle with primitive health shocks. In this model, health capital determines an individual's mortality rate. Individuals accumulate human capital through medical consumption. A health shock in this model is a shock to the depreciation rate of health capital. This model can be calibrated to match data on medical expenditures and mortality rates over the life cycle and across individuals with different health status.[3]

To illustrate the utility of this new framework, I evaluate simple policy change within the context of the calibrated model. In particular, I consider policies which reduce the co-payment rate for 'sick'[4] individuals by making a medical expenditure-dependent transfer to them, and finance this transfer to sick individuals using a lump-sum transfer from all individuals. I find that these policies reduce welfare,[5] in stark contrast to the result implied by a model with exogenous medical expenditures. The reason for this is that a reduction in the marginal cost of medical purchases induces individuals to increase medical purchases at the expense of non-medical consumption. Marginal co-payment rates for medical purchases

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[1]See, for example, Janicki (2011) and Paschenko and Porapakkarm (2011).

[2]See Newhouse (1993).

[3]Health status in the model corresponds to self-reported health status in the Medical Expenditure Panel Survey.

[4]Sick individuals in the model correspond to individuals who report fair or poor health in the Medical Expenditure Panel Survey.

[5]In the tradition of Lucas (1987), I consider consumption-equivalent welfare for the ex-ante household.

are already quite low in the US, and further reduction results in welfare loss because the reduction in the variation in non-medical consumption across individuals of different health status is outweighed by the increased distortion of the medical purchase decision.

The remainder of the paper is organized as follows. Section 2 presents the model used for policy evaluation. Section 3 details the methods used to calibrate the model parameters. Section 4 presents the data used to calibrate the model. Section 5 details the policy which is evaluated within the context of the model, and the main results. Section 6 concludes.

2   Model

In this section, I develop a life cycle model of the accumulation and depreciation of health capital over the life cycle, similar to Lawver (2011 b), extended to include shocks to the depreciation rate of health capital.

Demographics, Timing, and Endowments

The economy is populated by ex-ante identical individuals. Individuals differ by their health status, indexed by $i = 1, 2$, and their age, indexed by $t = 0, 1, ..T$. In each period, α_i individuals are born at age 0 with health status i. The probability that an individual at age t of health status i survives to age $t+1$ is denoted s_{ti}. Of the individuals that survive, fraction $\pi_{tii'}$ have health status i' at age $t+1$. There are two sub-periods in each period, hereafter referred to as 'beginning' and 'end,' indexed by $j = 0, 1$. Subscripts are used to refer to age t and health status i and superscripts are used for the sub-period j. Health capital is the only variable which varies across sub-periods, and is denoted H_{ti}^{j}. Each individual is endowed with a lifetime stream of health status-contingent income, denoted y_{ti}, and an initial health status-contingent health capital stock, denoted H_{0i}^{0}.

Medical Consumption

In each period, individuals allocate their income to medical purchases x_{ti} and non-medical consumption c_{ti}. The quantity of medical purchases correspond to the quantity of the composite medical good measured by the BLS, and can be thought of as the number of treatments that an individual receives.[6] Individuals value medical purchases because of the associated

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[6]For more discussion, see Lawver (2011).

increase in end of period health capital. The rate at which medical purchases increases end of period health capital depends on the quality of medical purchases, denoted A_{ti}. Medical consumption m_{ti} is defined to be the product of the quantity of medical purchases x_{ti} and the quality of medical purchases A_{ti}. Increasing end of period health capital has two effects. First, it increases an individual's survival rate in the current period. Second, it increases health capital at the beginning of the next period contingent on survival.

Health Capital Accumulation and Survival

Individuals invest in health capital over the life cycle through medical consumption. Health capital in sub-period j for an individual at age t with health status i is denoted H_{ti}^j. Health capital at the end of the period is a function of health capital at the beginning of the period as well as medical consumption m_{ti} according to the following function g:

$$H_{ti}^1 = g(H_{ti}^0, m_{ti})$$

Function g is increasing in both arguments, and concave in medical consumption. I restrict function g, which I will call the health capital accumulation function, to be in the following form:

$$g(H_{ti}^0, m_{ti}) = H_{ti}^0(1 + m_{ti}^\gamma)$$

where γ is an elasticity parameter.

The probability that an individuals survives to the next period is a function of an individual's end of period health capital, and therefore depends on beginning of period health capital and period medical consumption. An individual's period mortality rate is the inverse of end of period health capital. An individual's period survival rate, then, is written:

$$s_{ti} = 1 - \frac{1}{H_{ti}^1}$$

Health Status Transitions and Health Capital Depreciation

Individuals face uncertain health capital depreciation rates. Of the individuals which survive from age t to age $t+1$, share $\pi_{tii'}$ will be of health status i' at age $t+1$, and these individuals will have health capital depreciation rate δ_{tij}. Health capital in the beginning of the next period for individuals that transition between health status i and health status i' is written

as:

$$H^0_{t+1,i'} = (1 - \delta_{tij})H^1_{ti}$$

In this setting, 'health shocks' are shocks to the depreciation rate of health capital. Transitioning from a healthy state today to an unhealthy state tomorrow means an individual's health capital depreciation rate is relatively large, and vice versa. One alternative approach in this setting would be to model health shocks as shocks to the level of health capital rather than its depreciation rate. Conceptually, these approaches are very similar.

