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HISIM2—CBO's New Health Insurance Simulation Model

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Geena Kim and Sean Lyons

Health, Retirement, and Long-Term Analysis Division

Current Model Specification

Overview of HIUs' Behavior

A health insurance unit (HIU) is the decisionmaking unit in HISIM2.

- A single person is his or her own HIU.
- Otherwise, an HIU is the set of individuals who could be covered by a family plan (any plan that covers two or more people) if an employer were to offer that plan.

An HIU collectively chooses the type of health insurance coverage in which to enroll each of its members. People within the same HIU may not be eligible for the same type of coverage and do not necessarily choose the same coverage option.

HIUs make decisions by maximizing utility in a random utility model.

CBO models insurance characteristics by applying the plan's deductible, coinsurance, and maximum out-of-pocket limit to an HIU's expected total health care spending distribution.

- This allows us to more easily model policies that change the generosity of insurance plans.

HIUs' Utility

The utility of each alternative depends on the HIU's total income, health care spending (including premiums, an out-of-pocket spending distribution, and any applicable subsidies, taxes, and mandate penalties), financial risk, and unobserved factors.

- Out-of-pocket spending is determined by the health status of each member of the HIU and by the cost-sharing characteristics of the insurance plan (deductible, coinsurance, and maximum out-of-pocket limit).
- Utility is specified to decrease as financial risk increases.

Many utility function parameters are estimated by minimizing the difference between the coverage predictions from the model and coverage targets for the base year of data.

- Coverage targets are CBO's preliminary estimates from individual data sources of the actual number of people with a particular coverage status.

The remaining parameters are set on the basis of CBO's assessment of the research literature.

HIUs' Insurance Options

HIUs select the type of insurance for each person in the unit:

- Employment-based coverage—single or family
- Nongroup coverage in the marketplaces—bronze, silver, or gold
- Nongroup coverage outside the marketplaces—bronze, silver, or gold
- Medicaid
- Children's Health Insurance Program (CHIP)
- Medicare
- None (Uninsured)

Employment-based coverage is coverage offered by a current or former employer—either one's own or a family member's. Firms are restricted to offer only one type of plan: a high deductible health plan (HDHP), health maintenance organization (HMO), or preferred provider organization (PPO). Nongroup coverage is coverage that a person purchases directly from an insurer or through a health insurance marketplace, rather than through an employer. Plans in the nongroup market are categorized into tiers (which are named after metals) on the basis of their actuarial value (the percentage of total average costs for covered benefits for which a plan pays). "Bronze" plans are those with an actuarial value of 60 percent, "silver" plans are those with an actuarial value of 70 percent, and "gold" plans are those with an actuarial value of 80 percent.

Utility Specification

The utility for HIU i from alternative n with multiple members $j = 1, \dots, J_i$ (U_{in}), is the predicted value that the HIU places on the alternative, βV_{in} , and an idiosyncratic unobservable component, ε_{in} .

$$U_{in} = \beta V_{in} + \varepsilon_{in}$$

$$V_{in} = y_i - C_{in} - E_s[H_{in}] - \frac{1}{2} \rho_n \text{Var}_s(H_{in}) + \Delta_{in}(y_i, a_1, \dots, a_{J_i}, e_1, \dots, e_{J_i})$$

y_i is income for HIU i , a_j is the age of member $j \in i$, and e_j is eligibility for coverage for member $j \in i$.

C_{in} is the cost to HIU i of alternative n , which includes premiums and applicable individual-mandate penalties.

$E_s[H_{in}]$ and $\text{Var}_s(H_{in})$ are the expectation and variance, respectively, of HIU i 's out-of-pocket health care spending for each alternative n where the expectation and variance are taken over health states s . Out-of-pocket health care spending for the uninsured alternative is capped at a value that increases with income to capture uncompensated care and bankruptcy.

ρ_n is the coefficient of absolute risk aversion.

Δ_{in} is the alternative-specific constant for alternative n and is allowed to vary with age, eligibility, and income. When HIU size is one, $\Delta_{in} = \delta_{1n}(y_i, a_j)$, and when HIU size is greater than one,

$$\Delta_{in} = \sum_{j=1}^{J_i} \delta_{2n}(y_i, a_j, e_j).$$

Utility Specification (Continued)

The unobservable component is modeled so that it implies a generalized nested logit (GNL) model. For notation purposes, the GNL choice probability is:

$$P_{in} = \frac{\sum_{\ell} \left[(\alpha_{n\ell} \exp(\beta V_{in}))^{\frac{1}{\mu_{\ell}}} \left(\sum_{k \in B_{\ell}} (\alpha_{k\ell} \exp(\beta V_{ik}))^{\frac{1}{\mu_{\ell}}} \right)^{\mu_{\ell}-1} \right]}{\sum_{\ell} \left(\sum_{k \in B_{\ell}} (\alpha_{k\ell} \exp(\beta V_{ik}))^{\frac{1}{\mu_{\ell}}} \right)^{\mu_{\ell}}}$$

In this equation, nests (employment-based, public, nongroup marketplace, nongroup off marketplace, and uninsured) are indexed by ℓ and the set of choices in nest ℓ is denoted B_{ℓ} .

