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# **HISIM2—CBO's New Health Insurance Simulation Model**

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# Agenda

- What is HISIM2 used for?
- How does HISIM2 model households' and employers' decisions?
- What data does CBO use and how?
- How does CBO validate the results?
- How would HISIM2 estimate the effect on health insurance coverage from reinstating the individual mandate penalty?
- How does CBO's model differ from others?

# **What Is HISIM2 Used For?**

## What Is HISIM2 Used For?

CBO's health insurance simulation model, HISIM2, is a new version of the model CBO uses to generate estimates of health insurance coverage and premiums for the population under age 65.

The model is used in conjunction with other models to develop baseline budget projections (which incorporate the assumption that current law generally remains the same).

It is also used to estimate the effects of proposed changes in policies that would affect health insurance coverage—for example:

- Elimination of the excise tax on high-premium health plans,
- Reinstatement of the individual mandate penalty, and
- Expansion of premium tax subsidies to people with income over 400 percent of the federal poverty level.

# 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 <sup>a</sup>											
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 <sup>b</sup>											
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 <sup>c</sup>	1	1	1	1	1	1	1	1	1	1	1
Medicare <sup>d</sup>	8	8	8	8	8	8	8	8	8	8	8
Other Coverage <sup>e</sup>	3	3	3	3	3	3	3	3	3	3	3
Uninsured <sup>f</sup>	30	32	33	33	34	34	34	34	35	35	35
<b>Memorandum:</b>											
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

# **How Does HISIM2 Model Households' and Employers' Decisions?**

# Overview of HIUs' Behavior

**What Is a Health Insurance Unit?** An 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—that is, any plan that covers two or more people—if an employer were to offer that plan.

**What Decisions Do HIUs Make?** 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.

**How Do HIUs Make Decisions?** HIUs make decisions by maximizing utility in a random utility model. Each alternative in the choice set is assigned a probability derived from a statistical model.

# HIUs' Insurance Options

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

- Employment-based coverage—a high-deductible health plan (HDHP), health maintenance organization (HMO), or preferred provider organization (PPO)
- 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. The plans that firms can offer in HISIM2 are high-deductible health plans, health maintenance organizations, and preferred provider organizations. 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.

## Choice Sets

The set of insurance choices available to each HIU is determined by the characteristics of that HIU (for example, income and members' ages).

Single-person and multiperson HIUs have different choice sets.

The choice set of an HIU is restricted by the eligibility of its members for public insurance, subsidized marketplace insurance, and employment-based insurance.

CBO restricted the choice sets in the model to maintain as much realism as possible while keeping the model simple enough to limit the computing time that it takes to simulate coverage effects of proposed policies.

## Choice Set: Single-Person HIUs

The choice set for single-person HIUs consists of alternatives that are categorized into one of five “nests.”

Alternatives within the same nest are considered closer substitutes than alternatives in different nests.

Nest	Alternatives
Employment-based coverage	HDHP, HMO, PPO
Nongroup outside the marketplaces	Bronze, silver, gold
Nongroup in the marketplaces	Bronze, silver, gold
Public insurance	Medicaid, Medicare
Uninsured	Uninsured

Within the public-insurance nest, the choices between Medicaid and Medicare are mutually exclusive. CHIP is not an alternative for single-person HIUs because only children are eligible for CHIP and a child cannot be in an HIU by himself or herself.

HDHP = high-deductible health plan; HMO = health maintenance organization; PPO = preferred provider organization.

## Choice Set: Multiperson HIUs

Multiperson HIUs have a larger choice set than single-person HIUs do because different members of an HIU can have different types of coverage.

Each alternative represents a combination of coverage types in which HIUs can enroll their members.

Under each alternative, members of the HIU are sorted into different types of coverage on the basis of their eligibility.

The generalized nested logit model used in HISIM2 allows an HIU's health insurance coverage choices to span multiple nests.

## HIUs' Utility

The utility of choosing each alternative depends on the HIU's:

- 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 (which are alternative-specific).

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).

## HIUs' Utility (Continued)

The alternative-specific unobserved factors measure such concepts as:

- Awareness of insurance alternatives,
- Access to insurance alternatives (including the ease of enrolling through a web portal and the ease of determining eligibility),
- Attitudes toward insurance (which may be affected, for example, by the stigma associated with public coverage), and
- Unmeasured differences in insurance alternatives, such as network size.

CBO estimates the alternative-specific unobserved factors by finding values that minimize the difference between coverage predictions from the model and coverage targets by type of insurance, age, and income. (Coverage targets are CBO's preliminary estimates from individual data sources of the actual number of people with a particular coverage status.)

# Overview of Employers' Behavior

Employers make decisions about whether to offer employment-based insurance and what type of plan to offer.

The plans that employers can offer in HISIM2 are HDHP, HMO, and PPO.

Employers select the coverage option that maximizes workers' valuation of an offer net of the expected cost to the employer.

