Possibility of Cost Offset in Expanding Health Insurance Coverage: Using Medical Expenditure Panel Survey 2008

Thesis Advisors: Professors Frank A. Sloan and Michelle P. Connolly

Catherine S. Moon

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ABSTRACT

The Patient Protection and Affordable Care Act aims to substantially reduce the number of the uninsured over time and asserts that the financial burden of extending insurance coverage to the previously uninsured will be offset by the benefit of the attendant improvement in their health. Motivated by this policy, I explore whether health-insurance status and type affect one's likelihood of improving or maintaining health using the Medical Expenditure Panel Survey data. I build a set of ordered regression models for health-status transitions under the first-order Markov assumption and estimate it using maximum likelihood estimation. I perform a series of likelihood ratio tests for pooling to determine whether the latent propensity index is the same between adjacent initial health-status groups.

Empirical results imply that expanding health care to the unwillingly uninsured due to severe economic constraints and extending the scope of public insurance to that of private insurance will lead to improvement or maintenance of health for the relatively healthy population, implying the possibility of cost off-set in the expansion of coverage and the extension of scope.

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Table of Contents

I. Introduction

In comparison to the health care systems of Canada, Britain, and Japan, the U.S. system has been criticized for leaving a sizable number of its people (about 15% of the adults under age 65) uninsured. After much political struggle, the Patient Protection and Affordable Care Act (PPACA, Public Law 111–148, March 23, 2010) was signed by President Obama on March 23, 2010, and its main goal is to reduce the uninsured substantially over time. By 2014 all U.S. citizens and legal residents must purchase minimum insurance coverage or face tax penalties. Insurers will face new rules and regulations in offering and designing insurance such as insurance exchanges, while large employers are required to provide insurance to their workers.

Expansion of health insurance coverage requires financing costs, which cover the subsidies to be provided through insurance exchanges, increased outlays for Medicaid and the Children's Health Insurance Program, and tax credits for certain small employers. Some of these costs are borne by net savings from coverage expansion such as changes in Medicare and reduction in government's payment to the care of the previously uninsured. The PPACA also specifies new revenue sources such as the excise tax to high-premium insurance plans and tax penalties from people failing to purchase minimum insurance coverage (CBO, 2011).

The PPACA stipulates that the additional financial burden in the expansion of insurance coverage to the uninsured will be matched or offset by the additional benefit arising from change (improvement) in the health of the previously uninsured. In the literature on the efficacy of the medical treatment, it is often said that additional health care (in the form of primary or preventive care) to the uninsured or the poor, who are constrained in the access and consumption of health care, generates more benefit than harm while additional heath care to other groups generates both benefit and harm (arising from excessive use of medicine) to a comparable level, more or less cancelling each other. If we accept this view, then we expect cost-offset in expanding insurance coverage to the uninsured or the poor. The expansion of insurance to these people will open access to health care and allow them to consume health care service to the point closer to the optimal level, thus improving their health.

However, whether this cost-offset exists is an empirical issue. On the cost side, it is relatively easy to estimate the additional monetary amount for the expansion. However, on the benefit side, it is hard to come up with the additional benefit accrued from the expansion in monetary terms. Valuing health or its change is a difficult task. In economics, for example, we may use compensating wage differentials and differences of insurance premiums across jobs in risk exposure to death or accident to value human life.[1] Yet, in other fields, valuation of human life or health is not considered legitimate since human life is priceless.

In charting the research plan of this thesis, I note that it is neither possible to quantify the change in the state of health nor value the change in the state of health. Hence, rather than examining cost-offset comparing the marginal cost and benefit from the expansion of insurance coverage to the uninsured, I focus on the possibility of this cost-offset: whether the expansion of health insurance to the uninsured or the poor raises their chances of improved health. If the possibility of cost-offset is negated, then cost-offset is not possible at all. If the possibility of cost-offset is validated, still it is short of proving cost-offset. That is, in the latter case it is still possible that the marginal benefit of expanding insurance coverage is positive but may be outweighed by the marginal cost.

I examine the possibility of cost-offset at the individual level using Medical Expenditure Panel Survey (MEPS) 2008. The MEPS is a set of large-scale surveys of families and individuals, their medical providers, and employers across the U.S. Most components of the survey of families and individuals are mostly public. However, other components are confidential.

The thesis is organized as follows: Chapter II includes a brief review of a selected literature of direct relevance to my thesis, Chapter III discusses the economic framework, Chapter IV discusses data and their sources, Chapter V presents the econometric framework of analysis, and Chapter VI presents preliminary quantitative results. Chapter VII concludes with a summary and a few words on policy implications.

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[1] See Sloan, ed. (1995), Brent (2003), Edejer et al. (2003), Miller, Robinson, and Lawrence, eds. (2006), and Muennig (2008).

II. Literature Review: Economics of Health Insurance, Health Care Demand, and Efficacy of Health Care Consumption

Health Insurance, Access to Health Care and Health Outcomes

Health insurance, financial resources, geographic location, language and culture, and transportation are all integral to health care access. However, the Institute of Medicine (2004, 2009) documents persuasive evidence that it is the absence of health insurance that leads most to deleterious health outcomes by limiting access to potentially beneficial health care services.

Fuchs (1991) notes that poverty is not the only reason why people are uninsured. Even though the poor is the largest group of uninsured people, many of them are insured under public programs such as Medicaid and Medicare. He divides the insured into six categories: the poor, the sick and disable (who have preexisting health problems), the difficult (who may be self-employed or out of labor force), low users (for whom health insurance is not worth the premium), gamblers (who are risk-lovers or chance-takers), and free-riders. According to Greenwald (2010, p. 198), surprisingly nearly 80 percent of people belonging to the first category hold jobs or are members of families in which there is one or more job holder. They however hold jobs in firms that do not offer insurance and may not have enough money to pay for insurance even when it is offered on the job. Hence, in my empirical modeling, I distinguish the unwillingly uninsured due to severe economic constraints and the willingly uninsured due to other reasons.

Medicaid as a Major Public Insurance Program

Medicaid is the largest public insurance program applicable to the working-age population, the target group of my study. Since the Federal government mandates only the minimum requirements for matching federal funds, Medicaid programs vary widely across states in terms of eligibility requirements, medical services covered, cost-sharing policies, and payments to providers. Although Medicaid fees to health care providers are generally lower than comparable private and Medicare rates, their variation across states creates both access and quality-of-care problems for persons covered by Medicaid. Zuckerman et al. (2004) report that in 2003 the average ratio of Medicaid fee to Medicare fee was 0.69 and the state-level variation in Medicaid fees ranged from 0.56 to 2.28 of the national weighted average Medicaid fee.

Health Status as a Global Indicator and Its Determinants

Transition in health status between the first and last rounds of the survey year is the key variable in my analysis. Transition in health status for each individual is constructed using "perceived health status" or self-assessed health status from MEPS. Pol and Thomas (2001) summarize shortcomings and usefulness of self-reported health status as a measure of health status.

Mortality, morbidity, life-expectancy, self-assessed health status, work-lost days, school-missing days, bed-restricted days, and level of limitations are typical indicators of health status reflecting deaths, chronic conditions, healthy life years, perceived health, medical outcomes and functional limitations, respectively. The first three indicators are relevant for a population or community, while the remaining indicators are applicable to the individual level. Among these latter indicators, self-assed health status is a global measure while work-lost days, school-missing days, bed-restricted days, and level of limitations reflect specific, limited aspects of multi-dimensional health state or outcome. Hence, Pol and Thomas (2001, p. 283) state: "*The most direct, and probably the most subjective, approach to measuring health status involves self-assessments by survey respondents. These are referred to as "global indicators" because they address overall health status.*"

Self-assessed health status clearly has shortcomings as Pol and Thomas (2001, p. 283) also note: "*While self-reported ratings of health status are attractive in their simplicity, critics contend that they are too subjective.*"

Empirical evaluation on validity and consistency of self-assessed heath status is mixed.[2] Assessing both sides of the literature, Pol and Thomas (2001) conclude that a reasonable correlation has been found between self-assessed ratings of health status and more objectively derived indicators of health status. McGee *et al.* (1999) show that self-reported health status is a strong prognostic indicator of subsequent mortality. While Larsen *et al.* (1998) raises concern about comparison of self-assessed health status across respondents with widely different background (especially ethnicity), it is not a major issue in my study, as I examine transition in health status across individuals rather than health status itself and include diverse control

[2] Refer to Larsen *et al.* (1998) on the negative side and Proctor *et al.* (1998), McGee *et al.* (1999), and Rogers *et al.* (2000) on the positive side of self-assessed heath status.

variables such as ethnicity.

From the perspective of health demography or health epidemiology, Pol and Thomas (2001, pp. 288-317) subsequently focus on demographic variables affecting health status. Specifically, they discuss biosocial variables such as age, sex and racial classification, socio-cultural variables such as marital status, socioeconomic status (in relation to income, education, occupation, and employment status) and religion. Here, I additionally consider institutional and policy variables such as insurance status and types of insurance when insured.

Citing relevant literature, Santeree and Neun (2010, pp. 50-53) put forward the following as the determinants of health among nonelderly adults: access to and consumption of medical care, education, income, lifestyle, environment, age and marital status. The determinants of health among children and among the elderly are somewhat different but these groups of people are excluded in my study.

Efficacy of Health Care Consumption

Gawande (2009) provides a descriptive evaluation of the workings of health care practice in two comparable towns, McAllen and El Paso, in Texas by diagnosing their wide cost differences while excluding Medicare costs. He concludes that over-use of medicine (quantity over quality) and fragmented care are prevalent and drive cost upward, implying that a substantial portion of U.S. health care expenditures are spent ineffectively.

