Incentives for "Medicaid Works"

John Pepper Steven Stern

August 31, 2010

Abstract

This report addresses Task #2 D of MOU #09-226 between the Virginia Department of Rehabilitative Services (DRS) and The University of Virginia. We develop a structural model of disabled people choosing whether to work and how financial incentives affect that choice. We propose using data from the Medical Expenditure Panel Survey (MEPS) to estimate a model, and provide some summary statistics of these data. We are currently in the process of estimating a basic version of this model, and results should be available shortly. Ultimately, this model will be used to predict behavior of individuals, budget costs, and related savings of the program, along with the well-being of affected individuals. This framework will also be used to predict how proposed changes in the Medicaid Works program would affect behavior.

1 Introduction

This report aims to develop a framework to understand the incentive effects of the Virginia Medicaid Works program that provides disabled Medicaid recipients the option to earn higher income while ensuring continued Medicaid coverage. In 2009, for example, this voluntary plan allowed enrollees to have annual earnings as high as $44,100 [200-400% of FPL]. By decoupling labor market decisions from Medicaid receipt, the primary objective of the Works program is to increase the employment and earnings of disabled recipients.[1]

Assessing the efficacy of the Virginia program, however, has proven to be difficult. To date, only a very small number of disabled Medicaid recipients participate in the Works program, and the slow growth rate of new cases means it will take many years before there are enough participants to perform any reliable statistical analyses using data on the Virginia caseload (see Task 2, Part A). Another option might be to examine data from other states (see Task 2, Part C), but there are two basic problems with this approach. First, access to the

[1] For further details, see http://www.dmas.virginia.gov/downloads/pdfs/mb-FactSheet_Medicaid.pdf. Other useful references include http://www.dmas.virginia.gov/mb-proposal.htm and http://www.workworld.org/wwwebhelp/va_medicaid_works_overview.htm.

other-state data is severely restricted, which will hinder the ability to undertake any meaningful analysis. Second, and more important, the Mathematica data has information only on participants in similar programs. Such data can never provide information about the effectiveness of incentives to join such a program because there is no information about people who chose not to join.

Thus, rather than using data on recipients in Virginia or other states, this report develops a structural model of disabled people choosing whether to work and how financial incentives affect that choice, and describes data from the Medical Expenditure Panel Survey (MEPS) that can be used to estimate this model. In developing this model, we have focused on addressing Task #2, Part D of MOU #09-226 between the Virginia Department of Rehabilitative Services (DRS) and The University of Virginia:

> Task 2D: ... use national data sets to develop a structural modeling framework to predict the impacts of Medicaid Works-type program on the labor supply decisions of individuals with disabilities.
>
> The first task for 2D will be to determine whether to use panel data such as the PSID or NLS or to use a repeated cross-section with better health and disability information such as the NHIS. On the one hand, many of the issues associated with programs like Medicaid Works are dynamic in nature, thus favoring the panel data. On the other, behavior might be quite sensitive to specific features of health or disability not observed in the panel data. Still another possibility, requiring some methodological work, would be to combine a panel data set with a repeated cross-section with better health information.
>
> The second task for 2D will then incorporate one of the existing similar models (see for example, Stern, 1996; Benitez-Silva et al., 1999; Kreider 1998, 1999) and build on them as a starting point. It will be very important to carefully model how the availability of Medicaid insurance depends on the labor force participation choice.
>
> *Deliverable:* A report detailing the appropriate data set and structural model used to predict the effect of the Medicaid Works program. The model will be used to predict behavior of individuals, budget costs, and related savings of the program, along with the well-being of affected individuals. This framework will also be used to predict how proposed changes in the Medicaid Works program would affect behavior.

After considering the available data, we have decided that the MEPS, which provides information on earnings, hours worked, disability status (and many other health measures), health care coverage, health care utilization, and health care expenditures, is the most appropriate for our purposes. In Section 2, we describe these data. Then, in Sections 3 and 4, we develop a modelling framework that allows us to jointly evaluate decisions about whether to work, whether to collect government financial support and Medicaid, and how much to spend on medical care. Section 5 describes how to estimate the parameters of the structural model. We do not yet have estimates from this model. Sections 6 and 7 present additional technical details of the estimation algorithm and the data.

2 MEPS

To evaluate the Medicaid Works program, we propose using data from Medical Expenditure Panel Survey (MEPS). MEPS is a nationally representative survey of the U.S. civilian noninstitutionalized population that provides detailed information on earnings, hours worked, disability status and other health measures, health care coverage, health care utilization, and health care expenditures. With details on both labor market behaviors, health and disability, health insurance, and health care utilization and expenditures, MEPS provides much of information needed to evaluate the VA Medicaid Works Program.[2]

For this preliminary analysis, we assemble and examine data from the most recent wave (2007) of MEPS. In total, there are 30,964 respondents in the 2007 survey. To focus the analysis on the working-aged adults with disabilities, we drop the 9,182 respondents younger than 18, the 6,302 respondents older than 55, and the 14,347 respondents who are not disabled. We also drop another 73 respondents with missing data or no family income. Thus, our final sample includes 1,060 respondents.[3]

Moments of the included explanatory variables are presented in Table 1. This table provides information on the means, standard deviations, minima, and maxima for each explanatory variable. For each respondent, we observe variables on gender, race, education, age, region, marital status, number of dependents, union status, and whether the respondent's primary language is English. Relative to the general population, this sample has a higher proportion of females, blacks, and high school graduates. We also observe information on the health and health limitations of each respondent. In this sample of disabled working-aged adults, 76% report being in fair or poor health, 32% are classified as having troubles with instrumental activities of daily living (IADLS), and 17% have troubles with basic activities of daily living (ADLS). In contrast, only 20% of the 30,964 respondents in the full 2007 wave of MEPS report being in fair or poor health, 5% receive help for IADLS and 3% for ADLS.

In addition to these explanatory variables, we also observe decisions about whether to work, whether to collect government financial support and Medicaid, and how much to spend on medical care. Using this information, variables mea-

[2] A detailed list of the variables in MEPS can be found in http://www.meps.ahrq.gov/mepsweb/data_stats/download_data/pufs/h113/h113doc.pdf. See Section D. Also, coding details for these variables can be found at: http://www.meps.ahrq.gov/mepsweb/data_stats/download_data_files_codebook.jsp?PUFId=H113

[3] There are two ways we might supplement the sample for future analyses. First, we could examine other waves of the survey. This will be useful to improve the statistical precision of our estimators. Second, we might use other information in the survey. In the publicly available data, for example, there is a wide range of health and disability measures we do not include in this analysis. Restricted data may provide geographic identifies that would be useful if we want to account to details of state medicaid programs.

suring the respondents weekly consumption choices and income are constructed. For each respondent, we observe three types of consumption variables: leisure, medical care, and the consumption of all other goods and services. We define leisure as the fraction of time per week spent out of the labor market. We also observe three types of income: potential weekly earnings, government benefits – namely, SSI and SSDI – and other income which includes non-labor market income and income from family members. Using data on the hourly wage rate, potential weekly wages are found by computing how much a respondent could earn (in thousands of dollars) if she were to work 168 hours per week. Many respondents do not work, and thus we do not observe a hourly or weekly wage rate. As described below, we will impute wages for respondents that do not work. Finally, while MEPS does not provide information on medical prices or a standardized measure the quantity of care consumed, the survey does provide information on total expenditures, total out-of-pocket expenditures, and the number of different types of health care visits (i.e., office visits, outpatient visits, emergency room visits, and inpatient visits). As described in Section 7, we use the observed data on expenditures and visits to construct measures of the price per unit of medical care and the quantity of care consumed, both of which are measured in dollars.

Table 1: Moments of Explanatory Variables

Variable	Mean	Std Dev.	Minimum	Maximum
Male	0.39	0.49	0.00	1.00
Black	0.27	0.44	0.00	1.00
Age/100	0.41	0.11	0.18	0.55
High School Diploma	0.65	0.48	0.00	1.00
GED	0.06	0.23	0.00	1.00
College	0.15	0.36	0.00	1.00
Northeast	0.14	0.35	0.00	1.00
Midwest	0.23	0.42	0.00	1.00
South	0.37	0.48	0.00	1.00
Marry	0.36	0.48	0.00	1.00
# Dependents	2.34	1.50	0.00	10.00
English	0.90	0.29	0.00	1.00
Union	0.05	0.21	0.00	1.00
ADL	0.17	0.37	0.00	1.00
IADL	0.32	0.47	0.00	1.00
Poor Health	0.76	0.43	0.00	1.00

Table 2 provides information on the means, standard deviations, minima, and maxima for each of these variables. On average, respondents have potential earnings of $650 per week, but they spend 95% of their time out of the labor market. Thus, for many respondents, a large fraction of their weekly resources comes from non-wage income. Average weekly benefits from SSI/SSDI are about

$80 and other income averages $510 per week. Non-medical consumption averages about $680 per week.

