Methodology

Documentation

2011 National Version
HIPSM Methodology

Introduction

The Health Insurance Policy Simulation Model (HIPSM) is a detailed microsimulation model of the health care system. It estimates the cost and coverage effects of proposed health care policy options. HIPSM is designed for quick-turnaround analysis of policy proposals. It can be rapidly adapted to analyze a wide variety of new scenarios—from novel health insurance offerings and strategies for increasing affordability to state-specific proposals—and can describe the effects of a policy option at a number of points in time.

HIPSM was developed by researchers in the Health Policy Center at the Urban Institute (UI), a nonprofit, nonpartisan policy research organization. The Health Policy Center has a long history of health insurance simulation work, including extensive experience working with state and national policymakers to examine the impact, costs, and financing of alternative strategies to cover the uninsured. The HIPSM research team includes innovative researchers, economists, mathematicians, and other experienced policy experts.

Our most notable early work in health reform simulation, using a predecessor to HIPSM, provided a road map for the design of the landmark 2006 health care reform legislation in Massachusetts. That research garnered the prestigious Health Services Research Impact Award in 2007. More recently, the new HIPSM has been used to analyze reform options in New York and national reform options proposed in Congress. These analyses have been disseminated in published research reports and policy briefs designed for policymakers in Congress, the media, and stakeholders. The model was also used to provide technical assistance in Massachusetts, Missouri, New York, Virginia, and Washington, as well as to the federal government.

To evaluate how the health care system would be affected by policy changes, HIPSM simulates the decisions of employers, families, and individuals to offer and enroll in health insurance coverage. The model is designed to show the impact of policy on changes in government and private health care spending, uncompensated care costs, health insurance premiums in employer and nongroup health insurance risk pools, rates of employer offers of coverage, and health insurance coverage. To calculate the impacts of reform options, HIPSM uses a flexible new simulation approach based on the relative desirability of the health insurance options available to each individual and family under reform. The approach (known as a “utility-based framework”) allows new coverage options to be assessed without simply extrapolating from historical data, as in previous models. Within HIPSM, health insurance decisions made by individuals, families, and employers are calibrated to findings in the best empirical economics literature.

The model’s capabilities are broad, and include but are not limited to the following policies.

- The consequences over time of maintaining the status quo in the health care system;
- Medicaid/Children’s Health Insurance Program (CHIP) eligibility expansions, with different eligibility rules for children, parents, and nonparents;
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- Effects of reducing Medicaid and CHIP maintenance-of-eligibility requirements for adults and children;
- New public coverage options;
- Health insurance exchanges, with specified premium rating rules (e.g., age and tobacco use rating) and alternative benefit packages;
- Other health insurance market reforms, including changes in premium rating rules and rules of issue;
- Income-related premium and/or cost-sharing subsidies for the nongroup market, group market, and/or a new exchange;
- Plan choice between comprehensive and high-deductible plans, public plan options, and capability to model plans with differing levels of actuarial value;
- Individual mandates, pay-or-play employer mandates, and employer assessments (e.g., by employee wage);
- The Basic Health Plan option under the Patient Protection and Affordable Care Act (ACA);
- Tax credits for employer premium contributions;
- Multiyear estimates of health care costs and savings under a reform;
- Single payer systems;
- Reinsurance for high-cost cases; and
- Choice of year in which reforms are to be applied, with adjustments made to population characteristics and dollar amounts based on specified demographic, economic, and health care cost trends.

The documentation of HIPSM is divided into two main sections. The first describes the construction of baseline data needed to run the model. The second describes the model itself and how behavior is simulated and calibrated to results from the empirical literature.

A very brief summary of constructing the baseline is as follows:

- We use multiple years of the Current Population Survey (CPS) and the Household Component of the Medical Expenditure Panel Survey (MEPS-HC);
- We estimate health care expenditures for each individual in the data set in each possible coverage status, including out-of-pocket spending, spending covered by insurance, Medicaid/CHIP spending, and uncompensated care for the uninsured;
- We impute offers of employer-sponsored insurance, immigration status, and type of Medicaid/CHIP eligibility; and
- We group together workers with the same employment characteristics, such as firm size and industry, into simulated firms.