Newhouse *et al.* (1993) find that households in low coinsurance plans consume more medical services but their level of health is virtually the same as those in high coinsurance plans. At least for the insured, consuming more health care services does not always lead to better health outcomes and it may sometimes be harmful, as shown by Fisher *et al.* (2002), Wennberg and Wennberg (2003), Fuchs (2004) and Wennberg and Fisher (2006). That is, low out-of-pocket price of medical service leads to high consumption, which does not necessarily lead to health improvement.

III. Economic Framework

To explore the possibility of cost-offset in expanding insurance coverage, I focus on change in self-assessed health statuses between the first and third rounds of MEPS 2008. As noted in Section II, self-assessed health status is drawn from subjective judgment but yet is a global indicator of multi-faceted health and is highly correlated with diverse health outcomes.

Utility theory can be employed to explain why health is desired for consumption and investment purposes. Likewise, production theory can be used to explain production of health, which is produced by medical inputs and other factors.

Santeree and Neun (2010, pp. 42-43) present a generalized short-run health production function for an individual as the following:

health = H(medical care, technology, profile, lifestyle, socioeconomic status, environment)

where health is the level of health at a point in time, and hence a stock variable; medical care is the quantity of medical care consumed; technology is the state of medical technology at a given point in time; profile refers to the individual's mental and physical profile at a point in time; lifestyle refers to a set of lifestyle variables such as diet and exercise; socioeconomic status reflects social and economic factors, such as education, income and poverty; and environment refers to various environmental factors, including air and water quality.

However, it is appropriate to re-interpret the above function as the function explaining 'change in health state' since the variables appearing as arguments on the right-hand side of the function are either flow variables or state variables. Hence, the above function is the starting point of my empirical model.

Medical inputs (in quantity and quality) are hard to both measure and obtain for empirical purposes. Thus, I use determinants of demand for medical services instead. With this approach, I can include institutional variables such as insurance status and types of insurance, among many others. Since my analysis is cross-sectional, for medical technology I need to account cross-sectional variation, which hopefully is captured by geographic regions and urban/rural classification. Variables for profile, lifestyle, socioeconomic status, and environment are drawn from health demography and economics literature that will be detailed in Sections IV and V.

IV. Data: MEPS 2008

Overview of MEPS and MEPS 2008

Medical Expenditure Panel Survey (MEPS), compiled by Agency for Healthcare Research and Quality (AHRQ), began in 1996 and includes large-scale annual surveys of families and individuals, their medical providers, and employees across the U.S. It consists of three major components: the Household Component (MEPS-HC), the Insurance Component (MEPS-IC), and the Medical Provider Component (MEPS-MPC). MEPS-HC is drawn from a nationally representative subsample of households that participated in the prior year's National Health Interview Survey and is mostly public. MEPS-IC, also known as the Health Insurance Cost Study, collects data from a sample of private and public sector employers on the health insurance plans they offer to their employees, and is confidential. MEPS-MPC covers hospitals, physicians, home health care providers, and pharmacies identified by MEPS-HC respondents, and is confidential except the ones supplementing MEPS-HC.

MEPS-HC covers extensive survey items in the areas of identification, demographics, health status and attitude, access to care, employment, income, insurance, health care utilization, total charges, total expenditures, and expenditures by source of payment, and sampling weights.[3]

The most recent survey year for which MEPS-HC is available is 2008, which covers 33,066 persons and 16,416 health insurance eligibility units (HIEUs). I base my econometric analysis on MEPS 2008.

Data Pruning Process and Data Construction

The variable of my primary focus is health transition at the individual level. Thus, I accordingly refine the MEPS 2008 data further by sequentially applying three sample eligibility criteria.

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[3] Partial list of important survey items that MEPS-HC covers, in the areas mentioned above, is included in Appendix I.

The first criterion is an age restriction: I kept the individuals whose age falls between 18 and 64 as of the last round of the survey year, 2008. The elderly aged 65 or above are all covered by Medicare, while the children aged 17 and below are mostly non-working with insurance provided through parents or State Children's Health Insurance Program (SCHIP). As presented in Table 1, 19,831 individuals survive this criterion out of the 33,066 individuals in MEPS 2008.

The second criterion is whether valid responses to health status questions at both the first and last rounds were provided. Health statuses at both the first and last rounds are required to define health transition and the initial health status variables. This process reduces the remaining sample from 19,831 to 19,159.

The last criterion excludes individuals who failed to provide valid answers to any questions related to the set of explanatory variables for my regression equations, which will be explained later. This last process further reduces the sample from 19,159 to 18,814. In sum, my final data set consists of 18,814 working age individuals with complete information on key variables.

Table 1 **Sequential Data Pruning Process**		
pruning process	# of individuals passing the current process	# of individuals passing the current and prior processes
initial sample (MEPS 2008)	33,066	
aged between 18 and 64 at the last round of 2008	19,831	19,831
provided valid responses to health status questions at the first and last rounds	31,352	19,159
provided valid answers to all questions related to the set of explanatory variables	28,686	18,814

Table 2
Cross-tabulation of Health Statuses at the First and Third Rounds of the Survey Year, 2008

unit of analysis: individual (sample restricted to individuals aged between 18 and 64 and provided valid answers to all relevant questions)

health status=1 for excellent; =2 for very good; =3 for good; =4 for fair; and =5 for poor

for each cell, frequency, percent, and row percent are listed from top to bottom

		Health Status at the Third Round (h_t)					
		1 (y=4)	2 (y=3)	3 (y=2)	4 (y=1)	5 (y=0)	row total
Health Status at the First Round (h_{t-1})	1	3,063 16.28% 57.88%	1,411 7.50% 26.66%	691 3.67% 13.06%	112 0.60% 2.12%	15 0.08% 0.28%	5,292 28.13%
	2	1,214 6.45% 20.45%	2,913 15.48% 49.07%	1,528 8.12% 25.74%	246 1.31% 4.14%	35 0.19% 0.59%	5,936 31.55%
	3	528 2.81% 10.45%	1,389 7.38% 27.50%	2,460 13.08% 48.70%	603 3.21% 11.94%	71 0.38% 1.41%	5,051 26.85%
	4	101 0.54% 5.27%	231 1.23% 12.04%	667 3.55% 34.78%	773 4.11% 40.30%	146 0.78% 7.61%	1,918 10.19%
	5	7 0.04% 1.13%	38 0.20% 6.16%	96 0.51% 15.56%	203 1.08% 32.90%	273 1.45% 44.25%	617 3.28%
	column total	4,913 26.11%	5,982 31.80%	5,442 28.93%	1,937 10.30%	540 2.87%	18,814 100.00%

Preliminary Examination of Focus Variable and Key Variables

The variable of my primary focus is health transition at the individual level. Table 2 presents the frequency and shares in the final sample and in the relevant initial health status group of each health transition type. Health status at the first round, h_{t-1}, is noted in the first and second columns while health status at the last round, h_t, is noted in the first and second rows of the main part of the table. Health status is an ordered categorical variable, whose values are denoted by 1 for excellent, 2 for very good, 3 for good, 4 for fair and 5 for poor.

The row total cells in the last column indicate that the sample shares of the five initial health status groups are 28.13, 31.55, 26.85, 10.19, and 3.28%, respectively. The lowest two initial health status categories constitute about 13% of the sample. Each cell pertains to one type of health transition. For example, the cell positioned at the cross of the third row and the first column of the main cell section shows that there are 528 individuals experiencing transition from "3 = good" to "1 = excellent", signifying a two-category improvement in health status between the first and last round of the survey year. The 518 individuals constitute 2.81% of the total sample and 10.45% of the sample reporting the "3 = good" health status at the first round. Note also that the row totals of the initial health statuses are grossly similar to the column totals of the health statuses at the last round. That is, the empirical distribution of h_{t-1} is similar to that of h_t, assuring the stability of health status categorization between the two survey rounds.

The diagonal cells (marked red) correspond to no change in health status and take 40-58% of corresponding row totals. Then, transition to the adjacent categories takes the next largest shares. Still there are individuals experiencing the most distant transition possible for each row.

Key variables other than health transition and initial health status are explanatory variables entering the regression equation specifying the propensity of improving health for each initial health status. Below, I provide a list of variables chosen for the analysis. The variables are selected based on existing theoretical and empirical literature (in health demography and demand for and efficacy of health care) and my search for the best model that is described later in the results section. The list and definition of key variables are as follows:

(1) per adult equivalent income

(2) interaction terms of no insurance and in-poverty status, and interaction terms of insurance

status and type

- uninsured and in poverty[4] [uninsured due to severe economic constraints]
- uninsured but not in poverty [uninsured but not solely due to severe economic constraints]
- part-year insured by public insurance only[5]
- part-year insured by private insurance for any month
- full-year insured by public insurance only
- full-year insured by private insurance for any month [reference dummy]

(3) dummy for residing in an MSA, i.e., not a rural area (reference dummy: non-MSA)

(4) 3 region dummies for Midwest, South, and West (reference dummy: Northeast)

(5) dummy for female (reference dummy: male)

(6) 3 race dummies for black, Asian, and other races (reference dummy: white)

(7) age

(8) years of schooling

(9) dummy for any limitation (having ADL, IADL, activity, functional, or sensory limitations) (reference dummy: no limitation)[6]

(10) dummy for "not employed" for all three rounds

(11) dummy for "married" at the first round

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[4] "In poverty" means "below Federal Poverty Level", which differs across family size.