Table 2: Moments of Other Variables

Variable	Mean	Std Dev	Minimum	Maximum
Leisure	0.95	0.09	0.52	1.00
Potential Wage	0.65	1.25	0.00	10.02
Other Income	0.51	0.64	0.00	5.53
Benefit Receipt	0.44	0.50	0.00	1.00
Benefit Amount	0.08	0.08	0.00	0.68
Medical Care	0.02	0.05	0.00	0.82
Medical Price	1.83	2.59	0.00	9.35
Consumption	0.66	0.68	0.08	5.52

Table 3 displays the conditional means of leisure, out-of-pocket medical expenditures per week (in thousands), benefit receipt and benefit levels per week by the different control variables. This table reveals, for example, that older respondents have much higher medical expenditures, rates of benefit receipt and benefit levels. Similar patterns are revealed for respondents in poor health. In contrasts, high school and college graduates have higher medical expenditures, but lower rates of benefit receipt and mean benefit levels.

Finally, we observe indicators of the types of medical insurance plans for each respondent. Table 4 summarizes the frequency of different combinations of coverage. There is much variation in the types of coverage. Nineteen percent of the respondent have no coverage, 22% are covered only by private insurance, 30% only by Medicaid, and 7% only by Medicare. The remaining 21% of respondents have more than one type of coverage.

Table 5 displays how weekly medical expenditures (in thousands) and the employment rate vary by the type of insurance coverage of the respondent. Interestingly, respondents with private coverage and Medicaid coverage have similar mean expenditure levels of about $220 per week, while those with no coverage and Medicare have expenditures of about $130 per week. Out-of-pocket expenditures vary between $10 and $40 per week depending on the type of coverage. The last panel of Table 5 shows interesting variation in employment rates and, among the employed, the fraction of time spent in the labor market stratified by the type of insurance coverage. Medicare and Medicaid recipients are the least attached to the labor market with employment rates of 0.07 and 0.11 respectively. In contrast, the employment rate for respondents with private insurance is 0.58, and the rate for those without insurance is nearly 0.50.

Table 3: Mean of Leisure, Medical Expenditure, Benefit Receipt, and Benefit Level Conditional on the Explanatory Variables

	Leisure		Medical Expenditure		Benefit Receipt		Benefit Levels (in $000s)	
Variable	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
Male	0.95	0.94	0.02	0.02	0.44	0.45	0.08	0.09
Black	0.94	0.96	0.02	0.01	0.42	0.5	0.08	0.09
Age < 30	0.95	0.95	0.01	0.02	0.35	0.46	0.05	0.09
High School Diploma	0.97	0.93	0.01	0.02	0.51	0.4	0.09	0.08
GED	0.95	0.96	0.02	0.01	0.45	0.32	0.09	0.06
College	0.95	0.91	0.01	0.03	0.47	0.3	0.09	0.07
Northeast	0.95	0.95	0.02	0.02	0.44	0.47	0.09	0.07
Midwest	0.95	0.95	0.02	0.02	0.44	0.46	0.08	0.09
South	0.94	0.95	0.02	0.02	0.42	0.47	0.08	0.09
Marry	0.95	0.94	0.01	0.02	0.53	0.3	0.10	0.07
# dependents	0.91	0.95	0.05	0.02	0.25	0.44	0.04	0.08
English	0.95	0.95	0.01	0.02	0.4	0.45	0.07	0.09
Union	0.95	0.81	0.02	0.01	0.47	0.04	0.09	0.01
IDL	0.94	0.98	0.02	0.02	0.41	0.58	0.08	0.12
IADL	0.93	0.98	0.02	0.02	0.37	0.59	0.07	0.11
Poor Health	0.92	0.96	0.01	0.02	0.37	0.47	0.07	0.09

Table 4. Frequency of Combinations of Insurance

Insurance Plans	**Frequency**	**Fraction**
Medicaid	318	0.30
Private	237	0.22
No Insurance	203	0.19
Medicaid & Medicare	143	0.13
Medicare	76	0.07
Private & Medicare	36	0.03
Private & Medicaid	22	0.02
Other Public	8	0.01
Private, Medicare & Medicaid	7	0.01
Medicaid & Other Public	6	0.01
Medicare & Other Public	5	0.00
Private & Other Public	2	0.00
Medicaid, Medicare & Other Public	1	0.00

Table 5: Moments of Medical Expenditures and Employment by Insurance Types

All Expenditures

Insurance	# Obs	mean	std dev	minimum	maximum
None	167	0.11	0.38	0	3.91
Private	294	0.23	0.34	0	2.22
Medicare	73	0.13	0.15	0	0.75
Medicaid	514	0.22	0.48	0	7.71
Other Public	7	0.13	0.17	0.08	0.42

Out of Pocket Expenditures

Insurance	# Obs	mean	std dev	minimum	maximum
None	167	0.02	0.03	0	0.2
Private	294	0.03	0.04	0	0.52
Medicare	73	0.02	0.03	0	0.2
Medicaid	514	0.01	0.02	0	0.12
Other Public	7	0.04	0.05	0	0.15

Employment

			Time Working Among Employed	
Insurance	# Obs	Rate	Fraction	std dev
None	167	0.47	0.15	0.09
Private	294	0.58	0.2	0.08
Medicare	73	0.07	0.09	0.04
Medicaid	514	0.17	0.11	0.07
Other Public	7	0.29	0.33	0.09

The models we eventually estimate depend critically on the density of shares of family income among leisure, medical care, and other consumption. Figure 1 shows the joint density of medical care and other consumption for those observations with observed wages, and Figure 2 shows the same for observations with missing wages. Leisure's share is implied by the condition that the three shares must add up to one. It is clear that leisure has, by far, the largest share and that medical care has a very small share. This is true for both observations with observed and missing wages. There are some observations where the consumption share is very close to 100%. This occurs not because the individual spends no time in leisure; rather it is because the individual's wage is low enough so the potential labor market income is very small.

Since medical expenditures have a very small share, we can focus on the share of consumption. Figure 3 shows the marginal distribution of consumption share for observations with and without observed wages. It is clear that there are not large differences between the two subsamples. Figures 4 and 5 show how the marginal distribution depends on family size. It is clear the consumption share increases with family size; this occurs because other family members consume out of the same share. Thus, in our structural model, it will be necessary to allow the marginal utility of consumption to depend on family size. However, both Figures 4 and 5 imply that the effect may be nonlinear in family size. Thus we will experiment with different ways to allow for a family size effect.