The general flow of a HIPSM simulation is as follows:
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- The model constructs available insurance packages and computes premiums based on current enrollment;
- Simulated employers choose whether or not to offer coverage and whether to offer coverage inside or outside the exchange (if applicable);
- Individuals and families choose from among the coverage options available to them: employer-sponsored insurance, nongroup insurance, health benefit exchanges (if applicable), Medicaid/CHIP, or uninsured;
- Employer, individual, and family decisions are calibrated so that overall behavior is consistent with a number of results from the health economics literature; and
- Premiums are updated based on the new enrollment decisions. The cycle is repeated until equilibrium—in other words, until there is little change between successive iterations of the model.

**Baseline Construction**

**Survey Data, Medical Expenditures, and Standard Insurance Packages**

Key information for the HIPSM baseline comes from the CPS. The CPS is a monthly household survey that collects nationally representative data on employment, income, demographic, and socioeconomic characteristics, as well as health insurance status. The CPS interviews households in the civilian noninstitutionalized population, as well as members of the armed forces living in civilian housing units in the United States or on a domestic military base. From its interviewees in March each year, it collects detailed information on income and health insurance from the previous year. The core microdata file that defines HIPSM’s population base is a pooled data set of the March 2009 and 2010 CPS Annual Social and Economic Supplement (ASEC). The March ASEC is the largest CPS data set, and is the main national source of demographic characteristics and insurance coverage used by many analysts (and the media). The survey generally samples more than 78,000 households and contains 200,000 sets of observations on individuals. Information on age, sex, race, and household relationship is collected. In addition to the usual labor force data, the March ASEC also collects information on income, migration, work experience, and noncash benefits.

*Employer-sponsored insurance offer and eligibility.* In preparing the HIPSM files, we impute the offer of employer-sponsored insurance (ESI) and worker eligibility for ESI to CPS observations, since such information is not available on the ASEC. The February 2005 CPS Contingent Work and Alternative Employment Supplement is the most recent survey that asked questions about ESI offer and eligibility. Consequently, we developed a regression model to impute offer and eligibility status using a match of the February 2005 CPS and the March 2005 ASEC and the wealth of socioeconomic data on both surveys. This regression captures the variation in offer and eligibility across workers of different

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1 The American Community Survey has a much larger sample, but lacks data such as firm size and many detailed income components used in the construction of the HIPSM prebaseline data. ACS versions of our immigration status and Medicaid eligibility models are in progress, but were not available at the time of writing.
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characteristics. For example, most part-time workers are not eligible for ESI, even if other workers in their firm are offered coverage and are eligible for it. Wherever possible, we link CPS records directly across these two surveys. The probability of offer from the regression model is adjusted to give results matching the latest available ESI offer rates from the Medical Expenditure Panel Survey Insurance Component.

*Baseline health care expenditures.* Healthy expenditures by individuals and families are central pieces of information necessary for computing health insurance premiums, evaluating the health insurance options facing families, and assessing the costs of the components of the ACA. The CPS does not collect data on health care expenditures, so we statistically match health care expenditure data from individuals in the Medical Expenditure Panel Survey—Household Component (MEPS-HC) to individuals in the CPS. A number of adjustments to the MEPS data are made as well, and these are described below.

MEPS is a survey of individuals and families, employers, and medical providers across the United States that provides information about health care expenditures and health insurance coverage. There are two major components of MEPS. The Household Component collects data from individuals, families, and their health care providers, while the Insurance Component collects information on employer-based insurance from employers.