[5] Public insurance includes Medicare, Medicaid, SCHIP (State Children's Health Insurance Program), and other public hospital/physician coverage, but it does not include state-specific programs that did not provide comprehensive coverage, for example, the Maryland Kidney Disease Program. Private insurance includes employer/union group insurance, non-group insurance, other group insurance, and TRICARE plans (Standard, Prime, Extra, For Life, or CHAMPVA). TRICARE plans may be classified into public insurance, but for the purposes of defining the public insurance only survey item, MEPS moves TRICARE plans to private insurance.

[6] ADL (activities of daily living), IADL (instrumental activities of daily living), functional, and sensory limitations are the terms used in medical surveys with specific medical criteria for classification.

Table 3

Summary Statistics of Key Variables by Initial Health Status

unit of analysis: individual

health status=1 for excellent; =2 for very good; =3 for good; =4 for fair; and =5 for poor

for each cell, sample mean, standard error of the sample mean, and sample standard deviation are listed from top to bottom

each colored cell denotes failure to reject the equality of group sample means between the left group and the group pertaining to the colored cell

	Health Status at the First Round (h_{t-1})				
	1	2	3	4	5
# of individuals	5,292	5,936	5,051	1,918	617
per-capita total health care expenditure in $ from all sources	1,629.2	2,355.0	3,056.7	5,964.4	13,229.9
	66.4	74.0	109.1	314.6	881.2
	4,832.9	5,704.5	7,755.7	13,776.6	21,887.6
Age	35.6	38.9	40.5	44.6	47.1
	0.2	0.2	0.2	0.3	0.5
	13.1	12.9	12.8	12.5	11.5
below Federal Poverty Level	0.116	0.141	0.190	0.261	0.374
	0.004	0.005	0.006	0.010	0.019
	0.320	0.348	0.392	0.439	0.484
per-adult equivalent income in $	42,845.5	39,145.2	33,017.2	26,042.3	19,643.8
	487.2	416.5	415.9	543.4	756.7
	35,443.6	32,091.7	29,556.3	23,796.7	18,795.8
# of months under insurance of any type	8.8	8.7	8.2	8.1	8.9
	0.1	0.1	0.1	0.1	0.2
	4.9	5.0	5.2	5.3	4.9
uninsured for the full year	0.204	0.218	0.256	0.262	0.193
	0.006	0.005	0.006	0.010	0.016

	0.403	0.413	0.437	0.440	0.395
public insurance coverage only among the insured for any month of the year	0.112	0.130	0.198	0.357	0.578
	0.005	0.005	0.006	0.013	0.022
	0.315	0.337	0.398	0.479	0.494
average years of schooling	13.2	13.1	12.2	11.5	11.1
	0.039	0.035	0.044	0.075	0.132
	2.8	2.7	3.2	3.3	3.3
any (activity/functional/sensory) limitation	0.072	0.122	0.215	0.463	0.788
	0.004	0.004	0.006	0.011	0.016
	0.259	0.327	0.411	0.499	0.409
not employed for the full year	0.154	0.153	0.200	0.367	0.671
	0.005	0.005	0.006	0.011	0.019
	0.361	0.360	0.400	0.482	0.470
Married	0.501	0.537	0.537	0.498	0.467
	0.007	0.006	0.007	0.011	0.020
	0.500	0.499	0.499	0.500	0.499
residing in an MSA	0.879	0.873	0.858	0.848	0.784
	0.004	0.004	0.005	0.008	0.017
	0.326	0.333	0.349	0.359	0.412
Female	0.485	0.546	0.552	0.570	0.580
	0.007	0.006	0.007	0.011	0.020
	0.500	0.498	0.497	0.495	0.494

Group sample means, standard errors of the sample means, and sample standard deviations of key variables by initial health status group are presented in Table 3. Note that in addition to the variables listed above, I also include in the table per-capital total health care expenditures from all sources of funds (out of pocket or self, private insurance, public insurance, and other public sources). The standard error for each group sample mean is to assess the significance of the individual group sample mean. To evaluate variation of group sample means across initial health groups statistically, I also conducted the t-test for equality of group sample means between each pair of two adjacent ordinal categories.[7] Then, non-rejection cases are marked so that each colored cell denotes failure to reject the equality of group sample means between the group immediately left to the cell and the group pertaining to that colored cell.

Full discussion on Table 3 appears in Appendix II. While group sample means of all 13 variables look different across initial health status groups, those of the 6 variables are found to be not always significantly different across initial health status groups. Focusing on the insurance-related variables, we note that the group sample means of 'the number of month under insurance of any type' and 'uninsured for the full year' are not always significantly different between adjacent initial health status groups while those of 'public insurance coverage only among the insured for any month of the year' are significantly different between all adjacent initial health status groups.

Overall and without controlling for coexistence of and correlation among explanatory variables, the healthier groups consist of younger, wealthier, more educated, and less limited individuals. The proportions of the insured are similar across initial health statuses but the proportions of 'public insurance only' conditional on being insured are much lower in the healthier groups. The proportions of full-year non-employment are much lower in the healthier groups.

[7] These t-tests are formal but yet provisional from the modeling perspective since they do not control other variables in drawing their individual association with health status or health transition.

V. Econometric Model for Change in Health Statuses

Construction of the Ordinal Variable from the Health Statuses at the First and Third Rounds

To model change in health status between the first round $(t-1)$ and the third round (t) of the year, I set up an ordered regression model. Model estimation is done through maximum likelihood, assuming the standard logistic distribution to the error terms of the regression equations of the latent propensity index variables.

Each individual sampled by MEPS 2008 reports the health "status" (1 = excellent, 2 = very good; 3 = good; 4 = fair; 5 = poor) at each of the three rounds of the survey year, 2008. I denote the health status at the first round and that at the third round as h_{t-1} and h_t, respectively. These can be portrayed as revelations of the underlying latent health "states", denoted by h^*_{t-1} and h^*_t. Notice, the latent health "states" that each individual base his/her estimation of reported health "status" are continuous on the whole real line, and measure health state from the excellent to the poor. Conceptually, the whole real line of h^*_t is partitioned (disjointly and exhaustively) into 5 "ordered" intervals and each interval is associated with each status by matching the order of h_t and the order of the portioned intervals of h^*_t.

To model change in health statuses, I introduce a latent propensity index denoted $y^*_{i,t}$. This index indicates the individual's propensity to change health scaled into a real line, with smaller values indicating deteriorating health (extending to the left end of the real line) and larger values improving health (to the right end of the real line). The latent propensity index $y^*_{i,t}$ also has an observed ordered counterpart, $y_{i,t}$, which I define as $y_{i,t} \equiv 5 - h_{i,t}$ so that the values indicating change in health will be coherent with $y^*_{i,t}$ irrespective of an individual's initial health status $h_{i,t}$. This coherency of $y_{i,t}$ across the combination of h_{t-1} and h_t can be confirmed by examining Figure 1, which illustrates change in health statuses and the corresponding value of the just-defined ordered variable. In examining the figure, note that the end values of h_t (health statuses 1 and 5) relate to the open ended intervals of h^*_t. That is, individuals reporting health status $h_{t-1} = h_t = 1$ (excellent) in both periods can be in one of the three cases: they are (1) in a just as healthy state as before, (2) in a state not as healthy as before but still within the range to report "excellent" health status in the last period, and most importantly (3) in a healthier state than before and was in a healthy enough state to report "excellent" in the first period also.[8]

Figure 1: transition in health statuses and the ordered variable for my analysis

$h_{i,t-1}$	$h_{i,t-1} \Rightarrow h_{i,t}$		$y_{i,t} \equiv 5 - h_{i,t}$
$h_{i,t-1}=1$	$1 \Rightarrow 1$	Improving health	$5-1=4$
	$1 \Rightarrow 2$		$5-2=3$
	$1 \Rightarrow 3$		$5-3=2$
	$1 \Rightarrow 4$	worsening health	$5-4=1$
	$1 \Rightarrow 5$		$5-5=0$
$h_{i,t-1}=2$	$2 \Rightarrow 1$	Improving health	$5-1=4$
	$2 \Rightarrow 2$		$5-2=3$
	$2 \Rightarrow 3$		$5-3=2$
	$2 \Rightarrow 4$	worsening health	$5-4=1$
	$2 \Rightarrow 5$		$5-5=0$
$h_{i,t-1}=3$	$3 \Rightarrow 1$	Improving health	$5-1=4$
	$3 \Rightarrow 2$		$5-2=3$
	$3 \Rightarrow 3$		$5-3=2$
	$3 \Rightarrow 4$	worsening health	$5-4=1$
	$3 \Rightarrow 5$		$5-5=0$
$h_{i,t-1}=4$	$4 \Rightarrow 1$	Improving health	$5-1=4$
	$4 \Rightarrow 2$		$5-2=3$
	$4 \Rightarrow 3$		$5-3=2$
	$4 \Rightarrow 4$	worsening health	$5-4=1$
	$4 \Rightarrow 5$		$5-5=0$
$h_{i,t-1}=5$	$5 \Rightarrow 1$	Improving health	$5-1=4$
	$5 \Rightarrow 2$		$5-2=3$
	$5 \Rightarrow 3$		$5-3=2$
	$5 \Rightarrow 4$	worsening health	$5-4=1$
	$5 \Rightarrow 5$		$5-5=0$

[8] The above formulation handles concerns for both floor and ceiling effects. The health status transition from $h_{i,t-1} = 5$ to $h_{i,t} = 5$, which results in $y_{5,i,t} = 0$, could indicate a further deterioration in true health state between periods $(t-1)$ and t. within the poor health status does not pose any problem since $\alpha_{5,0} = -\infty$ is open-ended. Similarly, The health status transition from $h_{i,t-1} = 1$ to $h_{i,t} = 1$, which results in $y_{1,i,t} = 4$, but true health state deteriorated further between $(t-1)$ and t within the excellent health status does not pose any problem since $\alpha_{1,5} = +\infty$ is open-ended.