Figure 1: Density for Observations with Observed Wages

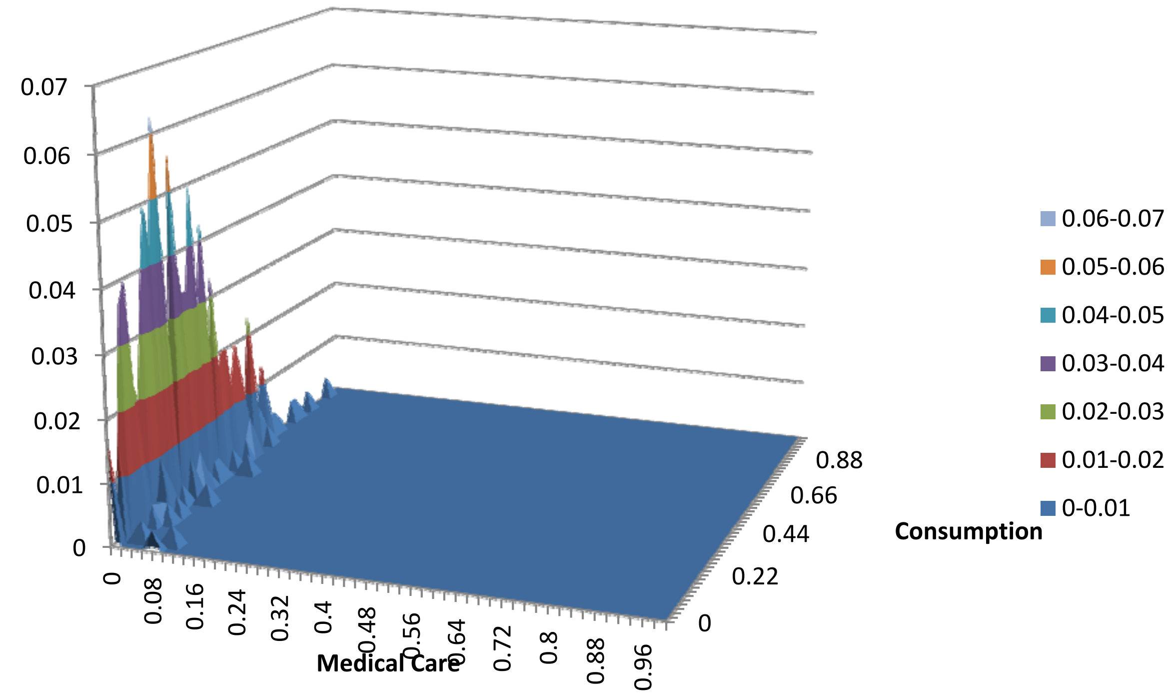
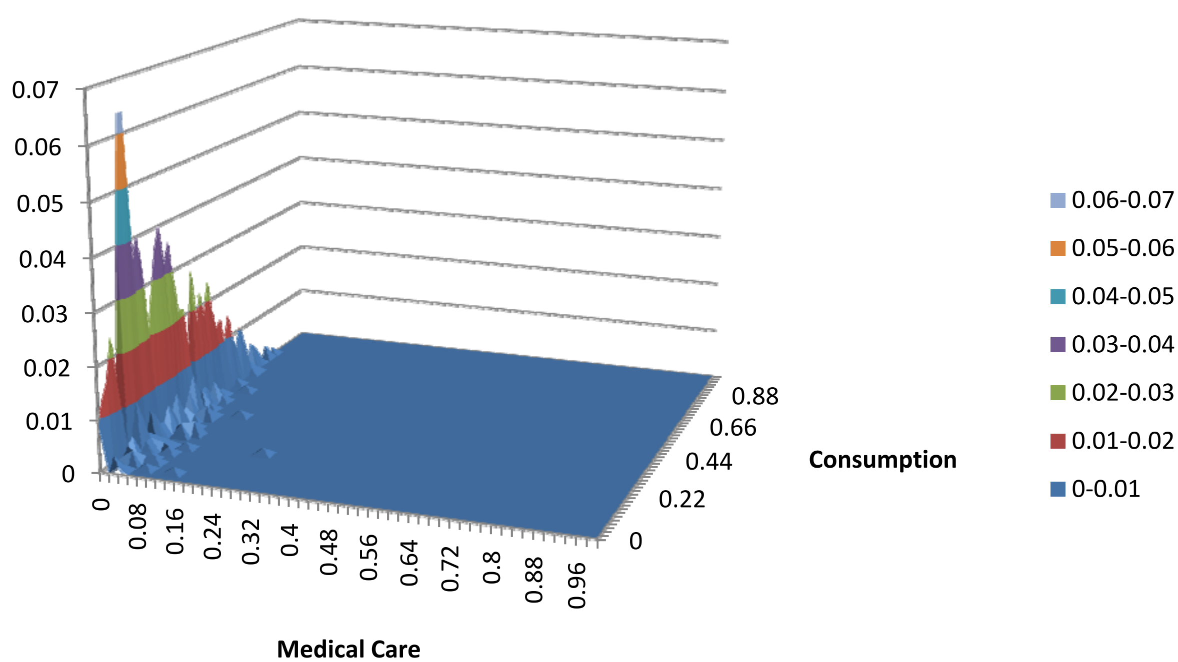


Figure 2: Density for Observations withMissing Wages



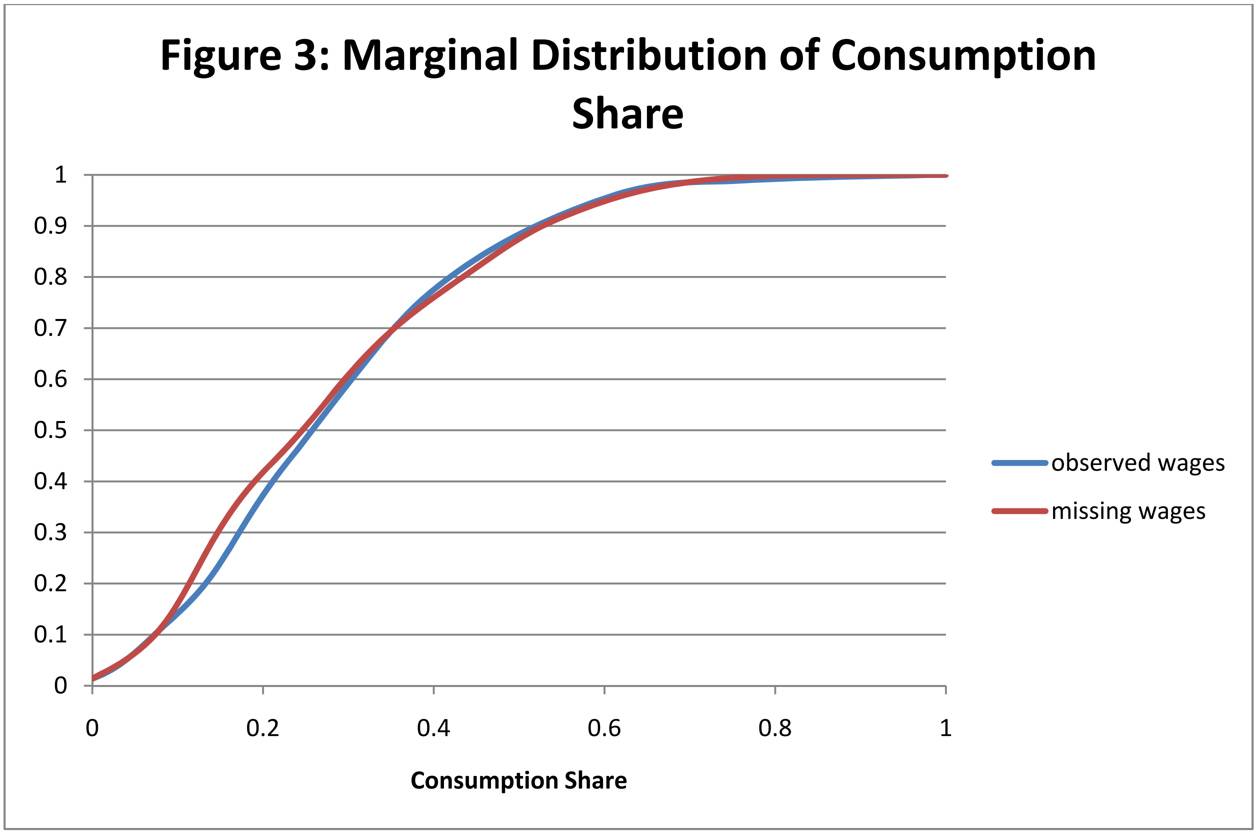


Figure 3: Marginal Distribution of Consumption Share
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
Consumption Share
observed wages
missing wages

Figure 4: Marginal Distribution of Consumption Share for Observations with Observed Wages