Preferences

Individuals value streams of state-contingent non-medical consumption according to the following utility function:

$$\sum_{t=0}^{T} \sum_{i=1}^{2} \beta^t \Pi_{ti} u(c_{ti})$$

where Π_{ti} denotes the probability that an individual survives to age t and has health status i. This probability depends on health status transition probabilities π_{tij} as well as the history of medical consumption and beginning of period health capital in period zero. For convenience, I define the consumption good in units of year 2000 dollars. Function u is the period utility function, which is increasing and concave. The utility from death is normalized to zero. I restrict u to be in the following form:

$$u(c) = \log(c) + \phi$$

where ϕ is the constant term in the period utility function, as in Hall and Jones (2007). This term is important in models with endogenous survival rates. Since the utility of death is normalized to zero, the level of utility while alive affects the optimal level of medical purchases. Furthermore, the use of this term allows one to calibrate the model to be consistent with empirical estimates of the value of a statistical life. This means that willingness to pay for medical purchases in the model will be consistent with empirical estimates of willingness to pay for mortality reduction.

Budget

Individuals are endowed with a lifetime stream of health status-contingent income, denoted y_{ti}. In each period, individuals allocate income to medical purchases x_{ti} and non-medical consumption c_{ti}. The relative price of medical purchases is denoted p.

Individuals have stylized insurance against medical expenses in the sense that pay a fraction of medical expenses out of pocket. Given medical expenditures px_{ti}, individuals pay $\theta_{ti}px_{ti} + P_{ti}$ out of pocket, where θ_{ti} is the marginal co-payment rate for medical purchases, and P_{ti} is a transfer. This feature is meant to replicate the fact that a large portion of medical expenses a financed indirectly via public and private insurance, and these parameters will be chosen in the calibrated model to match the average and the marginal co-payment rates faced by individuals. The main policy experiment will be to change these parameters and determine the effect of these changes on allocations and welfare.

Individual Decision Problem

In each period, individuals allocate income to maximize expected lifetime utility. This decision problem is written recursively as follows:

$$V_{ti}(H_{ti}^0) = \max_{x_{ti},c_{ti}}[u(c_{ti}) + \sum_{j} \pi_{ij}\beta s_{ti}V_{t+1,j}(H_{t+1,j}^0)]$$

$$\text{subject to:} \quad c_{ti} + px_{ti} = y_{ti}$$

$$H_{ti}^1 = g(H_{ti}^0, A_{ti}x_{ti})$$

$$H_{t+1,j}^0 = (1 - \delta_{tij})H_{ti}^1$$

$$s_{ti} = 1 - \frac{1}{H_{ti}^1}$$

3   Data

In this section, I will detail the data used to parameterize the model. I will use data on the life cycle profile of medical purchases by health status, survival rates, and other variables for males[7] in the US between 1996 and 2008 to construct an average life cycle profile. The data used here are annual and come from the Medical Expenditure Panel Survey (MEPS), the Bureau of Labor Statistics (BLS) and the Social Security Administration (SSA). This

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[7]Males are studied here for simplicity, as their medical decisions do not affect the health of unborn children.

data is used to construct observations of survival rates s_t, medical purchases x_{ti}, marginal co-payment rates θ_{ti}, average co-payment rates θ_{ti}^{avg}, and income endowments y_{ti} for each 5-year age group from 25-99,[8] and the relative price of medical purchases p.

The MEPS reports data on income, medical expenditures, and out-of-pocket medical expenditures at the individual level for males 25-84. An individual's income endowment is defined to be their total income, as reported by MEPS. I use the individual-level data to construct observations for each ti, hereafter referred to as group, by averaging across individuals in that group in all time periods. To calculate the average co-payment rate θ_{ti}^{avg} that individuals pay, I calculate the share of total medical expenses that are paid by each group. I estimate the marginal co-payment rate θ_{ti} faced by individuals as follows. First, I calculate the average co-payment rate across all individuals in each group. Then, I assume that the marginal co-payment rate for each individual is equal to the average co-payment rate. Then I calculate the group's marginal co-payment rate by averaging the average co-payment rate across all individuals in the group. Recall that θ_{ti} will be used in the model, and that a transfer P_{ti} will be calculated so average co-payment rate in the model will match the data. Overall, out-of-pocket payments make up a small fraction of medical expenses. Marginal co-payment rates generally decline with age, and decline for those in poor health. This pattern is shown in Figure 1.

Income endowments and co-payment rates for individuals 85 to 99 are chosen to be equal to their corresponding values for 80-84 year olds, because MEPS data is not available for these age groups. BLS data is used to construct the relative price of medical purchases by averaging the relative price of medical purchases between 1996 and 2008. Medical expenditures are calculated by determining average medical spending in each group. Medical expenditures as a share of income are shown in Figure 2. As shown in the figure, the share of income devoted to medical expenditures rises sharply with age, and for those in poor health.

Health status in the model corresponds to self-reported health status in MEPS. In particular, health status 2 in the model corresponds to a report of excellent, very good, or good health in MEPS, and health status 1 in the model corresponds to a report of fair or poor health in MEPS. The overlapping panel design of MEPS is exploited to calculate $\pi_{tii'}$, the probability of having health status i' at age $t+1$ conditional on having health status i at age t. This is calculated directly using the panel data. Two important patterns are seen in the data. First, the probability of being healthy in the next period is higher for individuals that are healthy in the current period. Second, the probability of being healthy in the next

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[8]25-29 year olds, 30-34 year olds, etc.