By defining $y_{i,t}$ as $y_{i,t} \equiv 5 - h_{i,t}$, notice that the larger value of $y_{i,t}$ points to the direction of improving health state (higher value of $y^*_{i,t}$) and the smaller value of $y_{i,t}$ points to the direction of worsening health state (lower value of $y^*_{i,t}$), irrespective of the initial health status. The $y_{i,t}$ values follow the ordered regression model's convention, ranging from 0 to 4 while taking integer values.

Informal Sketch of the Econometric Model

MEPS 2008 originally provided us with data $(h_{i,t-1}, h_{i,t}, \boldsymbol{z_{i,t}})$, initial health status, third round health status, and the set of explanatory variables for each individual (i). Through the above process, defining $y_{i,t}$ to take higher value for improving health and lower value for deteriorating health, now I have data of the form $(y_{i,t} \equiv 5 - h_{i,t}, h_{i,t-1}, \boldsymbol{z_{i,t}})$.

It is important to note that the final data set we are analyzing is essentially a cross sectional data, as we make the two rounds' health status information reveal the transition in health status based on the first-order Markov assumption.

Setting up my general regression model, the latent propensity index specific to each initial health status (denoted *m*), $y^*_{m,i,t}$, becomes the left-hand side variable. A vector of explanatory variables, $\boldsymbol{z_{i,t}}$, such as insurance status and type, and socioeconomic status, comes into our right-hand side.

In each regression for different initial health status groups, we use maximum likelihood estimation method to estimate two important set of parameters: The first relates to whether each determinant positively or negatively impact one's propensity of improving health and the second is thresholds dividing the real line representing the propensity to improve health from the initial health state.

Above, I have informally specified the most general model that I use in my estimation. However, there are some unanswered modeling questions: How do I know whether the general model works the best? For instance, we have to determine whether it is better to assume adjacent initial health status groups have similar characteristics in determining or experiencing health transition and thus I can fold them into one regression with a common propensity index. I explore a set of different specifications in the formal discussion, and attempt to narrow down to the best model.

Formal Description of the Econometric Model

In specifying the regression structure for $y^*_{i,t}$, I denote the set of explanatory variables as $\boldsymbol{z_{i,t}}$, which does not include a constant term. Thus, for my analysis, I re-record data provided by MEPS 2008, originally as $(h_{i,t-1}, h_{i,t}, \boldsymbol{z_{i,t}})$, to $(y_{i,t} \equiv 5 - h_{i,t}, h_{i,t-1}, \boldsymbol{z_{i,t}})$ for $i = 1, \dots, N$, with i denoting index for each individual. It is important to note that the final dataset I am analyzing is a cross-section under this regression structure. As in a typical ordered logit model, the latent propensity index $y^*_{i,t}$, the unobserved continuous counterpart of the observed ordered variable $y_{i,t}$, becomes the focus variable in the regression.

In specifying the parameters for the regression structure, I build up a general model incorporating the first-order Markov assumption in health transition. That is, the health transition regression structure depends on the previous period's health status. Under this specification, the latent propensity index $y^*_{i,t}$ is dependent on the previous health status $h_{i,t-1}$ and hence there are separate latent propensity index variables for different values of $h_{i,t-1}$. Thus, the notation for the latent propensity index variables is expanded to make it explicit that they are dependent on the initial health status.

From here on, I use $y^*_{m,i,t}$ to denote the latent propensity index applicable to the observations whose initial health status is $h_{i,t-1} = m$ in the general model. Since $y_{m,i,t}$ and $h_{i,t-1}$ are not continuous, I allow both the sets of parameters relating to the latent propensity index variable and of thresholds partitioning the latent propensity index in the regression structure to differ across different initial health status. This enables me to incorporate the first-order Markov assumption in its fullest flexible form. The general model (the fully flexible model under the first-order Markov assumption) is specified as follows:

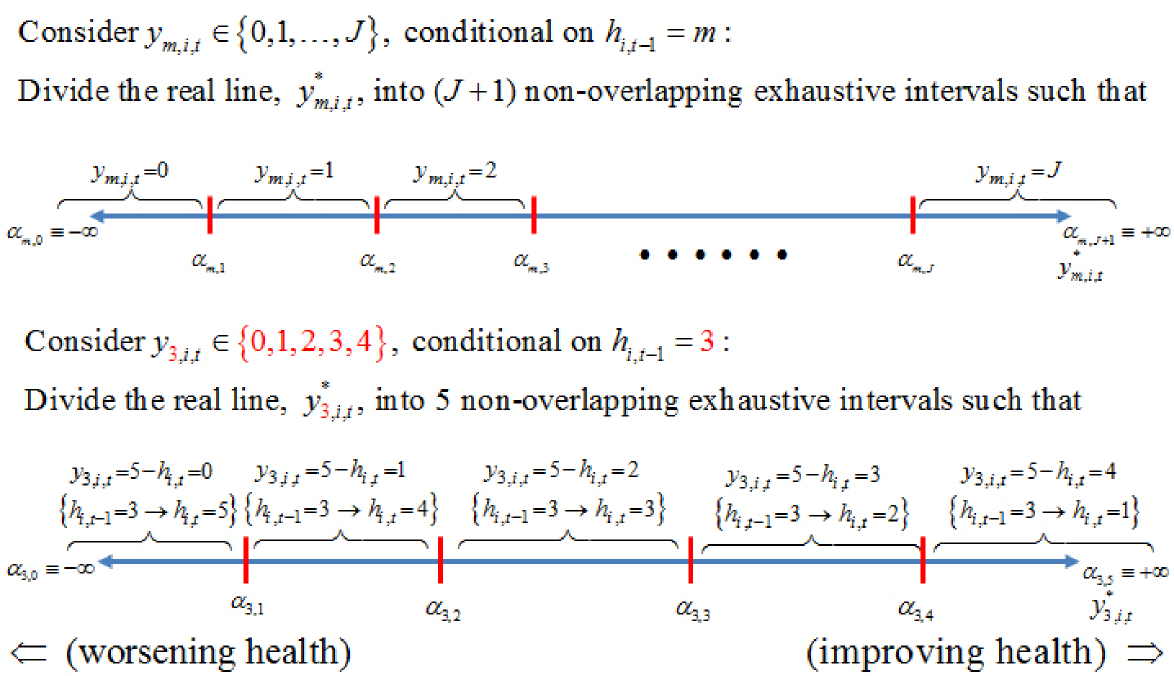
$$y^*_{m,i,t} = \boldsymbol{z'_{i,t}\beta_m} + \epsilon_{m,i} \text{ for } i \in \{i' : h_{i',t-1} = m\}$$

$$y_{m,i,t}(\equiv 5 - h_{i,t}) = \sum_{j=0}^{J} j \times 1(\alpha_{m,j} < y^*_{m,i,t} \leq \alpha_{m,j+1})$$

$$\text{where } \mathrm{m} \in \{0,1, \dots, \mathrm{J} = 4\}; \alpha_{\mathrm{m},0} = -\infty \text{ and } \alpha_{\mathrm{m},\mathrm{J}+1} = +\infty$$

Hence, for each $h_{i,t-1} = m \in \{0, 1, 2, 3, 4\}$, there are two sets of parameters, $\boldsymbol{\beta}_\mathbf{m}$ for the determinants and $\boldsymbol{\alpha}_\mathbf{m} \equiv \begin{bmatrix} \alpha_{m,1} \\ \vdots \\ \alpha_{m,J} \end{bmatrix}$ for the thresholds partitioning the latent propensity index, to be estimated. The partition of the latent propensity index for an initial health status is described in Figure 2.

Figure 2: Health Transition and Partition of the Latent Propensity Index



At the intermediate level, there are partially pooled models derived from the above general model by constraining $\boldsymbol{\beta_m}$ to be common for an adjacent subset of $m \in \{0, 1, 2, 3, 4\}$ while imposing no restriction on $\boldsymbol{\alpha_m}$. The most constrained partially pooled model constrains $\boldsymbol{\beta_m}$ to be common for all $m \in \{0, 1, 2, 3, 4\}$ (and hence $y^*_{m,i,t} = y^*_{i,t}$ for all m) while imposing no restriction on α_m.

For example, in the most constrained partially pooled model constraining $\boldsymbol{\beta_m}$ to be common for all $m \in \{0, 1, 2, 3, 4\}$ while imposing no restriction on $\boldsymbol{\alpha_m}$, the latent propensity index of health transition is assumed to be the same across initial health statuses. In this case, however, the sets of thresholds partitioning the common latent propensity index of health transition into ordered intervals matching the ordered observed variables (the degree of health transition from the initial health status) are maintained to be different across initial health statuses. This implies a reasonable structure that the partitioned ordered interval matching the transition from $h_{i,t-1} = 2$ to $h_{i,t} = 1$ (and hence is coded as $y_{i,t} \equiv 5 - h_{i,t} = 4$) is different from that matching the transition from $h_{i,t-1} = 3$ to $h_{i,t} = 1$ (and hence coded as $y_{i,t} \equiv 5 - h_{i,t} = 4$). The values of the observed ordered variable are the same but the former transition means health improvement from 2 (very good) to 1 (excellent). On the other hand, the latter transition means health improvement from 3 (good) to 1 (excellent).