We statistically matched health care expenditures, unique health insurance variables, and health conditions from three years (2006–2008) of pooled MEPS-HC data sets to our core CPS file, matching MEPS individuals and CPS individuals by insurance coverage, demographic, and other common characteristics in the two data sets. All expenditures from the three years of MEPS data are expressed in 2008 dollars. Using a propensity-weighting approach, we assigned a MEPS observation to each CPS observation, and we then appended the health expenditure data and information on health status and health conditions from the matched MEPS individuals to the records of their matched CPS individuals. We then confirmed that health expenditures in the appended CPS file maintained the statistical distributions and relationships with other variables that exist in the original MEPS data.

For each observation, we included expenditure data for seven service categories: hospital, physician, dental, other professional care, home health care, prescription drugs, and other medical equipment. We created these categories to be consistent with the National Health Accounts (NHA) Personal Healthcare Expenditures data, which are maintained by federal actuaries. According to Sing et al., compared to the NHA, MEPS routinely underestimates the aggregate insured costs associated with Medicaid and privately insured individuals. To correct for this discrepancy, we use adjustment factors to boost Medicaid and privately insured dollars, with the factors consistent with the relative differences in the two data sets identified by Sing et al. We apply these factors to each observation in our data set that reported positive Medicaid and/or privately insured expenditures. We then inflated our expenditures to

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the year 2011 using the NHA’s per capita growth in each expenditure category, assuming that recent average annual growth rates would persist between 2008 and 2011.

To adjust for any MEPS underreporting of the high-cost tail of the health expenditure distribution, we looked to the Society of Actuaries (SOA) High-Cost Claims Database. This comprehensive survey examined seven insurers and all of their claimants. It is designed to be representative of the national distribution of all claims to private insurers. We found that the 97th to 99th percentiles of private expenditures among the nonelderly in the MEPS data fell below the same percentiles in the SOA. The discrepancy ranged from less than 1 percent (97th percentile) to 13 percent (99th percentile). We used these discrepancies as adjustment factors for all privately insured individuals with private expenditures above the 97th percentile. In order to keep total health expenditures in our MEPS-appendend CPS file consistent with the NHA totals following the SOA adjustment of the tail of the distribution, we decreased the private expenditures of the privately insured individuals in the lower portion of the distribution by a fixed percentage.

**Spending under different coverage types.** The same individual will incur different levels of health expenditures when insured differently (e.g., employer coverage versus Medicaid, or Medicaid versus uninsured). This is because out-of-pocket costs and costs covered by insurance will vary depending upon plan cost-sharing requirements (e.g., deductibles, copayments, out-of-pocket maximums) and benefits covered, effectively altering the price an individual will face when consuming medical care. The higher the out-of-pocket price faced, the less the individual is apt to consume. Thus, in order to understand the value of care an individual will obtain under various coverage options pre-and postreform, we compute health care spending for each observation under several alternate “states” or statuses of health coverage: uninsured, insured by Medicaid/CHIP, insured under a typical comprehensive ESI package, and insured under a typical nongroup (individual) package. For the uninsured, we divide total spending into out-of-pocket and uncompensated care. For the other states, we divide spending into insured expenses and out-of-pocket costs.

Each of our CPS observations is either insured or uninsured in the baseline. For the uninsured, expenditures in their uninsured state are obtained from the MEPS-HC, as was described above, but we need to estimate what they would spend if insured (an alternate “state” that may occur under reform). Conversely, we need to know what the insured would spend if they were uninsured. To simulate spending under insurance (and, conversely, under no insurance), we estimated two-part models using MEPS-HC data. For example, consider an uninsured person:

- **Step 1:** Estimating the probability of having any health expenditures:
  - *Probability of having any expenditures if privately insured* is computed using a sample of the privately insured and controlling for an array of sociodemographic characteristics, health status, and health conditions.
  - *Probability of having any expenditures if enrolled in Medicaid* is estimated similarly, but using a sample of those reporting Medicaid coverage.
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- **Uninsured individuals are deemed to have expenditures or not in the case of being privately insured or enrolled in Medicaid** by comparing the probabilities computed to a random number from a uniform distribution.