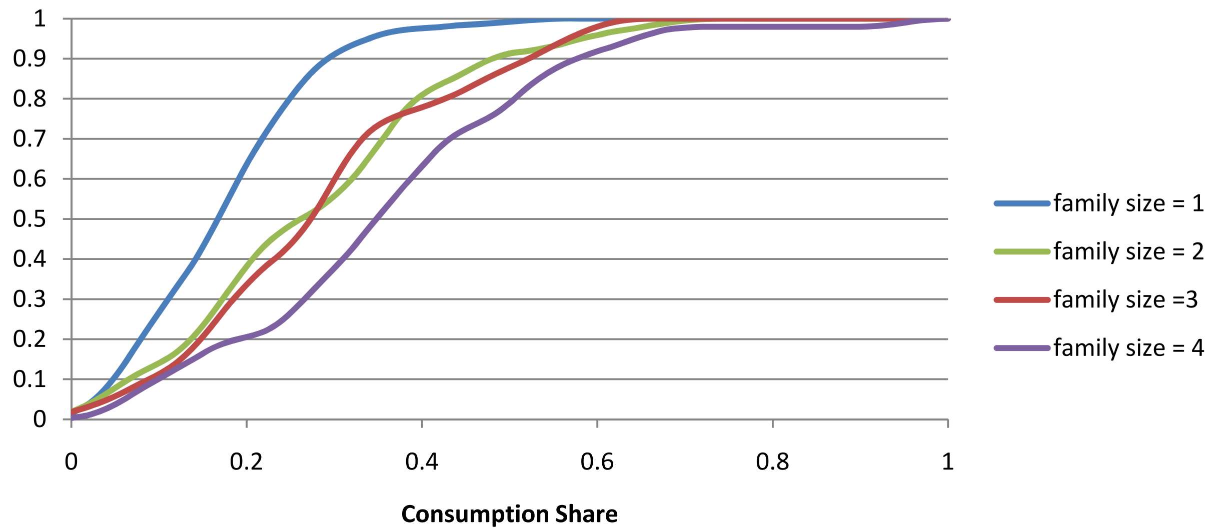
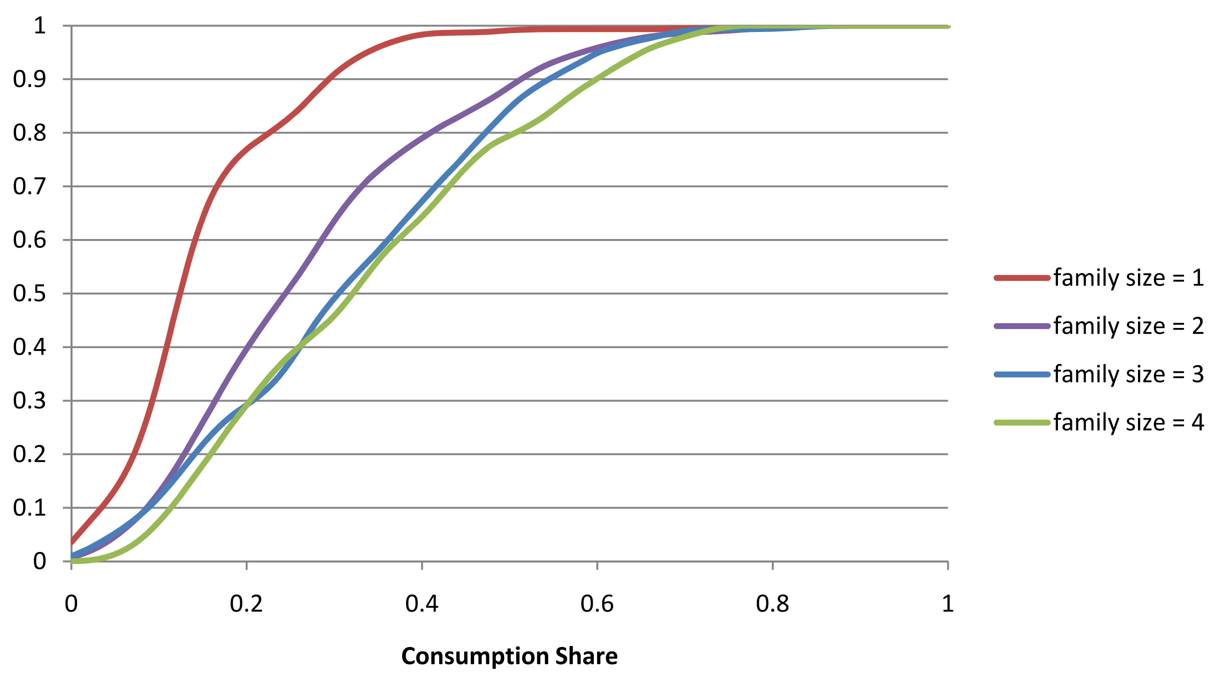


Figure 5: Marginal Distribution of Consumption Share for Observations with Missing Wages



3 Big Picture

We want to construct a model where agents in the model have to make decisions about whether to work, whether to collect government financial support and Medicaid, and how much to spend on medical care. Eventually, we want to address the following questions:

1. How valuable is Medicaid eligibility to disabled people?
2. How valuable is Medicaid relative to Medicare (extra drug benefits, lower copays)?
3. How does the nature of one's disability interact with the other issues?
4. What would the government budgetary effects and personal effects be of expanding the set of income-eligible people for Medicaid Works?
5. Effect on reductions in other govt benefits and work hours

Answering these questions requires us to evaluate the interplay between health, health insurance, consumption and employment. To do this, we develop a model of behavior where disabled individuals are making decisions about insurance coverage, medical care, leisure and consumption. There are several substantial advantages of developing this type of model. Most notably, specifying relationships among all of the important variables – program participation, employment, and medical care – forces us to think about the system as a whole and imposes significant discipline on the research process in that any proposed explanation for behavior in one part of the model must be consistent with all parts of the model. Finally, the complete structure of the model will allow us to perform a number of mathematical policy experiments using the estimated parameters of the model to predict the effects of changes in policy or of important environmental factors. For example, we will predict labor market changes resulting from expansions to the set of income-eligible people for Medicaid Works.

We begin by sketching out the basic ideas of model, and provide additional details in Section 4. Let h_{ijt} be the number of hours worked by person j in state i at time t, and let w_{ij} be his time-invariant hourly wage. Define $y_{ijt} = w_{ij}h_{ijt} + v_{ijt}$ as his income if not eligible for government support where v_{ijt} is non-labor-market income. If a person satisfies eligibility requirements $e_i\left(y_{ijt}, a_{ijt}\right) > u_{ijt}$ where $e_i\left(\cdot,\cdot\right)$ is a state-specific eligibility rule, a_{ijt} is the agent's assets,[4] and u_{ijt} is a threshhold that might depend on other characteristics of the agent including "stigma effects" or other effects that cause eligibles to not participate,[5] then he can receive b_{ijt} as a government benefit and enroll in Medicaid. Thus, if not eligible for the government subsidy, then his budget constraint is

$$w_{ij}h_{ijt} + v_{ijt} \geq c_{ijt} + p_{ijt}m_{ijt}$$

[4] Almost surely, we will have to ignore assets because of data issues.

[5] We might want to remodel to have two conditions necessary for participation: eligibility and voluntary participation.

where c_{ijt} is consumption on all goods other than medical care (numeraire), p_{ijt} is the out-of-pocket price of medical care, and m_{ijt} is the units of medical care consumed. If eligible for the government subsidy, then his budget constraint is

$$b_{ijt} + w_{ij} h_{ijt} + v_{ijt} \geq c_{ijt}.$$

The agent's utility function is

$$U\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right)$$

where x_{ijt} is a vector of exogenous observable taste-shifters (including some measures of health), ε_{ijt} summarizes the effect of a vector of exogenous unobservable taste-shifters (including some measures of health), and where $U_1 < 0$, $U_2 > 0$, and $U_{33} < 0$ with a maximum at $m^+\left(x_{ijt}, \varepsilon_{ijt}\right)$.

We can think of the choices made each period as first a) whether to work $d^1_{ijt} = 1\left(h_{ijt} > 0\right)$ and whether to participate in the government program $d^2_{ijt} = 1\left(E_i\left(y_{ijt}, a_{ijt}\right) > u_{ijt}\right)$. Conditional on the choice of $d_{ijt} = \left(d^1_{ijt}, d^2_{ijt}\right)$, the agent chooses the continuous choices h_{ijt} (if $d^1_{ijt} = 1$), c_{ijt}, and m_{ijt}. Let $q^*_{ijt} = \left(h^*_{ijt}, c^*_{ijt}, m^*_{ijt}\right)$ be the value of $q_{ijt} = \left(h_{ijt}, c_{ijt}, m_{ijt}\right)$ that maximizes utility given d_{ijt}.[6] We can construct the likelihood of someone choosing $q^*_{ijt} = \left(h^*_{ijt}, c^*_{ijt}, m^*_{ijt}\right)$ conditional on x_{ijt}.