Obviously, at the most restricted level, the pooled model imposing common $\boldsymbol{\beta}_m = \boldsymbol{\beta}$ and $\boldsymbol{\alpha}_m = \boldsymbol{\alpha}$ can be considered, but it is too restrictive. Imposing a common threshold on top of the common parameters for the determinants implies that the partitioned interval of the common propensity index for the transition to each value of $h_{i,t}$ (the third-round health status) is constrained to be the same across all different values of $h_{i,t-1}$ (initial health status), and thus seems unreasonable.

Model selection tests, such as the likelihood ratio test, are applied to find the best model for the data under analysis.

Lastly, based on the theoretical and empirical literature in demand for and efficacy of health care and my perspectives, I consider the following as explanatory variables ($\boldsymbol{z}_{i,t}$) and their functional forms:

- per-person equivalent income in $10,000[9]
- dummies for the cross of no insurance and poverty status and for that of insurance status and type
    - dummy for being uninsured and below Federal Poverty Level (FPL): uninsured due to severe economic constraints

[9] Per adult equivalent income is not used in the form of natural logarithm since some individuals have negative per-adult equivalent income. Hence, I adjusted the scale by expressing per adult equivalent income in $10,000.

- dummy for being uninsured and above FPL: uninsured but not solely due to severe economic constraints
- dummy for being part-year insured by public insurance only
- dummy for being part-year insured by private insurance for any month
- dummy for being full-year insured by public insurance only
- dummy for being full-year insured by private insurance for any month: reference dummy

- dummies for urban/rural classification
  - dummy for residing in urban area (an MSA)
  - dummy for residing in rural area: reference dummy
- dummies for regional classification
  - dummy for Midwest
  - dummy for South
  - dummy for West
  - dummy for Northeast: reference dummy
- dummies for gender
  - dummy for female
  - dummy for male: reference dummy
- dummies for race/ethnicity
  - dummy for black
  - dummy for Asian
  - dummy for other races
  - dummy for white: reference dummy
- ln(age)
- ln(years of schooling + 1)[10]
- dummies for limitation status
  - dummy for any limitation (having ADL, IADL, activity, functional, or sensory

[10] 1 is added to "years of schooling" before taking natural logarithm since there are some individuals reporting 0 (meaning 'no school' or 'kindergarten only').

limitations)
  - dummy for no limitation: reference dummy
- dummies for employment status
  - dummy for being not employed for all three rounds
  - dummy for being employed: reference dummy
- dummies for marital status
  - dummy for being in married status at the first round
  - dummy for being not in married status

VI. Econometric Results

Likelihood Ratio Tests for Model Selection

Since I estimate many models with varying levels of pooling constraints, Table 4 presents the likelihood ratio test results between each partially pooled model and the fully flexible model under the first-order Markov assumption, so that readers can establish a perspective to examine a series of estimation results to come.

For all individual tests, the alternative hypothesis remains the same, supporting the general model or the fully flexible model under the first-order Markov assumption. Against the general model we test each null hypothesis that pools adjacent categories together to have a common propensity index. The testing is done via likelihood ratio test, using the maximized log-likelihood values from both the general model and the constrained models.

Notice that all types of pooling are rejected except pooling “good” and “fair” initial health status groups. Hence, the best set of model estimation consists of the estimation results from ordered logit models separately for each of “excellent”, “very good”, and “poor” initial health groups and the partially pooled ordered logit model pooling “good” and “fair”.

Table 4

Likelihood Ratio Test Results

alternative hypothesis (the general model): the fully flexible model under the first-order Markov assumption

null hypothesis (the constrained model)	value of likelihood ratio test	degrees of freedom	p-value	test conclusion at 5% significance level
common propensity index for the individuals in two adjacent health statuses in the first period:				
"excellent" and "very good"	41.730	19	0.002	reject pooling
"very good" and "good"	58.767	19	0.000	reject pooling
"good" and "fair"	29.520	19	0.058	accept pooling
"fair" and "poor"	33.072	19	0.024	reject pooling
common propensity index for the individuals in three adjacent health statuses in the first period:				
"excellent", "very good", and "good"	132.807	38	0.000	reject pooling
"very good", "good", and "fair"	94.460	38	0.000	reject pooling
"good", "fair", and "poor"	80.107	38	0.000	reject pooling
common propensity index for the individuals in four adjacent health statuses in the first period:				
"excellent", "very good", "good", and "fair"	182.140	57	0.000	reject pooling
"very good", "good", "fair", and "poor"	153.682	57	0.000	reject pooling
common propensity index for the individuals in all five health statuses in the first period:				
"excellent", "very good", "good", "fair", and "poor"	250.258	76	0.000	reject pooling

In Tables 5 (1) through 5 (5), I present the estimation results from the fully flexible model, whose estimates are consistent even though less efficient, judging from the above model selection test results. Subsequently, Table 6 presents the estimation results from the ordinal regression model pooling "good" and "fair". Tables 5 (1), 5 (2), 6, and 5 (5) together constitute the estimation results for the best model identified through likelihood ratio tests. Lastly, in Table 7, I present the most constrained model from the pool of partially pooled model: the ordinal regression model where all five initial health statuses are pooled for a common propensity index. The estimates reported in Table 7 are inconsistent, judging from the above model selection test results. Estimation results for other intermediate models are omitted to save space.

Inference from the Most Flexible Model Incorporating the First-Order Markov Assumption

Summary of the maximum likelihood estimation results for the fully flexible ordered logit regression models are presented in Tables 5 (1) through 5 (5). The five tables are lined up from the table for the excellent initial health status to that for the poor health status.

Table 5 (1): Fully Flexible Model
Ordinal Regression Results for Initial Health = Excellent

Selected Parameters in the Propensity Index	Significance & Note	MLE	std. error
per-person equivalent income	***	0.065	0.011
uninsured and below FPL	**	-0.305	0.149
uninsured and above FPL	**	-0.187	0.084
part-year insured by public insurance only	***	-0.442	0.159
part-year insured by any private insurance		-0.075	0.094
full-year insured by public insurance only	**	-0.346	0.141
full-year insured by any private insurance	(reference dummy)		
residing in MSA		-0.021	0.098
black		-0.061	0.078
Asian	***	-0.281	0.106
other races		0.299	0.184
white	(reference dummy)		
ln (age)	***	-0.444	0.089

ln (years of education[+1])	***	0.851	0.127
any limiation*	***	-0.630	0.114
not employed	**	0.179	0.082
being married		0.043	0.067
threshold values	refer to Appendix III		
number of observations	5,292		

Table 5 (2): Fully Flexible Model
Ordinal Regression Results for Initial Health = Very Good

Selected Parameters in the Propensity Index	Significance & Note	MLE	std. error
per-person equivalent income	***	0.05	0.009
uninsured and below FPL	***	-0.391	0.122
uninsured and above FPL		-0.009	0.084
part-year insured by public insurance only		-0.192	0.156
part-year insured by any private insurance		-0.073	0.096
full-year insured by public insurance only		0.057	0.133
full-year insured by any private insurance	(reference dummy)		
residing in MSA		0.021	0.078
black		-0.053	0.07
Asian		0.077	0.108
other races		-0.004	0.161
white	(reference dummy)		
ln (age)	***	-0.675	0.084
ln (years of education[+1])	***	0.473	0.121
any limiation*	***	-0.537	0.084
not employed		0.053	0.074
being married	**	0.117	0.057
threshold values	refer to Appendix III		
number of observations	5,936		

Table 5 (3): Fully Flexible Model
Ordinal Regression Results for Initial Health = Good

Selected Parameters in the Propensity Index	Significance & Note	MLE	std. error
per-person equivalent income	***	0.037	0.010
uninsured and below FPL	***	-0.356	0.118
uninsured and above FPL		-0.131	0.081
part-year insured by public insurance only	***	-0.596	0.149
part-year insured by any private insurance	**	-0.247	0.098
full-year insured by public insurance only	***	-0.447	0.112
full-year insured by any private insurance	(reference dummy)		
residing in MSA	**	0.170	0.079
black		0.041	0.074
Asian	**	0.265	0.103
other races		-0.144	0.157
white	(reference dummy)		
ln (age)	***	-1.051	0.095
ln (years of education[+1])	***	0.323	0.093
any limiation*	***	-0.658	0.071
not employed		0.004	0.073
being married		-0.085	0.062
threshold values	refer to Appendix III		
number of observations	5,051		

*any limitation: ADL/IADL/activity/functional/sensory

From the better three out of the five initial health statuses (see Tables 5 (1) through 5 (3)) I found a significantly negative impact of uninsured status when accompanied by being-in-poverty status (note the MLE estimate for uninsured and below FPL). Also, in the “excellent” and “good” health groups (Tables 5 (1) and 5 (3)), we can observe significantly negative impacts for having exclusively “public insurance only” regardless of the length of coverage (full-year or part-year insured). This latter estimate is when compared to our reference case, full-year insured with at least one month of private insurance.