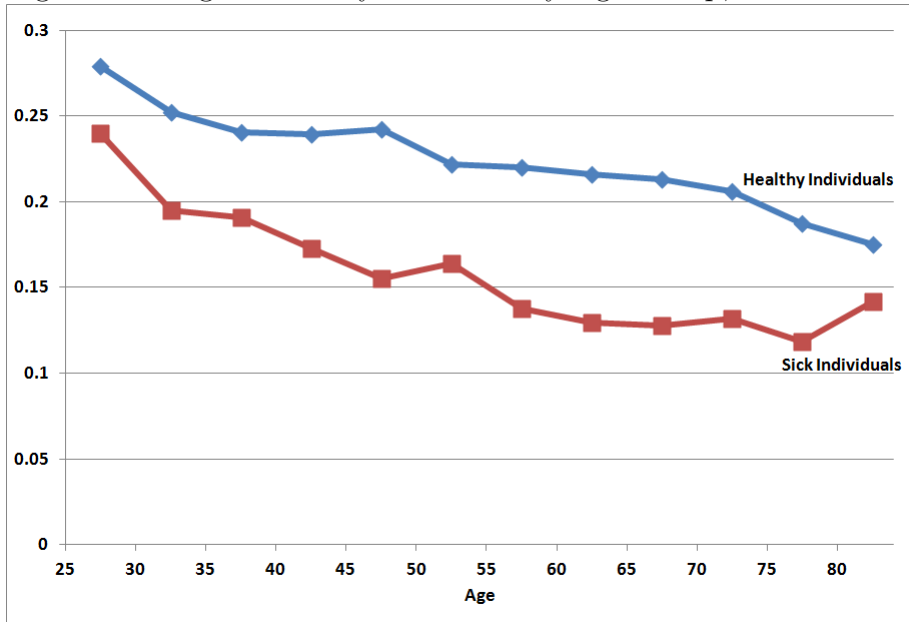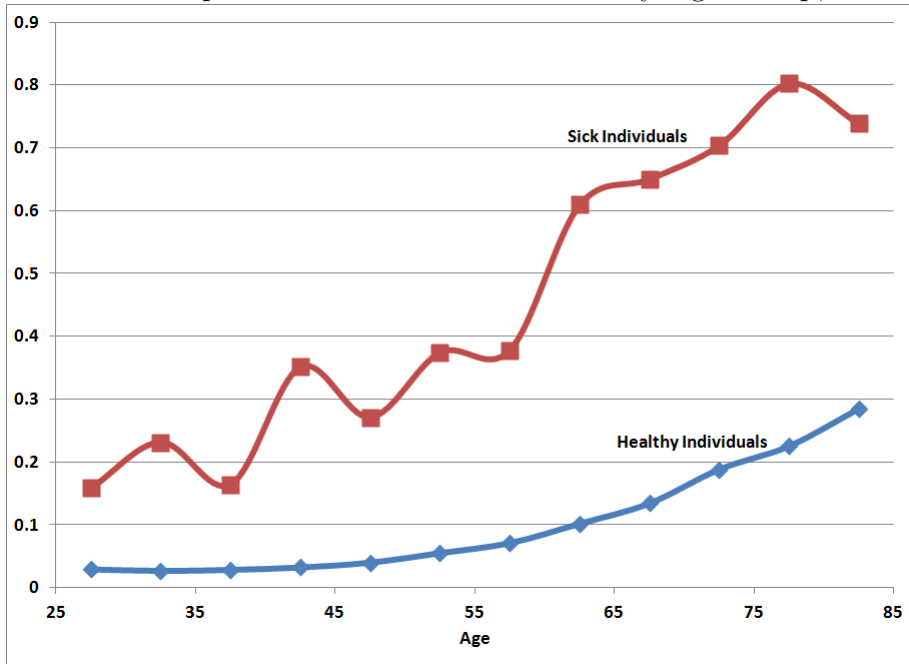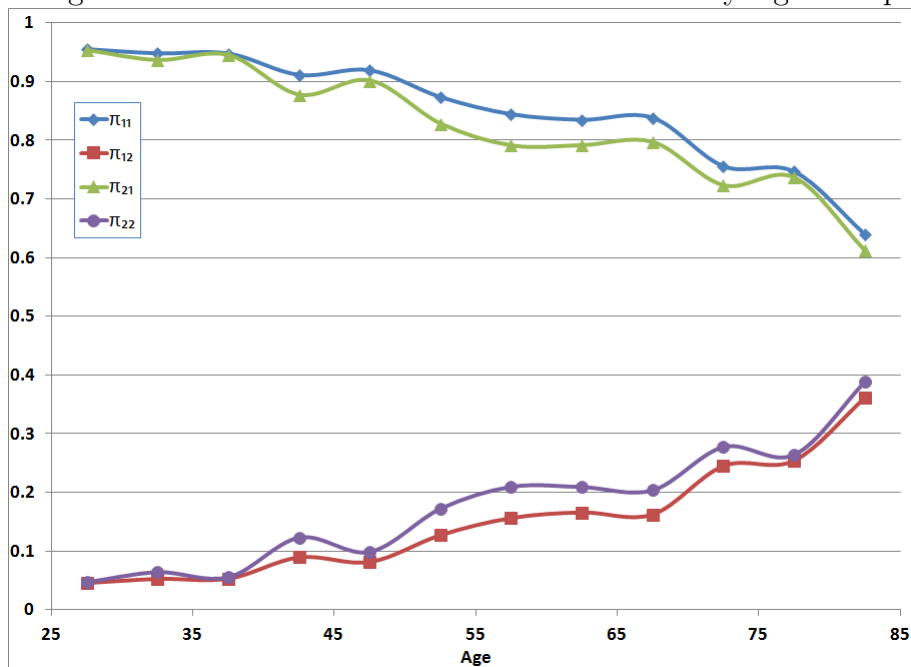Figure 1: Marginal Co-Payment Rate by Age Group, Health Status

Figure 2: Medical Expenditures Relative to Income by Age Group, Health Status

period declines with age. These patterns are documented in Figure 3.