CBO estimates most utility function parameters by fitting the model's equations to the data but sets the value of others on the basis of information from research and from experts on health insurance markets and this type of model.

The alternative-specific constants (Δ_{in}) and utility coefficient (β) are estimated.

All remaining parameters are set:

- The coefficient of absolute risk aversion (ρ_n) and the dissimilarity parameters (μ), which determine correlation between choices within a nest, are set on the basis of the available evidence.
- The allocation parameters (α) are set by calculating the fraction of individuals who would be covered under each source of coverage from all the HIUs that are able to make a given choice.

HIU Utility Parameters

CBO estimates the alternative specific constants (Δ_{in}) by finding values that minimize the difference between coverage predictions from the model and coverage targets by type of insurance, age, and income (minimum distance estimation).

The utility coefficient, β , determines the degree to which HIUs' decisions are predicted by the value function specification and are estimated on the basis of how well the model fits the underlying data.

Specifically, β is estimated via a maximum likelihood estimation in which the choice is insured versus uninsured.

The minimum distance estimation (MD) portion of the objective function is:

$$MD(\boldsymbol{\delta}_i, \beta) = \frac{1}{N} \Gamma(\boldsymbol{\delta}_i, \beta)' \Gamma(\boldsymbol{\delta}_i, \beta)$$

- Each element of $\Gamma(\cdot)$ is the model's predicted aggregate coverage total differenced from our target.

The maximum likelihood estimation (LL) portion of the objective function is:

$$LL(\boldsymbol{\delta}_i, \beta) = \frac{1}{N} \sum_i \left(\left(\sum_{j \in i} wgt_j \cdot P_{j \text{ ins}}(\boldsymbol{\delta}_i, \beta) \right) - \left(\sum_{j \in i} wgt_j \cdot d_{j \text{ ins}} \right) \right)^2$$

- wgt_j is person j 's sample weight, $d_{j \text{ ins}}$ is an indicator for whether or not the person is insured, and $P_{j \text{ ins}}(\boldsymbol{\delta}_i, \beta)$ is the probability that the person is insured.

So, the objective function is:

$$\min_{\boldsymbol{\delta}_i, \beta} MD(\boldsymbol{\delta}_i, \beta) + LL(\boldsymbol{\delta}_i, \beta)$$

Calibration Estimates

Calibration Results for Nongroup Coverage, 2015

Percent Description	HIU = 1		HIU > 1	
	Difference From Target	Take-Up Rate	Difference From Target	Take-Up Rate
Marketplace Bronze Subsidized FPL 0-69				
Marketplace Bronze Subsidized FPL 70-250	<.01	7.2	<.01	7.6
Marketplace Bronze Subsidized FPL 251-400	<.01	7.0	<.01	10.2
Marketplace Bronze Subsidized FPL 401+				
Marketplace Silver Subsidized FPL 0-69				
Marketplace Silver Subsidized FPL 70-138 age < 30	<.01	18.3	-0.01	35.2
Marketplace Silver Subsidized FPL 70-138 age 30-50	<.01	53.8	<.01	30.1
Marketplace Silver Subsidized FPL 70-138 age > 50	<.01	64.8	-0.01	57.2
Marketplace Silver Subsidized FPL 139-250 age < 30	<.01	14.4	<.01	55.8
Marketplace Silver Subsidized FPL 139-250 age 30-50	<.01	31.6	<.01	38.8
Marketplace Silver Subsidized FPL 139-250 age > 50	<.01	57.9	<.01	60.4
Marketplace Silver Subsidized FPL 250-400	<.01	7.6	<.01	12.5
Marketplace Silver Subsidized FPL 401+				
Marketplace Gold Subsidized FPL 0-69				
Marketplace Gold Subsidized FPL 70-400	<.01	2.1	<.01	4.2
Marketplace Gold Subsidized FPL 401+				
Marketplace Bronze Unsubsidized	<.01	1.3	0.01	0.2
Marketplace Silver Unsubsidized	<.01	1.7	<.01	0.3
Marketplace Gold Unsubsidized	<.01	0.7	0.01	0.1
Nongroup Outside-the-Marketplaces Bronze	<.01	3.4	<.01	0.6
Nongroup Outside-the-Marketplaces Silver	<.01	12.0	<.01	2.5
Nongroup Outside-the-Marketplaces Gold	<.01	1.1	<.01	0.3