4 Modelling Details

To complete the model, we must specify $U\left(\cdot \mid \cdot\right)$. The specification must allow for the role of enough unobserved components to avoid stochastic degeneracy. Also, it must have the feature that medical consumption is satiable to explain why an individual would not consume infinite care when all care is paid by insurance. Consider the utility function,

$$\begin{aligned} & U\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) \\ = \; & \beta^l_{ijt} \log\left(1 - h_{ijt} - \alpha^l\right) + \beta^c_{ijt} \log\left(c_{ijt} - \alpha^c\right) \\ & + \beta^m_{ijt} \log\left(m_{ijt} - \alpha^m_{ijt} + \gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)^2\right) + d^2_{ijt}\mu^d_{ijt} \end{aligned} \tag{1}$$

where

$$\begin{aligned} \beta^l_{ijt} &= \frac{\exp\left\{x_{ijt}\delta_l + \varepsilon^l_{ijt}\right\}}{1 + \sum_{k=l,c} \exp\left\{x_{ijt}\delta_k + \varepsilon^k_{ijt}\right\}}, \\ \beta^c_{ijt} &= \frac{\exp\left\{x_{ijt}\delta_c + \varepsilon^c_{ijt}\right\}}{1 + \sum_{k=l,c} \exp\left\{x_{ijt}\delta_k + \varepsilon^k_{ijt}\right\}} \\ \beta^m_{ijt} &= \frac{1}{1 + \sum_{k=l,c} \exp\left\{x_{ijt}\delta_k + \varepsilon^k_{ijt}\right\}} \\ \gamma_{ijt} &= -\exp\left\{x_{ijt}\delta_\gamma\right\} \end{aligned}$$

[6] It does not seem worthwhile to model dynamics because the dynamics associated with program are not that important and because the data we intend to use is a relatively short panel.

are "parameters" in the Stone-Geary utility specification that (possibly) depend on observable characteristics x_{ijt} and unobservable characteristics $\left(\varepsilon_{ijt}^{l}, \varepsilon_{ijt}^{c}\right)$, $\left(\alpha^{l}, \alpha^{c}, \alpha_{ijt}^{m}\right)$ are Stone-Geary minimum consumption levels,[7]

$$\alpha_{ijt}^{m} = x_{ijt}\delta_{\alpha} + \varepsilon_{ijt}^{\alpha}$$

$1 - h_{ijt}$ is leisure, and

$$\mu_{ijt}^{d} = x_{ijt}\delta_{d} + \varepsilon_{ijt}^{d}$$

is the stigma effect. Note that α_{ijt}^{m} can be negative; otherwise, $U\left(h\cdot \mid \cdot\right)$ is not defined in the neighborhood where $m_{ijt} + \gamma_{ijt}m_{ijt}^{2} - \alpha_{ijt}^{m} = 0$ (which occurs at $m_{ijt} > 0$). Assume that

$$\begin{aligned} \varepsilon_{ijt}^{k} &= e_{ij}^{k} + \eta_{ijt}^{k}, k = l, c, d, \alpha \\ \begin{pmatrix} e_{ij}^{l} \\ e_{ij}^{c} \\ e_{ij}^{d} \\ e_{ij}^{\alpha} \end{pmatrix} &\sim iidN\left(0, \Omega_{e}\right), \qquad (2) \\ \begin{pmatrix} \eta_{ij}^{l} \\ \eta_{ij}^{c} \\ \eta_{ij}^{d} \\ \eta_{ij}^{\alpha} \end{pmatrix} &\sim iidN\left(0, \Omega_{\eta}\right) \qquad (3) \end{aligned}$$

with $\Omega_{\eta 33} = 1$ (for identification).

The first order conditions (FOCs) for this model for a working individual consuming positive medical care are

$$\begin{aligned} U_{l}\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) &= \frac{\beta_{ijt}^{l}}{l_{ijt} - \alpha^{l}} - \lambda w_{ijt} = 0 \\ U_{c}\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) &= \frac{\beta_{ijt}^{c}}{c_{ijt} - \alpha^{c}} - \lambda = 0 \\ U_{m}\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) &= \frac{\beta_{ijt}^{m}\left(1 + 2\gamma_{ijt}\left(m_{ijt} - \alpha_{ijt}^{m}\right)\right)}{\left(m_{ijt} - \alpha_{ijt}^{m}\right) + \gamma_{ijt}\left(m_{ijt} - \alpha_{ijt}^{m}\right)^{2}} \qquad (4) \\ -\lambda p_{ijt} &= 0 \\ w_{ij}h_{ijt} + v_{ijt} + d_{ijt}^{2}b_{ijt} &= c_{ijt} + p_{ijt}m_{ijt}. \end{aligned}$$

Note that equation (1) requires that

$$\begin{aligned} 0 &< m_{ijt} - \alpha_{ijt}^{m} \\ &\Rightarrow 0 < m_{ijt} - \left(x_{ijt}\delta_{\alpha} + \varepsilon_{ijt}^{\alpha}\right) \\ &\Rightarrow \eta_{ijt}^{\alpha} < m_{ijt} - x_{ijt}\delta_{\alpha} - e_{ij}^{\alpha} \qquad (5) \end{aligned}$$

[7] We let α_{ijt}^{m} depend on observables and an error to avoid stochastic degeneracy associated with individuals choosing no medical care. There is no need to let the other α terms vary across individuals.

equation (4) requires that

$$\begin{aligned} 0 &\leq 1 + 2\gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right) \\ &\Rightarrow -\frac{1}{2\gamma_{ijt}} \geq m_{ijt} - \alpha^m_{ijt} \\ &\Rightarrow -\frac{1}{2\gamma_{ijt}} \geq m_{ijt} - \left(x_{ijt}\delta_\alpha + \varepsilon^\alpha_{ijt}\right) \\ &\Rightarrow \eta^\alpha_{ijt} \geq \frac{1}{2\gamma_{ijt}} + m_{ijt} - x_{ijt}\delta_\alpha - e^\alpha_{ij}. \end{aligned} \tag{6}$$

Equations (5) and (6) together require

$$\underline{Z}_{ijt} = \frac{1}{2\gamma_{ijt}} + m_{ijt} - x_{ijt}\delta_\alpha - e^\alpha_{ij} \leq \varepsilon^\alpha_{ijt} < m_{ijt} - x_{ijt}\delta_\alpha - e^\alpha_{ij} = \overline{Z}_{ijt}. \tag{7}$$

Equation (4) can be rearranged to

$$\frac{\beta^l_{ijt}}{w_{ijt}\left(l_{ijt} - \alpha^l\right)} = \frac{\beta^m_{ijt}\left(1 + 2\gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)\right)}{p_{it}\left(m_{ijt} + \gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)^2\right)}$$

$\Rightarrow$

$$l_{ijt} = \alpha^l + \frac{\beta^l_{ijt}}{\beta^m_{ijt}} \frac{p_{ijt}\left(\left(m_{ijt} - \alpha^m_{ijt}\right) + \gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)^2\right)}{w_{ijt}\left(1 + 2\gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)\right)} \tag{8}$$

$$c_{ijt} = \alpha^c + \frac{\beta^c_{ijt}}{\beta^m_{ijt}} \frac{p_{ijt}\left(\left(m_{ijt} - \alpha^m_{ijt}\right) + \gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)^2\right)}{\left(1 + 2\gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)\right)} \tag{9}$$

$$\begin{aligned} & w_{ij}\left[1 - \alpha^l - \frac{\beta^l_{ijt}}{\beta^m_{ijt}} \frac{p_{ijt}\left(\left(m_{ijt} - \alpha^m_{ijt}\right) + \gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)^2\right)}{w_{ijt}\left(1 + 2\gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)\right)}\right] \\ & + v_{ijt} + d^2_{ijt}b_{ijt} \\ = & \alpha^c + \frac{\beta^c_{ijt}}{\beta^m_{ijt}} \frac{p_{ijt}\left(\left(m_{ijt} - \alpha^m_{ijt}\right) + \gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)^2\right)}{\left(1 + 2\gamma_{ijt}\left(m_{ijt} - \alpha^m_{ijt}\right)\right)} + p_{ijt}m_{ijt}. \end{aligned} \tag{10}$$

Note that, when $p_{ijt} = 0$ (because of medical insurance provisions), equation (4) becomes

$$m_{ijt} = \alpha^m_{ijt} - \frac{1}{2\gamma_{ijt}}; \tag{11}$$

thus if α^m_{ijt} were either constant or did not have a random component, the model would be stochastically degenerate. Also note that, when $\gamma_{ijt} = 0$, equations

(8), (9), and (10) further simplify to

$$
\begin{aligned}
m_{ijt} &= \alpha^m_{ijt} + \frac{\beta^m_{ijt}}{p_{ijt}}\left[v_{ijt} + d^2_{ijt}b_{ijt} + w_{ij}\left(1-\alpha^l\right) - \alpha^c - p_{ijt}\alpha^m_{ijt}\right] \\
l_{ijt} &= \alpha^l + \frac{\beta^l_{ijt}}{w_{ijt}}\left[v_{ijt} + d^2_{ijt}b_{ijt} + w_{ij}\left(1-\alpha^l\right) - \alpha^c - p_{ijt}\alpha^m_{ijt}\right] \\
c_{ijt} &= \alpha^c + \beta^c_{ijt}\left[v_{ijt} + d^2_{ijt}b_{ijt} + w_{ij}\left(1-\alpha^l\right) - \alpha^c - p_{ijt}\alpha^m_{ijt}\right].
\end{aligned}
$$