Figure 3: Health Status Transition Probabilities by Age Group

The SSA reports mortality rates at every age for 1990, 2000, and 2010. I construct mortality rates in years that are not reported using linear interpolation. The mortality rate s_{ti} is defined to be the probability that an individual of health status i survives in each of the years making up period t. For $t = 0$, this corresponds to the probability of surviving from age 25 to age 30, averaged across years 1996 to 2008. To convert age-specific observations to age and health status-specific observations, information on the relationship between self-reported health status and mortality from McGee et al (1999) is used. Figure 4 plots the life cycle profile of survival rates over this period by health status.

4 Calibration

The unknown parameters in this model determine the life cycle profiles of the quality of medical purchases in the accumulation of health capital A_{ti}, the depreciation rate of health capital $\delta_{tii'}$, beginning and end of period health capital H_{ti}^{j}, the constant term in the period utility function ϕ, the exponent in the health capital accumulation function γ, and the time discount rate β. I will assume that the yearly discount rate is .96, implying that $\beta = .96^5$.

The key exercise here is to use the model to infer the life cycle profiles of the unobserved

Figure 4: Survival Rate by Age Group
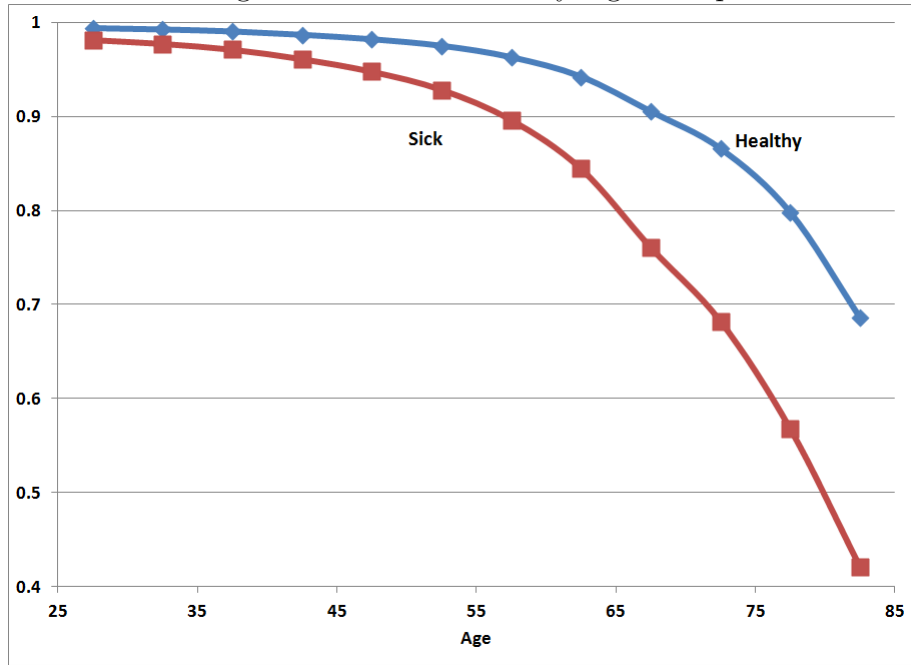
parameters using observations of the life cycle profiles of medical purchases x_{ti} and survival rates s_{ti}. The key to this exercise is to work backwards. In the final period, an individual's health capital stock does not affect their decisions, and therefore the depreciation rate of health capital in the second to last period does not affect decisions. As a result, it is straightforward to infer medical quality and beginning of period health capital in the final period, and therefore the depreciation rate of health capital in the second to last period. Given that these parameters have been inferred, it is straightforward to work one step backward. I will detail these steps in this section.

Inference of the life cycle profiles of the unobserved parameters are disciplined, in addition, by information on the value of astatistical life and by experimental evidence on the price elasticity of medical expenditures. In particular, as in Hall and Jones (2007), the constant term in the period utility function is calibrated to match the estimate of the value of a statistical life for 35-44 year olds in 2000 from Aldy and Viscusi (2008). This implies that willingness to pay for medical purchases in the model is grounded by evidence on willingness to pay for mortality reduction in the data. Further, the elasticity parameter in the health capital production function is calibrated to match the price elasticity of medical expenditures

implied by the RAND Health Insurance Experiment.[9]

Outline of Calibration Procedure

To calibrate the remaining parameters – A_{ti}, $\delta_{tii'}$, H_{ti}^j, and ϕ – I proceed as follows. First, I guess parameters ϕ and γ. After guessing these parameters, I choose all of the other parameters to be consistent with data on survival rates s_{ti} and medical purchases x_{ti}. Then, I calculate the value of life for 35-44 year olds in the model, and compare it to the estimate in Aldy and Viscusi (2008), and to the estimate of the price elasticity of medical expenditures implied by the RAND Health Insurance Experiment. I update my guess of ϕ and γ, based on this information, and repeat the process until convergence. Later in this section, I will detail the calculation of the value of life in the model.

To choose parameters other than ϕ and γ, taking these parameters as given, I work backwards. In the final period of life, individuals will use all of their income to purchase non-medical consumption no matter what their health capital stock is since their is no opportunity to live another period. In the next-to-last period of life, $t = T$-1, the variables relevant for decisions are the beginning of period health capital stock H_{it}^0 and medical quality A_{ti}. Health capital depreciation rates do not affect decisions, since the value of living to the final period of life does not depend on health capital. In the next-to-final period of life, then, the objective is to choose H_{ti}^0 and A_{ti} so that the model is consistent with observations s_{ti} and x_{ti}. For individuals of each type i, I guess A_{ti}. Then, I derive H_{ti}^0 consistent with optimal decision making and the observed level of medical purchases x_{ti}. Then, I determine whether or not A_{ti} and H_{ti}^0 are consistent with observed survival rate s_{ti}. I iterate on my guess of A_{ti} until the survival rate implied by these parameters is consistent with observations.