- **Step 2:** For those deemed to have expenditures if insured in step 1, the change in total expenditures after gaining coverage is estimated as follows:
  - **Expenditures if gaining private coverage** are computed using a sample of the privately insured incurring health care expenses and controlling for an array of sociodemographic characteristics, health status, and health conditions.
  - **Expenditures if gaining Medicaid coverage** are computed similarly, but using a sample of those with Medicaid coverage.

We impute expenditures if uninsured and if enrolled in Medicaid for those with private coverage, and we impute expenditures if uninsured and if privately insured for Medicaid enrollees. (Similar work in the past has helped UI estimate the costs of uninsurance in many states and nationally, and what savings would occur after health coverage reform.³)

**Uncompensated care.** Uncompensated care (donated or free care) associated with the uninsured is not fully captured by MEPS expenditure data. For each uninsured person, we now have estimates of out-of-pocket health care expenditures and total expenditures were that person to receive private coverage. We lower the total expenditures under private coverage to capture the moral hazard effect of the additional out-of-pocket spending resulting from being uninsured. The result is an estimate of the total expenditures of the uninsured person. We then calculate the difference between these expected costs and the original out-of-pocket costs for each uninsured person. This difference is a person’s uncompensated care. The estimates are calibrated to produce a total amount of uncompensated care consistent with the findings of Hadley et al.⁴

**Construction of insurance packages.** At this point, each individual in the file has been assigned health expenditures consistent with having private coverage. These total health expenditures, however, are reflective of the particular benefit package that the matched MEPS individual had at the time of the survey. For example, if two identical people were given two different health insurance policies, one with a high deductible and one with a low deductible, the person with the low deductible would have total health expenditures that were higher than would the one with the high deductible. Higher out-of-pocket liability lowers the expected spending (an effect referred to as moral hazard). To remove as much of the benefit package effect on total spending as possible, we standardize spending to be consistent with a typical benefit package for the ESI market and one for the nongroup market based on data from the

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2010 Kaiser Health Research and Educational Trust (HRET) and America’s Health Insurance Plan (AHIP) surveys, respectively. Each individual has his or her private health expenditures adjusted so that he or she has a calculated level of health expenditures consistent with each of the defined typical benefit packages.\(^5\) Induction factors provided by actuaries are used to incorporate a behavioral response for those individuals/families who would have different levels of out-of-pocket spending under the standardized policies than they are assumed to have had at the time of the MEPS. Those with decreases in out-of-pocket expenses are presumed to respond by increasing use and total expenditures, while those with increases in out-of-pocket expenses are presumed to decrease use and total expenditures. High spenders (those observed to have high medical needs) will respond less to changes in out-of-pocket expenses than will those who are lower in the spending distribution.

Once such packages are created, they can be modified to achieve a given actuarial value (i.e., the average share of spending on covered benefits paid for by the insurer). For example, under the ACA, packages in the small group and nongroup markets will include the same essential benefits but will differ in actuarial value due to different cost-sharing requirements. Also, today, average cost-sharing requirements in smaller group plans are higher than in large group plans. The actuarial adjustment factors mentioned earlier can be used to compute individual spending under alternative insurance packages that might be offered under reform.

Expenditures in HIPSM cannot be disaggregated into spending on individual benefits, such as pharmaceuticals or visits to particular types of providers. The process described above gives three benefit packages which can be adjusted to any actuarial value: an average comprehensive ESI package, an average nongroup package, and Medicaid benefits. At the time of writing, the essential health benefits in the ACA had not been delineated in regulation. Since they are to be based on a survey of current comprehensive ESI coverage, we construct exchange packages by taking the standard ESI package and adjusting it to the various actuarial value tiers. The relevant stop losses are also applied. For policy options involving explicit differences in benefits, we have worked with actuaries to disaggregate the costs of the benefits involved.