Table 5 (4): Fully Flexible Model
Ordinal Regression Results for Initial Health = Fair

Selected Parameters in the Propensity Index	Significance & Note	MLE	std. error
per-person equivalent income	**	0.052	0.021
uninsured and below FPL		0.021	0.171
uninsured and above FPL		-0.025	0.127
part-year insured by public insurance only		-0.018	0.204
part-year insured by any private insurance		-0.049	0.185
full-year insured by public insurance only		-0.165	0.145
full-year insured by any private insurance	(reference dummy)		
residing in MSA	**	0.255	0.119
black		0.061	0.109
asian	**	0.453	0.196
other races		0.115	0.248
white	(reference dummy)		
ln (age)	***	-1.082	0.163
ln (years of education[+1])	**	0.266	0.125
any limiation*	***	-0.960	0.099
not employed		-0.053	0.107
being married		0.058	0.098
threshold values	refer to Appendix III		
number of observations	1,918		

Table 5 (5): Fully Flexible Model
Ordinal Regression Results for Initial Health = Poor

Selected Parameters in the Propensity Index	Significance & Note	MLE	std. error
per-person equivalent income		0.044	0.053
uninsured and below FPL		0.317	0.347
uninsured and above FPL		-0.088	0.306

part-year insured by public insurance only	**	0.682	0.338
part-year insured by any private insurance		-0.152	0.353
full-year insured by public insurance only		-0.023	0.226
full-year insured by any private insurance	(reference dummy)		
residing in MSA		0.108	0.205
black		0.318	0.210
Asian		-0.060	0.429
other races	**	-0.768	0.341
white	(reference dummy)		
ln (age)	***	-1.051	0.317
ln (years of education[+1])		-0.055	0.188
any limiation*	***	-1.083	0.210
not employed	***	-0.793	0.190
being married		-0.010	0.234
threshold values	refer to Appendix III		
number of observations	617		

*any limitation: ADL/IADL/activity/functional/sensory

It is notable that generally both insurance status (insured vs. uninsured) and insurance type, when insured, do not impact the chances of health transition in the worst two health status groups (see Tables 5 (4) and 5 (5)). An exception is a significantly positive impact observed in 'part-year insured exclusively by public insured only' interaction term for the poor health-status group. This contrasts its significant negative impact in the better three health-status groups. Carefully looking into the observed characteristics of the poor health status group and what is different in this group compared to the others, we can conjecture why this may be the case. In the preliminary analysis of explanatory variables (refer to Table 3), we noted that about 57.8% of the part-year and full-year insured in the poor health-status group are covered exclusively by public insurance only. We should also note that this group mainly consists of those with serious illness, chronic illness and any limitation and with severe economic constraints. Hence, the full-year private insurance, serving as the reference point of insurance-related variables, which these persons afford to purchase is no better than public insurance. In addition, part-year insured by public insurance only are likely dominated by new entrants to the public insurance programs, who may have a better chance of making health improvement with any coverage.

Living in an MSA exerts positive impact for the middle initial health groups of "good" and "fair" but not significant for other health groups. Geographic regions do not seem to impact differently in comparison to the Northeast region except in the "good" initial health group, where Midwest and West significantly lower chances of health improvement in comparison to Northeast.

Compared to male, female seems to have higher chances of health deterioration in the "excellent" initial health group and lower chances of health improvement in the "poor" group. Surprisingly, being a black does not impact the chances of health transition differently from being a white. Being an Asian significantly increases chances of health deterioration when in the "excellent" health group initially while significantly increases chances of health improvement when in the "good" and "fair" health groups. Belonging to "other races" significantly lowers chances of health improvement only in the "poor" health group.

In all initial health groups, age and having 'any limitation' have significant negative impact on chances of health improvement. On the other hand, education has significant positive impact on chances of health improvement in all health groups, again, except the "poor" heath group. Being not employed impacts positively when in the "excellent" health status while negatively when in the "poor" health status. Employment status does not have statistically significant impact in other health status groups. Being married does not impact health transition except when in the "very good" health status.

Inference from the Partially Pooled Model with Common Latent Propensity Index for Some Adjacent Categories but Different Sets of Thresholds for Different Initial Health Statuses

While it rejected all the other pooling possibilities in favor of the fully flexible model, the likelihood ratio test of pooling has accepted the pooling of "good" and "fair" categories. Maximum likelihood estimation results for a partially pooled model for these two adjacent categories are presented in Table 6. Except the parameter estimates for regional dummies, the estimation results in Table 6 are quite similar to those in Table 5 (3) for the initially "good" health status. This similarity is expected since the number of individuals belonging to the initially "good" health status group greatly dominates that of belonging to the initially "fair" health status group (5,051 versus 1,918).

Table 6: Pooled Ordinal Regression Model with Common Propensity Index for "Good" and "Fair" Health Statuses

Selected Parameters in the Propensity Index	Significance & Note	MLE	std. error
per-person equivalent income	***	0.041	0.009
uninsured and below FPL	***	-0.254	0.098
uninsured and above FPL		-0.103	0.068
part-year insured by public insurance only	***	-0.411	0.119
part-year insured by any private insurance	**	-0.192	0.086
full-year insured by public insurance only	***	-0.381	0.088
full-year insured by any private insurance	(reference dummy)		
residing in MSA	***	0.193	0.066
black		0.044	0.061
Asian	***	0.305	0.091
other races		-0.067	0.131
white	(reference dummy)		
ln (age)	***	-1.050	0.081
ln (years of education[+1])	***	0.305	0.074
any limiation*	***	-0.767	0.057
not employed		-0.023	0.061
being married		-0.043	0.052
threshold values	refer to Appendix III		
number of observations	6,969		

*any limitation: ADL/IADL/activity/functional/sensory

For the individuals belonging to either "good" or "fair" health status initially, both "no insurance due to economic constraints" and "insured by public insurance only" impact significantly negatively the chances of health improvement/maintenance.

Table 7: Pooled Ordinal Regression Model with Common Propensity Index for All Five Health Statuses

Selected Parameters in the Propensity Index	Significance & Note	MLE	std. error
per-person equivalent income	***	0.052	0.005
uninsured and below FPL	***	-0.244	0.066
uninsured and above FPL	**	-0.100	0.043
part-year insured by public insurance only	***	-0.284	0.079
part-year insured by any private insurance	**	-0.110	0.052
full-year insured by public insurance only	***	-0.267	0.061
full-year insured by any private insurance	(reference dummy)		
residing in MSA	**	0.085	0.042
black		-0.017	0.039
Asian		0.047	0.059
other races		-0.019	0.082
white	(reference dummy)		
ln (age)	***	-0.730	0.047
ln (years of education)	***	0.450	0.055
any limiation*	***	-0.731	0.042
not employed		-0.014	0.040
being married		0.043	0.032
threshold values	refer to Appendix III		
number of observations	18,814		

*any limitation: ADL/IADL/activity/functional/sensory

Table 7 is for the most constrained partially pooled ordered logit model pooling all five initial health statuses for the latent propensity index. Note that the model reported in Table 7 was rejected earlier by the likelihood ratio test, and is only included here as a reference.

First, observe the sets of thresholds across initial health statuses are quite different, implying that the most constrained model imposing the common set of thresholds will not be supported. Insurance coverage and type dummies are all significant at the 5% significance and take negative parameter estimates. That is, compared to the reference dummy of ‘full-year insured by any private insurance’, incomplete insurance coverage (part-year insured or uninsured) and inferior insurance type (‘public insurance only’ when insured) have significant negative impact on the chances of health improvement or maintenance. The scope of public insurance is limited and hence ‘public insurance only’ seems not that helpful in health improvement or maintenance irrespective of being part-year or full-year insured.

Living in an MSA and education increase chances of health improvement while being a female, age, and having any limitation lower chances of health improvement. Geographic regions, race/ethnicity, employment status, and marital status are not significant.

VII. Conclusion

My analysis of MEPS 2008 data has reached some empirical results with direct implications for expansion of health insurance. Even if initially in a relatively good health (in the three best health categories under the fully flexible model and except for the “poor” health status under the best model), being unwillingly uninsured due to economic constraints has a significantly negative impact to improving or maintaining health. When in relatively healthy state, being insured exclusively by public insurance, regardless of whether full-year or only part-year insured, also has a large and significantly negative impact to improving or maintaining health, compared to when insured by private insurance. Impact of having public insurance becomes unclear in the relatively poor health state with one exception: For the poor health-status group, constituting only 3.3% of my final sample, part-year insured by public insurance only has a significantly positive impact. This implies some positive role of public insurance for the group of people under both severe economic constraint and serious illness. For these individuals, the private insurance that they can afford to purchase, whether due to economic constraint or due to unwillingness of private insurance to cover them, is no better (generous) than public insurance.

Overall, expanding health care to the unwillingly uninsured and extending the scope of public insurance to that of private insurance will lead to improvement or maintenance of health for the relatively healthy population. Especially as the relatively healthy group constitutes the majority of the population, this implies a good possibility of cost-off in the expansion of coverage and the extension of scope. For the poor health-status group with distinctive characteristics in terms of economic means and medical needs, public insurance has some significant positive role.

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Appendix I: Partial List of Important Survey Items from MEPS-HC

- Identification
    - Person, HIEU (Health Insurance Eligibility Unit)
- Demographics
    - Region, age, sex, race, education, marital status, family size
- Health status and attitude
    - Height, weight, body mass index, perceived health status, disability days
- Access to care
    - Usual source of care
- Employment
    - Employment status, wage rate, hours worked per week, # of employees, union membership, industry/occupation code, self employed or not
- Income
    - Poverty status, total person income, total family income, food stamp recipients
- Insurance
    - Health insurance from employment, Medicare coverage, Medicare Part D coverage, CHAMPUS/VA coverage, Medicaid coverage, public coverage, private coverage, duration without insurance, sources of private insurance, HMO/managed care enrollment, Medicaid HMO/gatekeeper coverage, private HMO/gatekeeper coverage, experience with public plans, dental insurance, prescription drug insurance
- Health care utilization
    - # of office-based visits, # of outpatient department visits, # of emergency room visits, # of hospital inpatient stays, # of home health events, # of prescribed medicine purchases, # of dental visits, # of orthodontist visits, # of alternative care visits
- Total charges
- Total expenditures
- Expenditures by source of payment

- Sampling weights

Appendix II: Preliminary Examination of the Key Variables Using Summary Statistics and Pairwise t-Tests

Group sample means and inter-group t-tests for the equality of group sample means between adjacent initial health statuses, reported in Table 3 of the main text, lead to the following observations:

Per-capita total health care expenditures from all sources of funds are monotonically increasing as we move along the initial health status from excellent to poor. Compare $1,629 for Group 1 (excellent health) with $13,230 for Group 5 (poor health).