Calibration Results for Employment-Based Coverage, 2015

Percent Description	HIU = 1		HIU > 1	
	Difference From Target	Take-Up Rate	Difference From Target	Take-Up Rate
PPO—Family, HIU > 1			<.01	53.8
HMO—Family, HIU > 1			<.01	48.8
HDHP—Family, HIU > 1			<.01	47.2
Nondependent Child, HIU > 1			<.01	22.6
PPO—Single, HIU = 1	<.01	77.7	<.01	24.6
HMO—Single, HIU = 1	<.01	85.2	<.01	24.4
HDHP—Single, HIU = 1	<.01	85.1	<.01	48.2
Employment-Based Coverage + Medicaid Children			<.01	22.4

Calibration Results for Public Coverage, 2015

Percent Description	HIU = 1		HIU > 1	
	Difference From Target	Take-Up Rate	Difference From Target	Take-Up Rate
Medicaid Children			<.01	90.2
Adults Made Eligible for Medicaid by the Affordable Care Act	<.01	58.5	<.01	70.6
Adults Otherwise Eligible for Medicaid	<.01	90.0	<.01	90.6
CHIP			<.01	48.5
Medicare With Offer of Employment-Based Coverage	<.01	59.5	<.01	54.5

Calibration Results for the Uninsured, 2015

Percent Description	HIU = 1		HIU > 1	
	Difference From Target	Take-Up Rate	Difference From Target	Take-Up Rate
Uninsured FPL < 70	<.01	32.9	<.01	14.1
Uninsured 70 ≤ FPL ≤ 138	<.01	34.1	<.01	17.6
Uninsured 138 < FPL ≤ 250	<.01	25.0	<.01	12.5
Uninsured 250 < FPL < 400	<.01	14.7	<.01	6.1
Uninsured FPL ≥ 400	<.01	6.0	<.01	3.0

Results

Health Insurance Coverage for People Under Age 65, 2019 to 2029

Millions of People, by Calendar Year

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Total Population Under Age 65	273	273	273	274	274	275	275	276	276	276	277
Employment-Based Coverage	159	159	159	159	158	158	158	158	158	159	159
Medicaid and CHIP ^a											
Blind and disabled	7	7	7	7	7	7	7	7	7	7	7
Children	30	30	30	30	30	30	30	30	30	30	30
Adults made eligible for Medicaid by the ACA	12	12	12	13	13	13	14	14	14	14	14
Adults otherwise eligible for Medicaid	13	12	12	12	13	13	13	13	13	13	13
CHIP	7	7	7	7	7	7	7	7	7	7	7
Subtotal	69	68	68	69	70	70	70	71	71	71	71
Nongroup Coverage and the Basic Health Program											
Nongroup coverage purchased through marketplaces ^b											
Subsidized	8	8	7	7	7	7	7	6	6	6	6
Unsubsidized	1	1	1	1	1	1	1	1	1	1	1
Subtotal	9	9	8	8	8	8	8	7	7	7	7
Nongroup coverage purchased outside marketplaces	5	5	4	4	4	4	4	4	4	4	4
Total, nongroup coverage	14	13	13	12	12	12	12	12	12	11	11
Coverage through the Basic Health Program ^c	1	1	1	1	1	1	1	1	1	1	1
Medicare ^d	8	8	8	8	8	8	8	8	8	8	8
Other Coverage ^e	3	3	3	3	3	3	3	3	3	3	3
Uninsured ^f	30	32	33	33	34	34	34	34	35	35	35
Memorandum:											
Number of Insured People	242	241	240	240	241	241	241	241	241	241	242
Insured as a Percentage of the Population											
Including all U.S. residents	89	88	88	88	88	88	88	88	87	87	87
Excluding noncitizens not lawfully present	91	90	90	90	90	89	89	89	89	89	89

Enrollment in Medicaid, 2016

Percent	Share of Medicaid Enrollees (Full-year-equivalent full-benefit enrollment of the non-elderly)	
	As Estimated by HISIM2	As Estimated by the Treasury (Form 1095-B)
Modified Adjusted Gross Income as a Percentage of the Federal Poverty Level		
Under 100	55	53
100–150	20	20
150–200	12	11
200–250	7	6
250–300	4	3
300–400	2	3
400–600	1	2
Above 600	<u>1</u>	<u>1</u>
Total	100	100