*Aging of data to the current year.* The model as discussed above is based on the latest two years of available survey data (currently 2008 and 2009). We, however, generally present model results as if reform were fully phased in in the current year, 2011. In order to do this, we apply estimates from Holahan and Garrett to estimate the impact of more recent changes in unemployment rates on changes in employer coverage, public coverage, nongroup coverage, and the uninsured over that period.\(^6\) To project the unemployment rate for the current year, we use forecasts from the Congressional Budget Office (CBO), Blue Chip (a consensus of 50 private forecasters), and Economy.com. We make further adjustments to ensure consistency with Census estimates of population growth, by age and gender cell. Wages and income grow at rates consistent with the Consumer Price Index-Urban, and health care costs grow at rates of growth projected by the National Health Expenditure Accounts.

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\(^5\) Our computation of moral hazard throughout the model is based on analysis by Actuarial Research Corporation.  
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We also extend our method for aging the data for future years when presenting out-year results. In implementing cost and income growth rate assumptions beyond the current year within HIPSM, we use the model to generate behavioral responses to the cumulative amount of health care cost growth, net of income growth, that is assumed to occur between the current and the target years. This rise in the relative price of health care and health insurance premiums is modeled as a “reform” within the baseline year. As private health insurance premiums rise, coverage becomes less affordable and demand falls. Fewer firms offer coverage and fewer workers take up their ESI offers. Fewer individuals purchase nongroup coverage. Those who are eligible for Medicaid or CHIP become more likely to enroll. More people become uninsured. Given these behavioral responses, we then age the population to the target year by making adjustments to the weights of the observations in the HIPSM output file. The reweighting adjustments take into account the assumptions for changes in employment, incomes, offer rates, and changes in the population by age and gender cells.

**Correcting the tail of the income and wage distributions.** Income and wages on the CPS are top-coded. Thus, the total income and distribution of high incomes are very different from tax data such as the Statistics of Income. While many health reform policies focus exclusively on lower-income families, other important factors such as the ESI tax advantage require getting the distribution of higher-income individuals right. We use the income distribution in the Statistics of Income (SOI) to modify the tail of the CPS income distribution so that it converges with the tail of the SOI distribution and the total income matches the total income of the United States according to tax data. A related adjustment is made to wages for the highest earners so that total wages in our data match tax data.

**Medicaid Eligibility and Enrollment, Immigration Status**

*Medicaid undercount.* To address the underreporting of Medicaid and CHIP in the CPS, we make adjustments to the microdata, drawing on approaches that have been applied to other surveys. We apply edits that take advantage of other coverage-related information present in our input data. The edit rules used to adjust the data are based on state-specific eligibility rules and enrollment procedures for Medicaid and CHIP, evidence of misreported coverage, along with other information collected on the survey that suggests that the CPS’s indicator of enrollment in Medicaid or CHIP may not be accurate.

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8 See V. Lynch, *Memo on applying logical coverage edits for analyzing Medicaid/CHIP participation and coverage in the 2008 ACS* (Washington, DC: Health Policy Center, Urban Institute, June 4, 2010).

9 Available administrative data suggest that the total number of children enrolled in full benefit Medicaid and CHIP coverage but not also enrolled in private coverage in June of 2008/2009 was 25.9/28.3 million. We derive this total by adjusting the reported Medicaid enrollment counts for children with restricted benefits and for those classified as having Medicaid and private coverage and for double counting of children who move across state lines and by adding in the reported CHIP enrollment count for the same period. The 2008/09 administrative data indicate that there were a total of 28.4/31.0 million children enrolled in Medicaid and CHIP, including children with restricted benefits like emergency Medicaid services or family planning services, as well as private coverage (e.g., Medicaid wrap-around coverage) and children who moved and reenrolled in another state. 2007 Medicaid Statistical
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Our derived estimate of the number of uninsured children is close to comparable estimates from the National Health Interview Survey and the American Community Survey in 2008 but above estimates from those two surveys in 2009 (data not shown). We make no further adjustments to the CPS coverage estimate beyond the edits described above, even though the resulting estimates are below the administrative total, because we believe that the administrative counts could overstate the number of children enrolled in Medicaid/CHIP coverage on a given day.\(^{10,11,12,13}\)

**Medicaid/CHIP eligibility model.** The model simulates eligibility for Medicaid and CHIP in each state using available information on eligibility guidelines, including the amount and extent of disregards, for each program in place as of 2009.\(^{14}\) Eligibility for CHIP is based on income and immigration status and does not take into account waiting periods that might apply to children who meet the income and immigration criterion but who have employer-sponsored insurance. Family-level characteristics used in determining eligibility, such as income, are based on the family grouping (i.e., the child’s health insurance unit) that states use during the eligibility process.