In general, equations (8), (9), and (10) can be thought of as two equations[8] in two unknowns $(\varepsilon^l_{ijt}, \varepsilon^c_{ijt})$ and be solved for using nonlinear methods. We can determine the threshhold for ε^d_{ijt} and integrate over ε^α_{ijt}. The threshhold for ε^d_{ijt} is

$$
\begin{aligned}
H_{ijt} = {} & \left[U\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}, d^2_{ijt} = 1\right) - \eta^d_{ijt}\right] \\
& - \left[U\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}, d^2_{ijt} = 0\right)\right]
\end{aligned}
$$

The FOCs for a working individual consuming no medical care are

$$
\begin{aligned}
U_l\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) &= \frac{\beta^l_{ijt}}{l_{ijt} - \alpha^l} - \lambda w_{ijt} = 0 \\
U_c\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) &= \frac{\beta^c_{ijt}}{c_{ijt} - \alpha^c} - \lambda = 0 \\
U_m\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) &= \frac{\beta^m_{ijt}\left(1 - 2\gamma_{ijt}\alpha^m_{ijt}\right)}{\gamma_{ijt}\left(\alpha^m_{ijt}\right)^2 - \alpha^m_{ijt}} - \lambda p_{ijt} \le 0 \\
w_{ij}h_{ijt} + v_{ijt} + d^2_{ijt}b_{ijt} &= c_{ijt}
\end{aligned}
$$

which simplify to

$$
l_{ijt} = \alpha^l + \frac{\beta^l_{ijt}}{w_{ijt}}\left[v_{ijt} + d^2_{ijt}b_{ijt} + w_{ij}\left(1-\alpha^l\right) - \alpha^c\right] \quad (12)
$$

$$
c_{ijt} = \alpha^c + \beta^c_{ijt}\left[v_{ijt} + d^2_{ijt}b_{ijt} + w_{ij}\left(1-\alpha^l\right) - \alpha^c\right] \quad (13)
$$

$$
\frac{\beta^m_{ijt}\left(1 - 2\gamma_{ijt}\alpha^m_{ijt}\right)}{\gamma_{ijt}\left(\alpha^m_{ijt}\right)^2 - \alpha^m_{ijt}} \le \frac{\beta^c_{ijt}}{c_{ijt} - \alpha^c}p_{ijt}. \quad (14)
$$

We can solve equations (12) and (13) for $(\varepsilon^l_{ijt}, \varepsilon^c_{ijt})$ and then use the remaining inequality constraints for the other errors.

The FOCs for a non-working individual consuming medical care are

$$
U_l\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) = \frac{\beta^l_{ijt}}{l_{ijt} - \alpha^l} - \lambda w_{ijt} \ge 0 \quad (15)
$$

$$
U_c\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) = \frac{\beta^c_{ijt}}{c_{ijt} - \alpha^c} - \lambda = 0 \quad (16)
$$

[8] The third equation is implied by the budget constraint and is redundant.

$$
\begin{aligned}
& U_m\left(h_{ijt}, c_{ijt}, m_{ijt} \mid x_{ijt}, \varepsilon_{ijt}\right) && (17)\\
= \quad & \frac{\beta_{ijt}^{m}\left(1+2\gamma_{ijt}\left(m_{ijt}-\alpha_{ijt}^{m}\right)\right)}{\left(m_{ijt}-\alpha_{ijt}^{m}\right)+\gamma_{ijt}\left(m_{ijt}-\alpha_{ijt}^{m}\right)^{2}}-\lambda p_{ijt}=0 \\
v_{ijt}+d_{ijt}^{2} b_{ijt} \quad \geq \quad & c_{ijt}+p_{ijt} m_{ijt}
\end{aligned}
$$

which can be simplified to get two equations in two unknowns $(\varepsilon_{ijt}^{m}, \varepsilon_{ijt}^{c})$. Then we can find the thresholds for $(\varepsilon_{ijt}^{l}, \varepsilon_{ijt}^{d})$ and integrate over $\varepsilon_{ijt}^{\alpha}$. The FOCs for a non-working individual consuming no medical care are straightforward given the other cases.

5 Econometrics

The log likelihood function is the joint density/distribution of the errors that are consistent with the choices observed in the data. There are eight cases in the data, corresponding to the eight cases for which first order conditions are described above.

1. $h_{ijt} > 0$, $p_{ijt} > 0$, and $m_{ijt} > 0$: Write the conditions in equations (8), (9), and (10) as

$$G_1\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{l}, \varepsilon_{ijt}^{c}\right)=0$$

where $y_{ijt} = (h_{ijt}, c_{ijt}, m_{ijt})$. Define

$$G_1^{-1}\left(y_{ijt}, x_{ijt}, 0\right)=\left(\varepsilon_{ijt}^{l}, \varepsilon_{ijt}^{c}\right).$$

Then the likelihood contribution for $ijt \mid e$ is

$$L_{ijt}^{1}(e)=\int_{\underline{Z}_{ijt}}^{\overline{Z}_{ijt}} \int_{\underline{H}_{ijt}}^{\overline{H}_{ijt}} \Im_1 f_\eta\left[G_1^{-1}\left(y_{ijt}, x_{ijt}, 0\right)-\left(e_{ijt}^{l}, e_{ijt}^{c}\right), \eta_d, \eta_\alpha\right] d\eta_d d\eta_\alpha$$

where $f_\eta[\cdot]$ is the joint density of η defined in equation (3), $\Im_1$ is the Jacobian corresponding to $G_1^{-1}(\cdot)$, and $\left(\underline{H}_{ijt}, \overline{H}_{ijt}\right)$ are the threshholds corresponding to the benefit choice:

$$\begin{pmatrix} \overline{H}_{ijt} \\ \underline{H}_{ijt} \end{pmatrix} = \begin{cases} \begin{pmatrix} -H_{ijt} \\ -\infty \end{pmatrix} & \text{if } d_{ijt}^{2}=0 \\ \begin{pmatrix} \infty \\ -H_{ijt} \end{pmatrix} & \text{if } d_{ijt}^{2}=1 \end{cases}$$

(note that $\left(\underline{H}_{ijt}, \overline{H}_{ijt}\right)$ depends on e) and $\left(\underline{Z}_{ijt}, \overline{Z}_{ijt}\right)$ are defined in equation (7).

2. $h_{ijt} > 0$, $p_{ijt} > 0$, and $m_{ijt} = 0$: Write the conditions in equations (12) and (13) as

$$G_2\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{l}, \varepsilon_{ijt}^{c}\right)=0,$$

and define

$$G_2^{-1}\left(y_{ijt}, x_{ijt}, 0\right) = \left(\varepsilon_{ijt}^l, \varepsilon_{ijt}^c\right).$$

Also write the condition in equation (14) as

$$G_{2a}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^l, \varepsilon_{ijt}^c, \varepsilon_{ijt}^\alpha\right) \leq 0,$$

and define

$$G_{2a}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^l, \varepsilon_{ijt}^c\right) \geq \varepsilon_{ijt}^\alpha$$

as the condition on ε_{ijt}^α. Then the likelihood contribution for $ijt \mid e$ is

$$L_{ijt}^2(e) = \int_{\underline{H}_{ijt}}^{\overline{H}_{ijt}} \int_{-\infty}^{G_{2a}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^l, \varepsilon_{ijt}^c\right)} \Im_2 f_\eta \left[G_2^{-1}\left(y_{ijt}, x_{ijt}, 0\right) - \left(e_{ijt}^l, e_{ijt}^c\right), \eta_d, \eta_\alpha\right] d\eta_\alpha d\eta_d$$

where $\Im_2$ is the Jacobian for $G_2^{-1}(\cdot)$.

3. $h_{ijt} > 0$, $p_{ijt} = 0$, and $m_{ijt} > 0$: Write the conditions in equations (12), (13), and (11) as

$$G_3\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^l, \varepsilon_{ijt}^c, \varepsilon_{ijt}^\alpha\right) = 0,$$

and define

$$G_3^{-1}\left(y_{ijt}, x_{ijt}, 0\right) = \left(\varepsilon_{ijt}^l, \varepsilon_{ijt}^c, \varepsilon_{ijt}^\alpha\right).$$

Then the likelihood contribution for $ijt \mid e$ is[9]

$$L_{ijt}^3(e) = \int_{\underline{H}_{ijt}}^{\overline{H}_{ijt}} \Im_3 f_\eta \left[G_3^{-1}\left(y_{ijt}, x_{ijt}, 0\right) - \left(e_{ijt}^l, e_{ijt}^c, e_{ijt}^\alpha\right), \eta_d\right] d\eta_d$$

where $\Im_3$ is the Jacobian for $G_3^{-1}(\cdot)$.