Enrollment in Employment-Based Coverage, 2016

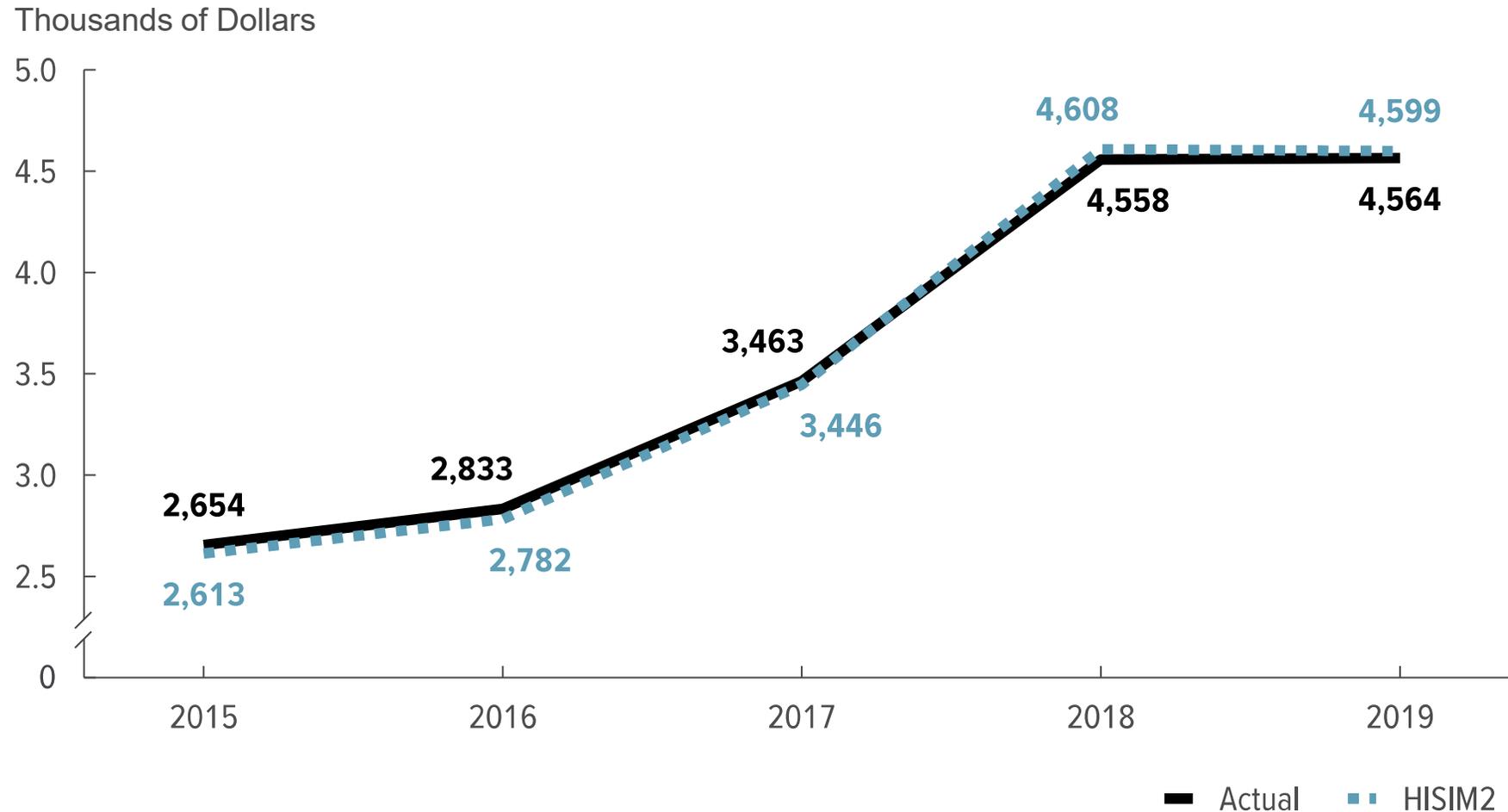
Percent

Employment-Based Coverage

Modified Adjusted Gross Income as a Percentage of the Federal Poverty Level	As Estimated by HISIM2	As Estimated by the Treasury (Covered life years)
Under 100	7	6
100–150	5	5
150–200	7	7
200–250	7	8
250–300	9	8
300–400	15	16
400–600	21	22
Above 600	<u>28</u>	<u>28</u>
Total	100	100

Marketplace Premium Estimates Compared With Actuals

Average Second-Lowest-Cost Silver Plan Gross Premium for a Single 21-Year-Old for Health Insurance Purchased Through the Marketplaces



CBO Sources

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