**Immigration status.** For noncitizens, the model also takes into account the length of residency in the United States in states where this is a factor in eligibility. Because the CPS does not contain sufficient

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\(^{10}\) While the derived administrative counts are considered to be more consistent than baseline administrative totals with respect to the Medicaid/CHIP coverage estimates from the ACS, they may still overstate this coverage on a given day because the adjustments do not take into account potential duplication in CHIP records. In addition, some people may remain on the administrative data after they have obtained another type of coverage, and families may not be aware that their child is enrolled in public coverage, due, for example, to misunderstandings about continuous eligibility periods or to automatic reenrollment/enrollment, and thus may behave as though the child is uninsured. Finally, both retroactive and presumptive eligibility may produce an overcount of enrollees relative to survey respondents’ beliefs regarding their coverage.


\(^{13}\) Additional imprecision in the administrative totals may be introduced by the adjustment method, which relies on multiple years of administrative data.

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information to determine whether an individual is an authorized immigrant, we impute documentation status for noncitizens based on an approach developed by Passel.\textsuperscript{15} Documentation status for children is imputed based on an imputation of the documentation status of coresiding adults (typically, the child’s parents). Estimates of the number of undocumented adults and children are designed to match, in the aggregate, published summary estimates of the U.S. undocumented population nationally, and in a subset of large states.

**Synthetic firms**

In order to compute firm level premiums for employer-sponsored coverage and to model firm decisions of whether to offer insurance or not, and if offering, the type of health insurance coverage they provide, workers were grouped into simulated, or “synthetic,” firms. These groupings allow HIPS M to model firm decisions related to health insurance in response to policy changes, reflecting the combined preferences and characteristics of the workers in each firm as well as their dependents who might also obtain coverage through the employer. The distribution of synthetic firms mimics the known distribution of employers by size, industry, region, and baseline offer status, and workers matched into each are those reporting employment in the same type of firms.

We designed and implemented a procedure to create synthetic firms that records the distribution of workers within and across firms, yet minimizes computational burden. The optimal number of synthetic firms must be relatively large in order to analyze the distribution of firms’ outcomes, and experiments on the optimal number of firms were performed. Observations of workers in our core CPS file were separated by specific factors: employer-provided health insurance offer status, region of residency, industry category, and firm size. Small partitions could be combined to ensure heterogeneity. Each observation in the CPS/MEPS data set was thus assigned to one particular firm to create a core set of employees with common characteristics for each firm, and each firm was then populated by coworkers of the core employees.

Very few data are available regarding how the distribution of wages in firms of similar size and industry varies. Since our algorithm is based on a representative population of workers, it approximates the actual distributions on average. However, there may be fewer extreme wage distributions in our synthetic firms than in reality if firms in a particular size and industry employ very different mixes of workers.

Analytical firm weights were constructed to reflect the distribution of firms in the United States by firm size, region, and industry. To calculate the weights, we relied on the data derived from the Statistics of U.S. Business and the sum of the weights of each synthetic firm’s core employees. To decrease computational complexity, the creation of synthetic firms is modified so that one individual observation can represent more than one individual employee, with modifications in order to maintain distributional characteristics across the firms. The analytic weight for each replicated individual observation was

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calculated. The result was a data set of synthetic firms that not only reflects the national distribution of firms but also has the ability to reflect the offering behavior of such firms.