4. $h_{ijt} > 0$, $p_{ijt} = 0$, and $m_{ijt} = 0$: This the same as in (2) except with $p_{ijt} = 0$.

5. $h_{ijt} = 0$, $p_{ijt} > 0$, and $m_{ijt} > 0$: Write the conditions in equations (16) and (17) as

$$G_5\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^c\right) = 0,$$

and define

$$G_5^{-1}\left(y_{ijt}, x_{ijt}, 0\right) = \varepsilon_{ijt}^c.$$

Also write the condition in equation (15) as

$$G_{5a}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^l, \varepsilon_{ijt}^c\right) \leq 0,$$

[9] Note the small abuse of notation associated with changing the order of errors in some of these equations in $f\eta[\cdot]$.

and define

$$G_{5a}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}\right) \geq \varepsilon_{ijt}^{l}$$

as the condition on ε_{ijt}^{l}. Then the likelihood contribution for ij is

$$L_{ijt}^{5}(e) = \int_{\underline{Z}_{ijt}}^{\overline{Z}_{ijt}} \int_{\underline{H}_{ijt}}^{\overline{H}_{ijt}} \int_{-\infty}^{G_{5a}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}\right)} \Im_5 f_\eta \left[G_5^{-1}\left(y_{ijt}, x_{ijt}, 0\right) - e_{ijt}^{c}, \eta_l, \eta_d, \eta_\alpha\right] d\eta_l d\eta_d d\eta_\alpha$$

where $\Im_5$ is the Jacobian for $G_5^{-1}(\cdot)$.

6. $h_{ijt} = 0$, $p_{ijt} > 0$, and $m_{ijt} = 0$: Write the condition in equation (16) as

$$G_6\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}\right) = 0,$$

and define

$$G_6^{-1}\left(y_{ijt}, x_{ijt}, 0\right) = \varepsilon_{ijt}^{c}.$$

Also write the condition in equation (15) as

$$G_{6a}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{l}, \varepsilon_{ijt}^{c}\right) \leq 0,$$

and define

$$G_{6a}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}\right) \geq \varepsilon_{ijt}^{l}$$

as the condition on ε_{ijt}^{l}; write the condition in equation (14) as

$$G_{6b}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}, \varepsilon_{ijt}^{l}, \varepsilon_{ijt}^{\alpha}\right) \geq 0,$$

and define

$$G_{6b}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}, \varepsilon_{ijt}^{l}\right) \geq \varepsilon_{ijt}^{\alpha}$$

as the condition on ε_{ijt}^{m}. Then the likelihood contribution for ij is

$$L_{ijt}^{6}(e) = \int_{\underline{H}_{ijt}}^{\overline{H}_{ijt}} \int_{-\infty}^{G_{6b}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}, \varepsilon_{ijt}^{l}\right)} \int_{-\infty}^{G_{6a}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}\right)} \Im_6 \cdot f_\eta \left[G_6^{-1}\left(y_{ijt}, x_{ijt}, 0\right) - e_{ijt}^{c}, \eta_l, \eta_d, \eta_\alpha\right] d\eta_l d\eta_\alpha d\eta_d$$

where $\Im_6$ is the Jacobian for $G_6^{-1}(\cdot)$.

7. $h_{ijt} = 0$, $p_{ijt} = 0$, and $m_{ijt} > 0$: Write the conditions in equations (16) and (11) as

$$G_7\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}, \varepsilon_{ijt}^{\alpha}\right) = 0,$$

and define

$$G_7^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}, 0\right) = \varepsilon_{ijt}^{\alpha}.$$

Also write the condition in equation 15) as

$$G_{7a}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{l}, \varepsilon_{ijt}^{c}\right) \leq 0,$$

and define

$$G_{7a}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}\right) \geq \varepsilon_{ijt}^{l}$$

as the condition on ε_{ijt}^{l}. Then the likelihood contribution for ij is

$$\begin{aligned} L_{ijt}^{7}(e) &= \int_{\underline{H}_{ijt}}^{\overline{H}_{ijt}} \int_{-\infty}^{\infty} \int_{-\infty}^{G_{7a}^{-1}\left(y_{ijt}, x_{ijt}, \varepsilon_{ijt}^{c}\right)} \Im_{7} f_{\eta}\left[\eta_{l}, \eta_{c},\right. \\ &\left.\eta_{d}, G_{72}^{-1}\left(y_{ijt}, x_{ijt}, 0\right) - e_{ijt}^{\alpha}\right] d\eta_{l} d\eta_{c} d\eta_{d} \end{aligned}$$

where $\Im_{7}$ is the Jacobian for $G_{7}^{-1}(\cdot)$.

8. $h_{ijt} = 0$, $p_{ijt} = 0$, and $m_{ijt} = 0$: This is the same as in (6) except with $p_{ijt} = 0$.

$$\int \prod_{t} L_{ijt}^{k_{ijt}}(e)\, dF_{e}(e)$$

where and $F_{e}(\cdot)$ is the joint distribution of e defined in equation (2) and k_{ijt} defines which case applies to ijt.

Table 6 displays the frequency of respondents in the MEPS data in each of these eight cases. Most respondents are either not working with medical care at a non-zero price (case 5) or are working with medical care at a non-zero price (case 1). There are no respondents making choices consistent with case 2 and case 6.

Table 6: Frequency of "Types" of Individuals

Type	**Frequency**	**Fraction**
h>0; p>0; m>0	303	0.29
h>0; p>0; m = 0	0	0.00
h >0; p = 0; m >0	18	0.02
h >0; p = 0; m =0	25	0.02
h = 0; p>0; m > 0	626	0.59
h = 0; p>0; m = 0	0	0.00
h = 0; p = 0; m >0	39	0.04
h =0; p=0; m = 0	44	0.04

Notes: h ≡ hours worked; p ≡ out of pocket price for care ;m ≡ medical care.

6 Appendix: Details for Estimation

1. $h_{ijt} > 0$, $p_{ijt} > 0$, and $m_{ijt} > 0$: Equations (8) and (9) can be written as

$$
\begin{aligned}
\frac{\beta^l_{ijt}}{\beta^m_{ijt}} &= \frac{w_{ijt}\left(1+2\gamma_{ijt}\left(m_{ijt}-\alpha^m_{ijt}\right)\right)}{p_{ijt}\left(\left(m_{ijt}-\alpha^m_{ijt}\right)+\gamma\left(m_{ijt}-\alpha^m_{ijt}\right)^2\right)}\left(l_{ijt}-\alpha^l\right) \\
\frac{\beta^c_{ijt}}{\beta^m_{ijt}} &= \frac{\left(1+2\gamma_{ijt}\left(m_{ijt}-\alpha^m_{ijt}\right)\right)}{p_{ijt}\left(\left(m_{ijt}-\alpha^m_{ijt}\right)+\gamma_{ijt}\left(m_{ijt}-\alpha^m_{ijt}\right)^2\right)}\left(c_{ijt}-\alpha^c\right)
\end{aligned}
$$

$$
\begin{aligned}
\eta^l_{ijt} &= \log\left[\frac{w_{ijt}\left(1+2\gamma_{ijt}\left(m_{ijt}-\alpha^m_{ijt}\right)\right)}{p_{ijt}\left(\left(m_{ijt}-\alpha^m_{ijt}\right)+\gamma\left(m_{ijt}-\alpha^m_{ijt}\right)^2\right)}\left(l_{ijt}-\alpha^l\right)\right] \\
&\quad -\left(x_{ijt}\delta_l+e^l_{ij}\right) \\
\eta^c_{ijt} &= \log\left[\frac{\left(1+2\gamma_{ijt}\left(m_{ijt}-\alpha^m_{ijt}\right)\right)}{p_{ijt}\left(\left(m_{ijt}-\alpha^m_{ijt}\right)+\gamma_{ijt}\left(m_{ijt}-\alpha^m_{ijt}\right)^2\right)}\left(c_{ijt}-\alpha^c\right)\right] \\
&\quad -\left(x_{ijt}\delta_c+e^c_{ij}\right).
\end{aligned}
$$

$$
\Im_1 = \begin{vmatrix} \left(l_{ijt}-\alpha^l\right)^{-1} & 0 \\ 0 & \left(c_{ijt}-\alpha^c\right)^{-1} \end{vmatrix}
$$