Age is also increasing monotonically as we move along the initial health status from excellent to poor. Compare the average age of 35.6 for Group 1 against 47.1 for Group 5.

The proportion of individuals below Federal Poverty Level also increases monotonically (from 11.6% to 37.4%) as we move along the initial health status from excellent to poor.

Per-adult equivalent income decreases monotonically (from $42,846 to $19,644) as we move along the initial health status from excellent to poor.

The number of months covered by insurance of any type is mildly U-shaped across the initial health status. Its value is similar across the initial health status, ranging from 8.1 to 8.9 months.

The proportion of the full-year uninsured is inverse U-shaped across the initial health status, ranging from 19.3% to 26.2%. The proportion of individuals covered by public insurance only 'among the insured for any month of the year' increases monotonically as we move along the initial health status from excellent to poor, 11.2% versus 57.8%.

Years of schooling decreases slowly and monotonically as we move from excellent to poor. 13.2 years on average versus 11.1 years.

The proportion of individuals with 'any ADL/IADL/activity/functional/sensory limitations' increases rapidly and monotonically as we move from excellent to poor. 7.2% versus 78.8%.

The proportion of individuals not employed for the full year increases monotonically (from 15.3% to 67.1%) as we move from excellent or very good to poor, although the sample means of the fair and poor groups are significantly higher than those of the other groups. Between the fair and the poor groups, the sample mean of the latter group is also significantly higher than that of the former group.

The proportion of individuals in married state is inverse U-shaped across the initial health status, ranging from 45.1% to 52.9%.

The proportion of individuals living in an MSA decreases slowly and monotonically (from 87.9% to 78.4%) as we move from excellent to poor, although only the poor group's mean is statistically different from the other groups' means.

The proportion of females in each group increases monotonically (from 48.5% to 58.0%) as we move from excellent to poor, although only the proportion in the excellent group is statistically different from those in remaining groups.

Appendix III: Full Regression Results

- Model 1 [whose results are presented in Tables A1 (1) – (5)]: Fully Flexible Model, Ordinal Regression Models for
    - Initial Health Status = Excellent
    - Initial Health Status = Very Good
    - Initial Health Status = Good
    - Initial Health Status = Fair
    - Initial Health Status = Poor
- Model 2 [whose results are presented in Tables A1 (1), A1 (2), A2, and A1 (5)]: Pooled Ordinal Regression Model with a Common Propensity Index for the "Good" and "Fair" Health Statuses
    - Note: This is the only adjacent health status group that passed the likelihood ratio test for pooling
- Model 3 [whose results are presented in Table A3]: Pooled Ordinal Regression Model with a Common Propensity Index for all the Five Initial Health Statuses
    - Note: This model did not pass the likelihood ratio test for pooling. It is included as it may be a more intuitive model for the general public, and it shows results consistent to the fully flexible model, or even stronger results.
- Model 4: (omitted)
    - Note: This model may be most intuitive appealing to the general public, but econometrically deemed not desirable, as discussed in the main text.

Table A1 (1)

Maximum Likelihood Estimation Result from the Ordinal Regression Model for the Initial Health Status = Excellent

	significance and note	MLE	standard error	p-value
parameters in the propensity index				
per-person equivalent income	***	0.065	0.011	0.000
dummy for being uninsured and below FPL	**	-0.305	0.149	0.041
dummy for being uninsured and above FPL	**	-0.187	0.084	0.027
dummy for being part-year insured by public insurance only	***	-0.442	0.159	0.005
dummy for being part-year insured by any private insurance		-0.075	0.094	0.423
dummy for being full-year insured by public insurance only	**	-0.346	0.141	0.014
dummy for being full-year insured by any private insurance	(reference dummy)			
dummy for residing in an MSA		-0.021	0.098	0.834
dummy for residing in a non-MSA	(reference dummy)			
dummy for Midwest		0.061	0.092	0.510
dummy for South	*	0.146	0.081	0.073
dummy for West		0.041	0.087	0.636
dummy for Northeast	(reference dummy)			
dummy for female	**	-0.139	0.056	0.013
dummy for male	(reference dummy)			
dummy for black		-0.061	0.078	0.434
dummy for Asian	***	-0.281	0.106	0.008
dummy for other races		0.299	0.184	0.104
dummy for white	(reference dummy)			
ln(age)	***	-0.444	0.089	0.000
ln(years of education[+1])	***	0.851	0.127	0.000
dummy for any	***	-0.630	0.114	0.000

(ADL/IADL/activity/functional/sensory) limitation				
dummy for no limitation	(reference dummy)			
dummy for being not employed	**	0.179	0.082	0.030
dummy for being employed	(reference dummy)			
dummy for being in married status		0.043	0.067	0.520
dummy for being not in married status	(reference dummy)			
thresholds				
thresholds for initial health status = 1				
th_11	***	-5.158	0.500	0.000
th_12	***	-2.982	0.438	0.000
th_13	**	-0.921	0.434	0.034
th_14		0.520	0.435	0.232
model fit				
maximized log-likelihood value		-5,322.326		
number of observations		5,292		

Table A1 (2)

Maximum Likelihood Estimation Result from the Ordinal Regression Model for the Initial Health Status = Very Good

	significance and note	MLE	standard error	p-value
parameters in the propensity index				
per-person equivalent income	***	0.050	0.009	0.000
dummy for being uninsured and below FPL	***	-0.391	0.122	0.001
dummy for being uninsured and above FPL		-0.009	0.084	0.914
dummy for being part-year insured by public insurance only		-0.192	0.156	0.218
dummy for being part-year insured by any private insurance		-0.073	0.096	0.448
dummy for being full-year insured by public insurance only		0.057	0.133	0.666
dummy for being full-year insured by any private insurance	(reference dummy)			
dummy for residing in an MSA		0.021	0.078	0.785
dummy for residing in a non-MSA	(reference dummy)			
dummy for Midwest		0.040	0.102	0.693
dummy for South		0.003	0.104	0.974
dummy for West		-0.014	0.101	0.888
dummy for Northeast	(reference dummy)			
dummy for female		-0.079	0.051	0.120
dummy for male	(reference dummy)			
dummy for black		-0.053	0.070	0.450
dummy for Asian		0.077	0.108	0.475
dummy for other races		-0.004	0.161	0.981
dummy for white	(reference dummy)			
ln(age)	***	-0.675	0.084	0.000
ln(years of education[+1])	***	0.473	0.121	0.000
dummy for any	***	-0.537	0.084	0.000

(ADL/IADL/activity/functional/sensory) limitation				
dummy for no limitation	(reference dummy)			
dummy for being not employed		0.053	0.074	0.478
dummy for being employed	(reference dummy)			
dummy for being in married status	**	0.117	0.057	0.039
dummy for being not in married status	(reference dummy)			
thresholds				
thresholds for initial health status = 2				
th_21	***	-6.263	0.480	0.000
th_22	***	-4.124	0.454	0.000
th_23	***	-1.901	0.453	0.000
th_24		0.344	0.453	0.448
model fit				
maximized log-likelihood value		-6,921.606		
number of observations		5,936		

Table A1 (3)

Maximum Likelihood Estimation Result from the Ordinal Regression Model for the Initial Health Status = Good

	significance and note	MLE	standard error	p-value
parameters in the propensity index				
per-person equivalent income	***	0.037	0.010	0.000
dummy for being uninsured and below FPL	***	-0.356	0.118	0.003
dummy for being uninsured and above FPL		-0.131	0.081	0.108
dummy for being part-year insured by public insurance only	***	-0.596	0.149	0.000
dummy for being part-year insured by any private insurance	**	-0.247	0.098	0.012
dummy for being full-year insured by public insurance only	***	-0.447	0.112	0.000
dummy for being full-year insured by any private insurance	(reference dummy)			
dummy for residing in an MSA	**	0.170	0.079	0.032
dummy for residing in a non-MSA	(reference dummy)			
dummy for Midwest	**	-0.182	0.091	0.046
dummy for South		0.047	0.085	0.582
dummy for West	***	-0.251	0.088	0.004
dummy for Northeast	(reference dummy)			
dummy for female		-0.067	0.055	0.221
dummy for male	(reference dummy)			
dummy for black		0.041	0.074	0.583
dummy for Asian	**	0.265	0.103	0.010
dummy for other races		-0.144	0.157	0.360
dummy for white	(reference dummy)			
ln(age)	***	-1.051	0.095	0.000
ln(years of education[+1])	***	0.323	0.093	0.001
dummy for any	***	-0.658	0.071	0.000

(ADL/IADL/activity/functional/sensory) limitation				
dummy for no limitation	(reference dummy)			
dummy for being not employed		0.004	0.073	0.958
dummy for being employed	(reference dummy)			
dummy for being in married status		-0.085	0.062	0.173
dummy for being not in married status	(reference dummy)			
thresholds				
thresholds for initial health status = 3				
th_31	***	-7.607	0.448	0.000
th_32	***	-5.172	0.440	0.000
th_33	***	-2.664	0.434	0.000
th_34	**	-0.933	0.435	0.032
model fit				
maximized log-likelihood value		-6,128.009		
number of observations		5,051		