In all preceding periods the procedure is similar, the difference being that health capital depreciation rates must also be inferred. This is straightforward. Survival rate s_{ti} implies H_{ti}^1, which along with $H_{t+1,i'}^0$ inferred in the previous step implies $\delta_{tii'} = 1 - H_{t+1,i'}^0/H_{ti}^1$ for each i and i'. The other steps are identical. Note that parameters $\delta_{tii'}$ are taken into account when determining the levels of various parameters that are consistent with optimal decision making in periods where they are relevant.

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[9]For more information, see Manning et al (1987).

Value of Statistical Life

Following Hall and Jones (2007), the parameter ϕ is chosen to match an estimate of the value of a statistical life. In particular, I will choose ϕ so that 34-44 year olds value their lives at 9.9 million dollars,[10] based on the estimate from Aldy and Viscusi (2008).[11] The value of a statistical life is the dollar value of an individual's expected utility stream. Following Kniesner, Viscusi, and Ziliak (2006), the value of a statistical life for individuals of age t with health status i, which I will call VSL_{ti}, is calculated as follows:

$$VSL_{ti} = \frac{\beta \pi_{ti1} V_{t+1,1}(H_{t+1,2}) + \beta \pi_{ti2} V_{t+1,2}(H^0_{t+1,2})}{u'(c_{ti})}$$

Recall that the value of a statistical life is the dollar value of an individual's expected future utility stream. The value function, evaluated at the realized values of health capital, is the individual's expected utility stream. To calculate the dollar value of the expected utility stream, it is divided by $u'(c_{ti})$, the marginal utility of wealth.[12] To calculate this value for 35-44 year olds, I calculate the average value across 35-44 year olds in the model.

Model parameters for 85-99 year olds

One complication in this procedure is that MEPS data does not include observations for these age groups. It is important to include these groups because the decisions of individuals younger than 85, for which data is available, depend on the value of living to these ages. Because of this, I assume that $\delta_{12,i,i'}$, and $\delta_{13,i,i'}$ are equal to $\delta_{11,i,i'}$ for each i, i', ie that the health capital depreciation rate is constant after ages 80-84 for all health statuses. Second, I assume that all individuals aged 85-99 have the same health status, for simplicity health status $i = 1$. Given these assumptions, it is straightforward to calculate $H^0_{12,1}$, $H^0_{13,1}$, and $H^0_{14,1}$ using observations of survival rates. To do so, I first guess $\delta_{11,1,1}$, which determines the health capital depreciation rate for the older groups. Then, I choose parameters $A_{12,1}, A_{13,1}$, and $A_{14,1}$ so that model predictions for survival rates are consistent with the data for these age groups. Then, I infer model parameters for individuals under 85. Then, I update the

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[10]There is considerable variation in estimates of the value of a statistical life. For a survey, see Viscussi and Aldy (2003). I will discuss the sensitivity of results to the choice of the value of a statistical life in Section 5.

[11]Their estimate corresponds to the value of life for individuals in this age group in 2000, which is roughly the midpoint of my sample.

[12]Recall that the non-medical consumption good is defined in units of year 2000 dollars.

guess of $\delta_{11,1,1}$, and repeat this procedure until convergence.

Results of Calibration

The parameter values derived using the calibration procedure are presented here. Recall that the parameters which are calibrated are health capital depreciation rates $\delta_{tii'}$, health capital stock levels H_{ti}^j, medical quality A_{ti}, γ, and ϕ. Recall also that these model parameters are calibrated so that the model matches all targeted moments, including data on medical expenditures and survival rates, exactly. As a result, the goodness of fit for the model will not be demonstrated.

Health capital at the beginning of each period in plotted in Figure 5 with a log base two scale. As shown in the figure, health capital at the beginning of each period declines as individuals age. The gap between the beginning of period health stock of the healthy persists over the life cycle, as expected, but shrinks slightly as individuals age.

Figure 5: Beginning of Period Health Capital by Age, Health Status
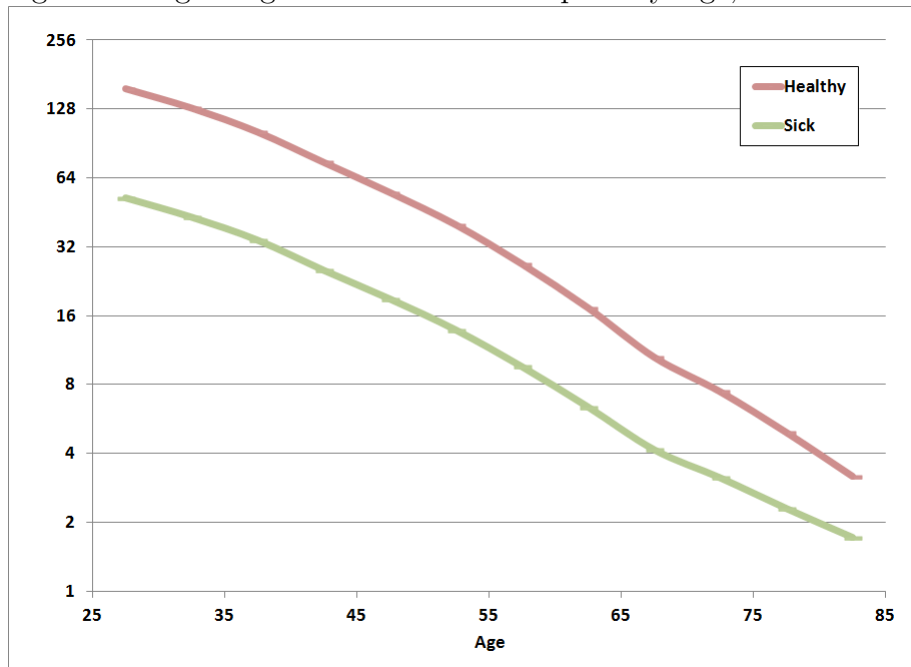
The life-cycle profile of health depreciation rates by health status in the current period and in the next period is plotted in Figure 6. As expected, depreciation rates are lower for individuals which are healthy in the next period rather than sick. One important thing to