2. $h_{ijt} > 0$, $p_{ijt} > 0$, and $m_{ijt} = 0$: Equations (12) and (13) can be written as

$$
\begin{aligned}
\eta^l_{ijt} &= \log\left[\frac{w_{ijt}}{v_{ijt}+d^2_{ijt}b_{ijt}+w_{ij}\left(1-\alpha^l\right)-\alpha^c}\left(l_{ijt}-\alpha^l\right)\right] \qquad (18) \\
&\quad -\left(x_{ijt}\delta_l+e^l_{ij}\right) \\
\eta^c_{ijt} &= \log\left[\frac{\left(c_{ijt}-\alpha^c\right)}{v_{ijt}+d^2_{ijt}b_{ijt}+w_{ij}\left(1-\alpha^l\right)-\alpha^c}\right] \qquad (19) \\
&\quad -\left(x_{ijt}\delta_c+e^c_{ij}\right),
\end{aligned}
$$

and then equation (14) can be written as

$$
\begin{aligned}
0 &\geq -\gamma_{ijt}\frac{\beta^c_{ijt}/\beta^m_{ijt}}{c_{ijt}-\alpha^c}p_{ijt}\left(\alpha^m_{ijt}\right)^2+\left[\frac{\beta^c_{ijt}/\beta^m_{ijt}}{c_{ijt}-\alpha^c}p_{ijt}-2\gamma_{ijt}\right]\alpha^m_{ijt}+1; \\
\eta^\alpha_{ij} &\leq \left[\frac{\left[\frac{\beta^c_{ijt}/\beta^m_{ijt}}{c_{ijt}-\alpha^c}p_{ijt}-2\gamma_{ijt}\right]+\sqrt{\left[\frac{\beta^c_{ijt}/\beta^m_{ijt}}{c_{ijt}-\alpha^c}p_{ijt}-2\gamma_{ijt}\right]^2+4\gamma_{ijt}\frac{\beta^c_{ijt}/\beta^m_{ijt}}{c_{ijt}-\alpha^c}p_{ijt}}}{2\gamma_{ijt}\frac{\beta^c_{ijt}/\beta^m_{ijt}}{c_{ijt}-\alpha^c}p_{ijt}}\right] \qquad (20) \\
&\quad -\left(x_{ijt}\delta_\alpha+e^\alpha_{ij}\right)
\end{aligned}
$$

$$\Im_2 = \begin{vmatrix} \left(l_{ijt} - \alpha^l\right)^{-1} & 0 \\ 0 & \left(c_{ijt} - \alpha^c\right)^{-1} \end{vmatrix}$$

3. $h_{ijt} > 0$, $p_{ijt} = 0$, and $m_{ijt} > 0$: Equations (12) and (13) can be written as in equations (18) and (19), and then equation (11) can be written as

$$\eta_{ij}^{\alpha} = m_{ijt} - \frac{1}{2\gamma_{ijt}} - \left(x_{ijt}\delta_{\alpha} + e_{ij}^{\alpha}\right) \tag{21}$$

$$\Im_3 = \begin{vmatrix} \left(l_{ijt} - \alpha^l\right)^{-1} & 0 \\ 0 & \left(c_{ijt} - \alpha^c\right)^{-1} \end{vmatrix}$$

4. $h_{ijt} > 0$, $p_{ijt} = 0$, and $m_{ijt} = 0$: Equations (12) and (13) can be written as in equations (18) and (19), and then equation (11) can be written as

$$\eta_{ij}^{\alpha} \leq -\frac{1}{2\gamma_{ijt}} - \left(x_{ijt}\delta_{\alpha} + e_{ij}^{\alpha}\right) \tag{22}$$

5. $h_{ijt} = 0$, $p_{ijt} > 0$, and $m_{ijt} > 0$: Equations (16) and (17) can be written as

$$\eta_{ijt}^{c} = \log\left[\frac{c_{ijt} - \alpha^c}{p_{ijt}} \frac{\left(1 + 2\gamma_{ijt}\left(m_{ijt} - \alpha_{ijt}^{m}\right)\right)}{\left(m_{ijt} - \alpha_{ijt}^{m}\right) + \gamma_{ijt}\left(m_{ijt} - \alpha_{ijt}^{m}\right)^2}\right] - \left(x_{ijt}\delta_c + e_{ij}^{c}\right),$$

and equation (15) (with a substitution from equation (16)) can be written as

$$\eta_{ijt}^{l} \geq \log\left[\frac{l_{ijt} - \alpha^l}{c_{ijt} - \alpha^c} w_{ijt}\right] + \left(x_{ijt}\delta_c + e_{ij}^{c} + \eta_{ijt}^{c}\right) - \left(x_{ijt}\delta_l + e_{ij}^{l}\right). \tag{23}$$

$$\Im_5 = \left(c_{ijt} - \alpha^c\right)^{-1}$$

6. $h_{ijt} = 0$, $p_{ijt} > 0$, and $m_{ijt} = 0$: Use equation (23) to get a threshhold for η_{ijt}^{l} and equation (20) to get a threshhold for η_{ijt}^{α}.

7. $h_{ijt} = 0$, $p_{ijt} = 0$, and $m_{ijt} > 0$: Use equation (23) to get a threshhold for η_{ijt}^{l} and equation (21) to get η_{ijt}^{α}.

$$\Im_7 = \left(c_{ijt} - \alpha^c\right)^{-1}$$

8. $h_{ijt} = 0$, $p_{ijt} = 0$, and $m_{ijt} = 0$: Use equation (23) to get a threshhold for η_{ijt}^{l} and equation (22) to get a threshhold for η_{ijt}^{α}.

7 Appendix: Estimating/Constructing Medical Prices and Medical Consumption

The MEPS data give us the number of "visits" of type k by individual ij at time t, v_{ijkt}, where types include office visits, outpatient visits, emergency room visits, and inpatient visits.[10] We also observe expenditure $p_{ijt}m_{ijt}$.[11] So consider a linear equation,

$$p_{ijt}m_{ijt} = \kappa_0\left(\iota_{ijt}\right) + \sum_k \kappa_k\left(\iota_{ijt}\right) v_{ijkt} + \zeta_{ijt}$$

where $\kappa\left(\cdot\right)$ is a vector of coefficients, possibly depending on the type of insurance ij has ι_{ijt}. $\kappa_k\left(\cdot\right)$ can be thought of as the price of visits of type k, $\kappa_0\left(\cdot\right)$ can be thought of as the cost of other non-enumerated medical care, and $\kappa\left(\cdot\right)$ can be estimated easily by disaggregating the MEPS data by type of insurance and maybe region and then running OLS regressions. We can also run the same regression using total expenditure (out-of-pocket and insurance cost together):

$$p^*_{ijt}m_{ijt} = \kappa^*_0 + \sum_k \kappa^*_k v_{ijkt} + \zeta^*_{ijt}$$

Next, we either need a way to construct p_{ijt} or m_{ijt}. Since we get to see neither, we have a "free parameter:" we can choose the units of m_{ijt}. Thus, we can define, without loss of generality,

$$m_{ijt} = \kappa^*_0 + \sum_k \kappa^*_k v_{ijkt}$$

and then

$$p_{ijt} = \frac{p_{ijt}m_{ijt}}{m_{ijt}} = \frac{\kappa_0\left(\iota_{ijt}\right) + \sum_k \kappa_k\left(\iota_{ijt}\right) v_{ijkt} + \zeta_{ijt}}{\kappa^*_0 + \sum_k \kappa^*_k v_{ijkt}}.$$

The summary statistics in Table 1 are based on these definitions.

Alternatively, we can define

$$p^*_{ijt}\left(\iota_{ijt}\right) = \kappa^*_{0i} + \sum_k \kappa^*_k \overline{v}_{ikt}\left(\iota_{ijt}\right)$$

or

$$p^*_{it} = \kappa^*_{0i} + \sum_k \kappa^*_k \overline{v}_{kt}$$

as the total cost of care where $\overline{v}_{ikt}\left(\iota_{ijt}\right)$ is the average number of type-k trips made by people in state i with insurance of type ι_{ijt} and $\overline{v}_{kt}$ is the average number of type-k trips made by people overalll. Then define

$$m_{ijt} = \frac{p^*_{ijt}m_{ijt}}{p^*_{ijt}\left(\iota_{ijt}\right)} \tag{24}$$

[10] We will need to address drug consumption in future drafts.

[11] We also observe total expenditure and thus might be able to infer something about the distribution of medical plans.

or

$$m_{ijt} = \frac{p^*_{ijt} m_{ijt}}{p^*_{it}} \tag{25}$$

where the numerator is data. The individual's price is then

$$p_{ijt} = \frac{p_{ijt} m_{ijt}}{m_{ijt}}$$

where the numerator is data and the denominator is determined from equation (24) or (25).