Table A1 (4)
Maximum Likelihood Estimation Result from the Ordinal Regression Model for the Initial Health Status = Fair

	significance and note	MLE	standard error	p-value
parameters in the propensity index				
per-person equivalent income	**	0.052	0.021	0.012
dummy for being uninsured and below FPL		0.021	0.171	0.900
dummy for being uninsured and above FPL		-0.025	0.127	0.843
dummy for being part-year insured by public insurance only		-0.018	0.204	0.931
dummy for being part-year insured by any private insurance		-0.049	0.185	0.794
dummy for being full-year insured by public insurance only		-0.165	0.145	0.255
dummy for being full-year insured by any private insurance	(reference dummy)			
dummy for residing in an MSA	**	0.255	0.119	0.032
dummy for residing in a non-MSA	(reference dummy)			

dummy for Midwest		0.168	0.151	0.267
dummy for South		0.087	0.132	0.510
dummy for West		0.073	0.145	0.613
dummy for Northeast	(reference dummy)			
dummy for female		-0.078	0.089	0.381
dummy for male	(reference dummy)			
dummy for black		0.061	0.109	0.575
dummy for Asian	**	0.453	0.196	0.021
dummy for other races		0.115	0.248	0.643
dummy for white	(reference dummy)			
ln(age)	***	-1.082	0.163	0.000
ln(years of education[+1])	**	0.266	0.125	0.033
dummy for any (ADL/IADL/activity/functional/sensory) limitation	***	-0.960	0.099	0.000
dummy for no limitation	(reference dummy)			
dummy for being not employed		-0.053	0.107	0.622
dummy for being employed	(reference dummy)			
dummy for being in married status		0.058	0.098	0.550
dummy for being not in married status	(reference dummy)			
thresholds				
thresholds for initial health status = 4				
th_41	***	-6.169	0.731	0.000
th_42	***	-3.554	0.722	0.000
th_43	**	-1.729	0.718	0.016
th_44		-0.332	0.726	0.648
model fit				
maximized log-likelihood value		-2,429.066		
number of observations		1,918		

Table A1 (5)

Maximum Likelihood Estimation Result from the Ordinal Regression Model

for the Initial Health Status = Poor

	significance and note	MLE	standard error	p-value
parameters in the propensity index				
per-person equivalent income		0.044	0.053	0.403
dummy for being uninsured and below FPL		0.317	0.347	0.362
dummy for being uninsured and above FPL		-0.088	0.306	0.773
dummy for being part-year insured by public insurance only	**	0.682	0.338	0.044
dummy for being part-year insured by any private insurance		-0.152	0.353	0.666
dummy for being full-year insured by public insurance only		-0.023	0.226	0.918
dummy for being full-year insured by any private insurance	(reference dummy)			
dummy for residing in an MSA		0.108	0.205	0.597
dummy for residing in a non-MSA	(reference dummy)			
dummy for Midwest		-0.010	0.284	0.971
dummy for South		0.076	0.253	0.765
dummy for West		0.288	0.275	0.294
dummy for Northeast	(reference dummy)			
dummy for female	**	-0.405	0.178	0.023
dummy for male	(reference dummy)			
dummy for black		0.318	0.210	0.129
dummy for Asian		-0.060	0.429	0.890
dummy for other races	**	-0.768	0.341	0.024
dummy for white	(reference dummy)			
ln(age)	***	-1.051	0.317	0.001
ln(years of education[+1])		-0.055	0.188	0.772
dummy for any	***	-1.083	0.210	0.000

(ADL/IADL/activity/functional/sensory) limitation				
dummy for no limitation	(reference dummy)			
dummy for being not employed	***	-0.793	0.190	0.000
dummy for being employed	(reference dummy)			
dummy for being in married status		-0.010	0.234	0.967
dummy for being not in married status	(reference dummy)			
thresholds				
thresholds for initial health status = 5				
th_51	***	-5.745	1.372	0.000
th_52	***	-4.029	1.362	0.003
th_53	*	-2.517	1.352	0.063
th_54		-0.503	1.391	0.718
model fit				
maximized log-likelihood value		-699.884		
number of observations		617		

Table A2

Maximum Likelihood Estimation Result from the Pooled Ordinal Regression Model with a Common Propensity Index for the "Good" and "Fair" Health Statuses Initially

	significance and note	MLE	standard error	p-value
parameters in the common propensity index				
per-person equivalent income	***	0.041	0.009	0.000
dummy for being uninsured and below FPL	***	-0.254	0.098	0.010
dummy for being uninsured and above FPL		-0.103	0.068	0.131
dummy for being part-year insured by public insurance only	***	-0.411	0.119	0.001
dummy for being part-year insured by any private insurance	**	-0.192	0.086	0.026
dummy for being full-year insured by public insurance only	***	-0.381	0.088	0.000
dummy for being full-year insured by any private insurance	(reference dummy)			
dummy for residing in an MSA	***	0.193	0.066	0.003
dummy for residing in a non-MSA	(reference dummy)			
dummy for Midwest		-0.088	0.078	0.256
dummy for South		0.060	0.072	0.405
dummy for West	**	-0.160	0.075	0.033
dummy for Northeast	(reference dummy)			
dummy for female		-0.071	0.047	0.126
dummy for male	(reference dummy)			
dummy for black		0.044	0.061	0.475
dummy for Asian	***	0.305	0.091	0.001
dummy for other races		-0.067	0.131	0.612
dummy for white	(reference dummy)			
ln(age)	***	-1.050	0.081	0.000
ln(years of education[+1])	***	0.305	0.074	0.000
dummy for any	***	-0.767	0.057	0.000

(ADL/IADL/activity/functional/sensory) limitation				
dummy for no limitation	(reference dummy)			
dummy for being not employed		-0.023	0.061	0.705
dummy for being employed	(reference dummy)			
dummy for being in married status		-0.043	0.052	0.412
dummy for being not in married status	(reference dummy)			
thresholds				
thresholds for initial health status = 3				
th_31	***	-7.546	0.385	0.000
th_32	***	-5.109	0.373	0.000
th_33	***	-2.592	0.368	0.000
th_34	**	-0.860	0.369	0.020
thresholds for initial health status = 4				
th_41	***	-6.201	0.384	0.000
th_42	***	-3.620	0.375	0.000
th_43	***	-1.823	0.374	0.000
th_44		-0.436	0.385	0.257
model fit				
maximized log-likelihood value		-8,571.835		
number of observations		6,969		
likelihood ratio test for pooling				
the value of LR test statistic		29.520		
degrees of freedom		19		
p-value		0.058		
testing conclusion at 5% significance level		accept pooling		

Table A3

Maximum Likelihood Estimation Result from the Pooled Ordinal Regression Model with a Common Propensity Index for the All Five Initial Health Statuses

	significance and note	MLE	standard error	p-value
parameters in the common propensity index				
per-person equivalent income	***	0.052	0.005	0.000
dummy for being uninsured and below FPL	***	-0.244	0.066	0.000
dummy for being uninsured and above FPL	**	-0.100	0.043	0.019
dummy for being part-year insured by public insurance only	***	-0.284	0.079	0.000
dummy for being part-year insured by any private insurance	**	-0.110	0.052	0.034
dummy for being full-year insured by public insurance only	***	-0.267	0.061	0.000
dummy for being full-year insured by any private insurance	(reference dummy)			
dummy for residing in an MSA	**	0.085	0.042	0.043
dummy for residing in a non-MSA	(reference dummy)			
dummy for Midwest		-0.003	0.056	0.959
dummy for South		0.057	0.047	0.222
dummy for West		-0.040	0.049	0.417
dummy for Northeast	(reference dummy)			
dummy for female	***	-0.082	0.029	0.004
dummy for male	(reference dummy)			
dummy for black		-0.017	0.039	0.657
dummy for Asian		0.047	0.059	0.425
dummy for other races		-0.019	0.082	0.814
dummy for white	(reference dummy)			
ln(age)	***	-0.730	0.047	0.000
ln(years of education[+1])	***	0.450	0.055	0.000
dummy for any	***	-0.731	0.042	0.000

(ADL/IADL/activity/functional/sensory) limitation				
dummy for no limitation	(reference dummy)			
dummy for being not employed		-0.014	0.040	0.732
dummy for being employed	(reference dummy)			
dummy for being in married status		0.043	0.032	0.183
dummy for being not in married status	(reference dummy)			
thresholds				
thresholds for initial health status = 1				
th_11	***	-7.177	0.342	0.000
th_12	***	-5.005	0.241	0.000
th_13	***	-2.958	0.228	0.000
th_14	***	-1.533	0.226	0.000
thresholds for initial health status = 2				
th_21	***	-6.571	0.283	0.000
th_22	***	-4.427	0.235	0.000
th_23	***	-2.195	0.229	0.000
th_24		0.060	0.229	0.792
thresholds for initial health status = 3				
th_31	***	-5.933	0.254	0.000
th_32	***	-3.504	0.231	0.000
th_33	***	-1.015	0.229	0.000
th_34	***	0.698	0.232	0.003
thresholds for initial health status = 4				
th_41	***	-4.556	0.244	0.000
th_42	***	-2.001	0.234	0.000
th_43		-0.230	0.236	0.331
th_44	***	1.145	0.252	0.000
thresholds for initial health status = 5				
th_51	***	-2.560	0.248	0.000
th_52	***	-1.010	0.251	0.000
th_53		0.390	0.277	0.160
th_54	***	2.343	0.445	0.000
model fit				
maximized log-likelihood value		-21,626.021		
number of observations		18,814		

likelihood ratio test for pooling					
the value of LR test statistic		250.258			
degrees of freedom		76			
p-value		0.000			
testing conclusion at 5% significance level		reject pooling			