notice is that individuals which transition from sick to healthy generally have a negative health capital depreciation rate. One potential reason for this is that, while the average level of medical quality for each age group is estimated here, individuals which transition from sick to healthy may have received medical treatment which was of higher quality than average, either because of uncertainty in the quality of treatment across individuals with the same condition or because they have a condition for which treatment is generally better.

Figure 6: Health Capital Depreciation Rates by Age, Health Status in Current/Next Period
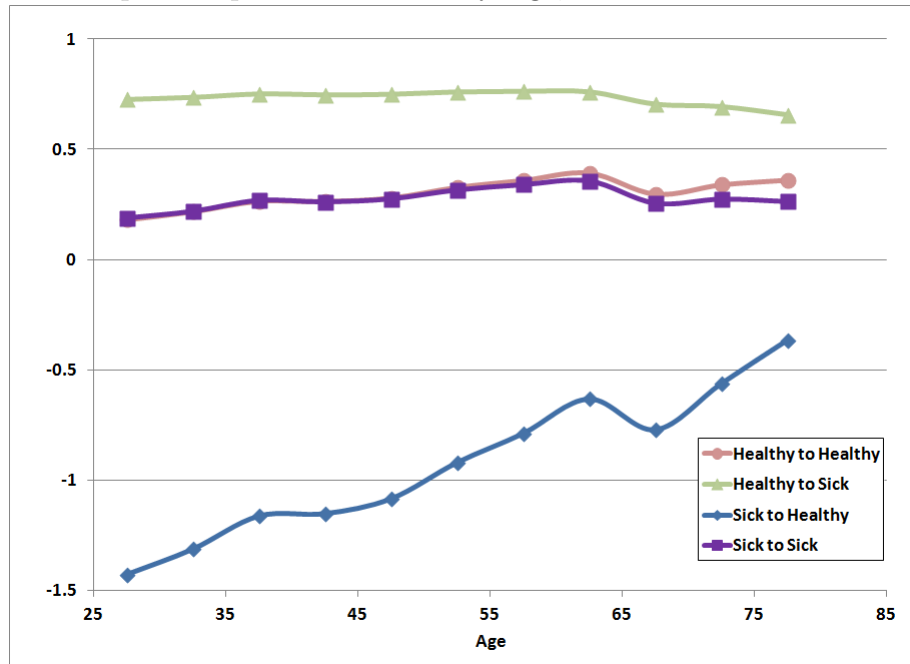
The life cycle profile of the quality of medical purchases, normalized so that medical quality equals one for healthy individuals aged 25-29, is plotted in Figure 7 with a log base ten scale. The most striking feature of the plot is the wide variation in the quality of medical purchases between healthy and sick individuals. This pattern very likely reflects variation in the set of conditions faced by individuals of different health status. An individual receiving treatment for a heart attack likely gets much more medical consumption per unit of medical purchases than an individual visiting the doctor for a check-up.

Figure 7: Medical Quality A_{ti} ($A_{0,1}$=1)
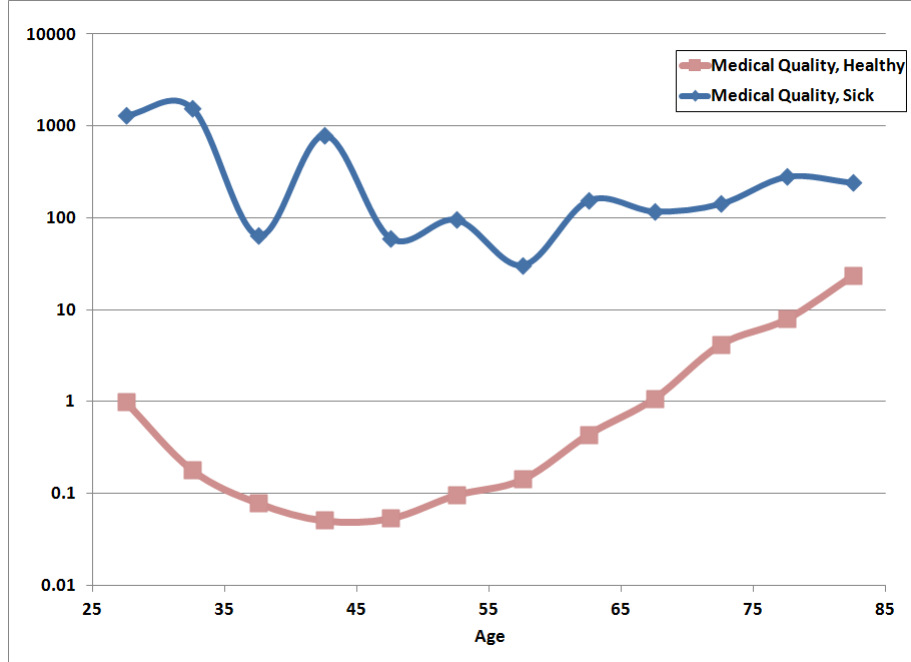
5   Policy Evaluation