# **What Data Does CBO Use and How?**

## CPS Data

The microdata used by HISIM2 begin with the Current Population Survey (CPS).

- The CPS is a nationally representative survey of about 95,000 households. It provides reliable, timely, and detailed information about many of the key variables needed to model health insurance.
- Those variables include demographic and family characteristics, income, employment, the availability of employment-based insurance coverage, and self-reported health status.

## Modifications to CPS Data

CBO modifies the CPS data in three ways. First, CBO edits the following variables, which are likely to have been reported with some error, so that they better match other survey and administrative data:

- The size of firms,
- Self-employment income, and
- Whether a worker's employer offers health insurance.

## Modifications to CPS Data (Continued)

Second, CBO supplements the CPS with additional variables necessary for modeling people's and employers' decisions about health insurance coverage, such as:

- Immigration status;
- Capital gains;
- Marginal tax rates;
- The probability distribution of health care spending for each individual;
- The characteristics of an employer's potential insurance offerings for three plan types (HDHP, HMO, and PPO) and two coverage types (single and family); and
- Eligibility for Medicaid and CHIP.

High-deductible health plans (HDHPs) allow the use of a tax-preferred health savings account to cover expenses not paid by the plans. Health maintenance organizations (HMOs) are insurance plans in which services obtained outside a specified network of providers are not covered. Preferred provider organizations (PPOs) tend to offer wider provider networks, cover services from providers outside of their network, and limit costs through cost-sharing arrangements and a deductible.

The characteristics of an employer's potential insurance offerings are assigned on the basis of its characteristics, such as its size, the state in which it operates, and the fraction of low-wage workers in it. Those characteristics include the plan's cost-sharing requirements and premium, the employer's contribution to the premium, and (for HDHP plans) whether and how much an employer contributes to a health savings account or health reimbursement account.

## **Modifications to CPS Data (Continued)**

Third, CBO defines various units to help model consumers' and employers' behavior.

CBO groups household members to build three types of units used to calculate income and taxes, determine eligibility for subsidies, and define the coverage choices that are available to people. Those units are called tax filing units, marketplace units, and health insurance units.

CBO also builds a synthetic firm for each employed respondent consisting of an imputed set of coworkers whose characteristics match the actual characteristics of such an employee's coworkers. CBO assigns coworkers on the basis of the size of the worker's firm (using the agency's edited version of firm size as reported in the CPS); whether or not the firm offers health insurance; and the worker's wages, age, and state of residence.

## Projecting Data Through the Entire Projection Period

After adjusting and supplementing the CPS data for a base year, CBO projects input data for each year through the end of the 11-year period covered by the agency's baseline budget projections.

CBO employs two main approaches to project population characteristics of the base-year data:

- The agency projects income, health care spending, and the characteristics of employment-based insurance offers to identify the growth patterns of those variables.
- CBO uses an optimization routine to simultaneously adjust the sample weights of people in the CPS sample during the period to match projections of population characteristics, including population growth and changes in patterns of employment.

The base year of data for CBO's spring 2019 baseline projections is 2015, and the 11-year period covered by those projections is 2019 to 2029.

# Sources of Data Used to Estimate Utility Function Parameters

Coverage	Source
Employment-Based	Medical Expenditure Panel Survey—Insurance Component (MEPS-IC) and Household Component (MEPS-HC), OPM
Nongroup	CMS Medical Loss Ratio data, CMS quarterly effectuated enrollment reports, Healthcare.gov insurance marketplace data, MEPS-HC, Covered California data, New York State of Health Data
None (Uninsured)	NHIS, MEPS-HC, CPS
Medicaid and CHIP	Form CMS-64, MSIS, Medicaid Analytic Extract data, Statistics Enrollment Data System (for CHIP)

CHIP = Children’s Health Insurance Program; CMS = Centers for Medicare & Medicaid Services; MSIS = Medicaid Statistical Information System; NHIS = National Health Interview Survey; OPM = Office of Personnel Management.

For more details on the data used for calibration, see Jessica Banthin and others, *Sources and Preparation of Data Used in HISIM2—CBO’s Health Insurance Simulation Model*, Working Paper 2019-04 (Congressional Budget Office, April 2019), [www.cbo.gov/publication/55087](http://www.cbo.gov/publication/55087).

# **How Does CBO Validate the Results?**

# Calibration Results for Employment-Based Coverage, 2015

Percent  <b>Description</b>	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 Nongroup Coverage, 2015

Percent  <b>Description</b>	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 Public Coverage, 2015

Percent  <b>Description</b>	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  <b>Description</b>	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

# Enrollment in Medicaid, 2016

Percent	Share of Medicaid Enrollees (Full-Year-Equivalent Full-Benefit Enrollment of the Nonelderly)	
	As Estimated by HISIM2	As Estimated by the Treasury <sup>a</sup>
<b>Modified Adjusted Gross Income as a Percentage of the Federal Poverty Level</b>		
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

a. See Ithai Z. Lurie and James Pearce, *Health Insurance Coverage From Administrative Tax Data*, Working Paper 117 (Office of Tax Analysis, February 2019), <https://tinyurl.com/y4fekr8h> (PDF, 19 MB).

# Enrollment in Employment-Based Coverage, 2016

Percent  Modified Adjusted Gross Income as a Percentage of the Federal Poverty Level	Employment-Based Coverage	
	As Estimated by HISIM2	As Estimated by the Treasury <sup>a</sup>
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

a. See Ithai Z. Lurie and James Pearce, *Health Insurance Coverage From Administrative Tax Data*, Working Paper 117 (Office of Tax Analysis, February 2019), <https://tinyurl.com/y4fekr8h> (PDF, 19 MB).

**How Would HISIM2 Estimate the Effect on Health Insurance Coverage From Reinstating the Individual Mandate Penalty?**

# Reinstating the Individual Mandate Penalty

The individual mandate imposed by the Affordable Care Act required most U.S. citizens, as well as noncitizens lawfully present in the country, to have health insurance that met specified standards. Those who did not comply were required to pay a penalty.

The penalty was repealed as part of Public Law 115-97, the major tax legislation that was enacted in 2017.

The policy under consideration here would reinstate the individual mandate penalty beginning in 2021. The policy incorporates the assumption that penalties and enforcement would be about the same as they were just before the individual mandate was repealed.

# Simulating Reinstatement of the Individual Mandate Penalty

The penalty is estimated in two ways in HISIM2.

- The model accounts for the **direct financial effect** of the penalty by imposing its statutory dollar amount on any uninsured people in an HIU who are legally subject to it.
- The model also accounts for the penalty's **nonfinancial effects**—that is, people's tendency to comply with laws, their changing attitudes about health insurance, and their greater responsiveness to penalties than to subsidies.

# **How Does CBO's Model Differ From Others?**

# Types of Health Coverage Model

- **Elasticity-based model with externally estimated elasticities**, such as the previous version of CBO's health insurance simulation model (HISIM1)
- **Expected utility model**, such as HISIM2 (CBO), COMPARE (the RAND Corporation), and HIPSM (the Urban Institute)

## Differences Between CBO's Model and Others

HISIM2's household decision model is probabilistic, which makes it less likely than models with deterministic decisions to have large swings in predicted insurance coverage given small changes in incentives.

HISIM2 projects behavior for the 11-year period covered by CBO's baseline budget projections; COMPARE and HIPSM typically project behavior in a certain year in the future.

HISIM2 calibrates key parameters within the model by using aggregate statistics from administrative and survey data.

# References

## CBO's Publications

Geena Kim and Sean Lyons, “HISIM2—CBO’s New Health Insurance Simulation Model” (presentation to the American Society of Health Economists Conference, June 24, 2019), [www.cbo.gov/publication/55390](http://www.cbo.gov/publication/55390).

Congressional Budget Office, *Federal Subsidies for Health Insurance Coverage for People Under Age 65: 2019 to 2029* (May 2019), [www.cbo.gov/publication/55085](http://www.cbo.gov/publication/55085).

Congressional Budget Office, “HISIM2—The Health Insurance Simulation Model Used in Preparing CBO’s Spring 2019 Baseline Budget Projections” (April 2019), [www.cbo.gov/publication/55097](http://www.cbo.gov/publication/55097).

Congressional Budget Office, “HISIM2 Code Segments, April 2019” (supplemental material for “HISIM2—The Health Insurance Simulation Model Used in Preparing CBO’s Spring 2019 Baseline Budget Projections,” April 2019), [www.cbo.gov/publication/55097#data](http://www.cbo.gov/publication/55097#data).

## **CBO's Publications (Continued)**

Jessica Banthin and others, *Sources and Preparation of Data Used in HISIM2—CBO's Health Insurance Simulation Model*, Working Paper 2019-04 (Congressional Budget Office, April 2019), [www.cbo.gov/publication/55087](http://www.cbo.gov/publication/55087).

Congressional Budget Office, *Health Insurance Coverage for People Under Age 65: Definitions and Estimates for 2015 to 2018* (April 2019), [www.cbo.gov/publication/55094](http://www.cbo.gov/publication/55094).

## Outside Sources

Ithai Z. Lurie and James Pearce, *Health Insurance Coverage From Administrative Tax Data*, Working Paper 117 (Office of Tax Analysis, February 2019), <https://tinyurl.com/y4fekr8h> (PDF, 19 MB).

Kenneth E. Train, *Discrete Choice Methods With Simulation* (Cambridge University Press, 2009), <https://doi.org/10.1017/CBO9780511805271>.

Chieh-Hua Wen and Frank S. Koppelman, “The Generalized Nested Logit Model,” *Transportation Research Part B: Methodological*, vol. 35, no. 7 (August 2001), pp. 627–641, [https://doi.org/10.1016/S0191-2615\(00\)00045-X](https://doi.org/10.1016/S0191-2615(00)00045-X).