In this section, I use the calibrated model to evaluate simple policy changes which reduce the co-payment rate for medical goods and services for sick individuals, by between zero and five percentage points, and finance the co-payment rate change using an age-specific[13] lump-sum transfer on healthy and sick individuals. Recall that out-of-pocket expenses given medical purchases x_{ti} is equal to $\theta_{ti}px_{ti} + P_{ti}$. When the co-payment rate for sick individuals is changed by Δ, I reduce both the average and marginal co-payment rate. This mean that θ_{t2} is reduced by Δ, and P_{ti} is chosen so the average co-payment rate in the model is reduced by Δ. Finally, age-specific lump-sum transfer Ω_t is chosen to be equal to the sum of the difference in medical expenses not paid out-of-pocket by age.

These policy changes are evaluated using ex-ante consumption-equivalent welfare change, in the spirit of Lucas (1987). By ex-ante, I mean before the realization of initial health status. The results of this policy evaluation are plotted in Figure 8 for reductions in the average and marginal co-payment rate between zero and five percentage points. As is readily apparent

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[13]An age-specific lump-sum transfer is used to avoid redistibution across age groups, specifically from young individuals with relatively low medical expenditures to old individuals with relatively high medical expenditures.

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in the figure, reductions in the co-payment rate lead to sizable reductions in welfare, despite the fact that there are no distortions associated with the finance of the policy change.

Figure 8: Ex-Ante Consumption-Equivalent Welfare Loss by Change in Co-Payment Rate
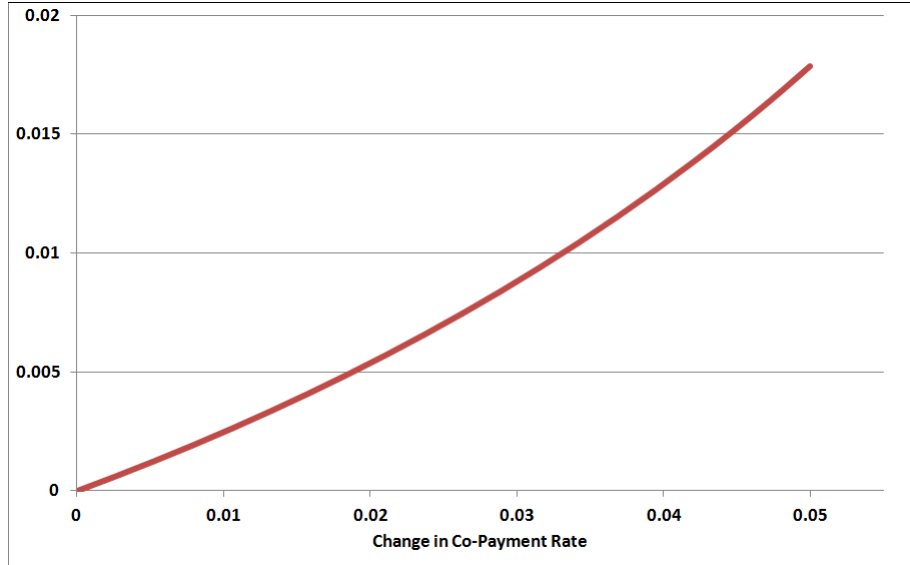

Consider instead a setting in which health shocks are shocks to the level of medical expenditures rather than to primitive which affect medical expenditures. In this setting, medical expenditures are exogenous. The effects of the policy changes studied here on allocations and welfare in this setting is very simple to determine. These policies reduce the variation in consumption across individuals of different health status without distorting any decisions. As a result, these policies increase ex-ante consumption-equivalent welfare. To illustrate this, I perform the same policy experiments using a model with exogenous medical expenditure shocks, and compare welfare results across the two economies. These results are plotted along with the main welfare results in Figure 9.

The results here stand in stark contrast to the results in an environment with medical expenditure shocks. The reason for this is that reduction in the co-payment rate distorts the medical decision, and leads to increases in medical expenditures at the expense of non-medical consumption. As shown in Figure 10, reducing the co-payment rate leads to a substantial increase in medical expenditures. There are two important reasons for this. First, individuals in the US place a high value on their lives. As mentioned previously, Aldy and Viscusi (2008) estimate that individuals aged 35-44 valued their lives at 9.9 million dollars in 2000. A back of the envelope calculation based on this estimate suggests that these individuals are willing

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Figure 9: Ex-Ante Consumption-Equivalent Welfare Loss by Change in Co-Payment Rate
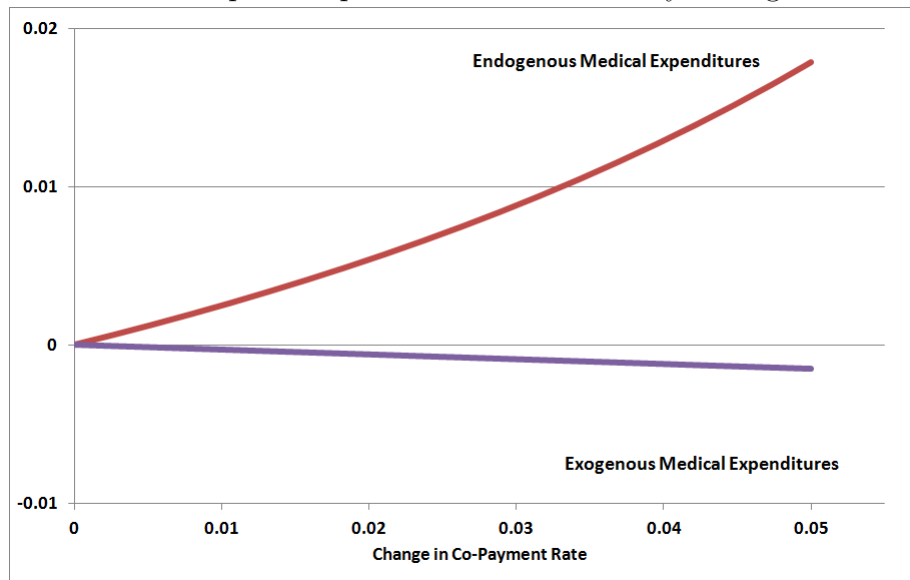

to pay \$99,000 for a one percentage point reduction in mortality. As a result, changes in the marginal cost of medical care can have a large impact on medical expenditures. Second, co-payment rates are already quite low in the US. As shown in Figure 1, a five percentage point reduction in the marginal co-payment rate leads approximately to a thirty-three percent reduction in the marginal co-payment rate on average across age groups.

One implication of these results is that it is very important to carefully model the health shocks which generate variation in medical expenditures. Choices regarding the nature of health shocks, in particular assuming that medical expenditures are exogenous, can have enormous effects on results. The assumption that policy does not affect medical expenditures, as mentioned previously, lies in contrast to existing evidence summarized in Newhouse (1992). While models with exogenous medical expenditures may be appropriate to study various questions of economic interest, the results here suggest that a model with endogenous medical expenditures and primitive health shocks is needed to understand the implications of health policy.

Sensitivity

In this section, I perform sensitivity analysis to see if the effect of policy on welfare depends critically on various parameter values and calibration targets. In particular, I determine

Figure 10: Percent Increase in Avg. Medical Expenditures by Change in Co-Payment Rate
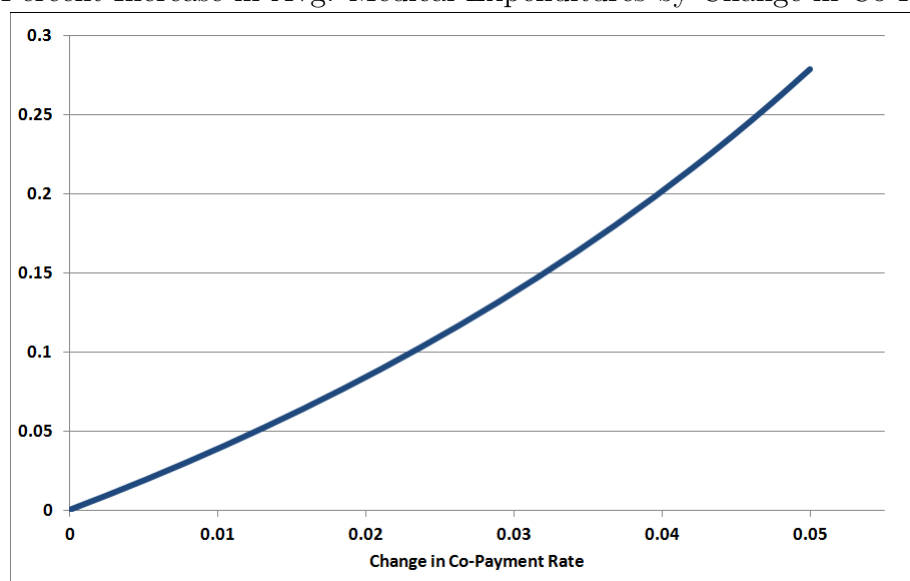
the extent to which the welfare effect of a five percentage point reduction in co-payment rates for unhealthy individuals depends on the targeted value of statistical life for 35-44 year olds, on the targeted value of the price elasticity of medical expenditures, and on the intertemporal elasticity of substitution. Quantitative results do not vary substantially in all three cases. For variation in the targeted value of a statistical life between three and twelve million dollars, the welfare loss associated with the policy change varies between 1.77 percent and 1.79 percent, respectively. For variation in the targeted price elasticity of medical expenditures between -0.1 and -0.3, the welfare loss varies between 1.67 percent and 1.90 percent, respectively. Finally, for variation in γ between 1 and 2, the welfare loss varies between 1.78 percent and 1.44 percent, respectively. In all three cases, the welfare affect of policy does not vary significantly, and is starkly different from the welfare loss in a setting with exogenous medical expenditures.

6   Conclusion

This paper studies the accumulation and depreciation of health capital over the life cycle in a model with primitive health shocks in order to better understand the aggregate effects of medical policy. To illustrate the utility of this framework, I consider a very simple policy changes which reduce the co-payment rate for medical goods and services for sick individuals,

and finances this co-payment rate reduction with a lump-sum transfer from all households. In a model in which health shocks are medical expenditure shocks, these policies would decrease the variation in non-medical consumption across individuals of different health status without distorting decisions, and would lead to increases in welfare. This need not be the case in a model with primitive health shocks which affect the medical decision. The results of this paper suggest that the opposite is true. Even without distortions associated with financing the policy change, distortions induced by the reduction in the co-payment rate for medical goods and services leads to a welfare decrease rather than increase. Since medical expenditures are affected by policy, the tools that economists use to evaluate health policy should reflect this fact, and feature primitive health shocks rather than shocks to medical expenditures.

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