The Flow of a Policy Simulation

HIPSM coordinates behavior by iterating a sequence of steps. Each iteration involves a sequence of four stages. At the beginning of an iteration, the health insurance industry sets premiums for all available health insurance plans given information observed in the last period and any policy changes that become effective this period. In the second stage, based on these premiums and information about their employees, employers decide whether to offer an employer-sponsored health insurance plan, and if so, the plan to be offered and the employees’ cash wages. In the third stage, individuals choose their optimal health insurance option given their available alternatives and associated premiums, income, and relevant tax incentives. Once the iteration is complete, the next period begins and the process repeats. Coverage decisions in the previous period are used to update premiums based on current risk pools, and so on. Iterations continue until coverage decision changes from the previous iteration fall below a specified level; in other words, until an equilibrium state has been reached.

The details of these stages are as follows:

Stage 1: Calculate health insurance packages and premiums

HIPSM calculates health insurance premiums using information on risk pools relevant to health insurance plans. For example, to calculate nongroup premiums in the current period, we rely on information of people who bought a nongroup health insurance plan in the last period, accompanied by information on any policy changes that may affect the risk pool in the current period.16 This feature ensures that self-selection into a specific coverage type will be reflected in the premiums.

Under this mechanism, any policy change that affects individuals’ health insurance decisions has a potential to affect premiums of all available coverage types. For example, a policy to expand public health insurance coverage will in general cause some people who formerly chose other types of coverage, such as nongroup health insurance, to become insured under the public program. Given the change in nongroup risk pools, nongroup premiums will change accordingly.17

Calculation of premiums from ESI risk pools. We compute single and family ESI premiums faced by each employee and each firm for both standard and high-deductible ESI packages. We base our premium computations on the expenses of the covered lives within each synthetic firm. Premiums are calculated

16 To be specific, we predict who should have bought a nongroup health insurance last period had the policies effective this period been in effect last period.
17 If the expansion results in higher-than-average-cost people leaving the nongroup market, the updated premiums will be lower. Lower premiums then induce more people into the nongroup market, and the premiums may increase if the new enrollees are of higher than average cost. The adjustment process will go on until an equilibrium has been reached.
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based on a blend between the weighted averages of actual and expected insured costs. From these blended costs we calculate expected values for the individual firm and for ESI groups defined by firm size, industry, and self-insured status. From these blended and expected costs, an average insured cost is calculated that is a blend of the firm’s average cost and the ESI group’s average cost. An administrative load that varies by firm size and industry is then applied. The worker’s share of premiums is then computed based on the firm contribution rates calculated previously. Our baseline national ESI premium estimates are calibrated to be compatible with premiums in the most recent MEPS-Insurance Component (MEPS-IC) and Kaiser/HRET surveys. Average premiums by firm size are calibrated by adjusting the actuarial value of ESI plans. Under reform, rating rules can change. Under the ACA, for example, a firm’s claims history can no longer be used in determining its premium. Medical Loss Ratio (MLR) requirements cap administrative loads at 20 percent, though this affects only the smallest firms. Small group is also defined as employers of 100 or fewer workers by the year 2016, instead of the pre-ACA norm of 50 or fewer workers. These changes affect the type of rating factors that HIPSM uses and the definition of employer groups types and their associated risk pools.

*Calculation of nongroup premiums.* We compute single and family nongroup premiums in each iteration. The initial premiums computed to begin a simulation are based on insured expenditures of those insured in the nongroup market at the baseline. In the following iterations, those individuals simulated to enroll in nongroup coverage in the immediately preceding period are used. We do not model the nongroup market regulations and rating rules of every state in the national model. Currently, only a small fraction of people have nongroup coverage; consequently, our core data set’s sample size does not permit this population to be separated into 51 separate state pools. However, we do capture some differences, such as the states with guaranteed issue nongroup markets. Our methodology captures the overall risk pooling in the nongroup market across individuals within and across rating cells, as well as individual-level underwriting. In the baseline, rating cells include age groups, gender, and health status. Baseline national nongroup premium estimates are calibrated to results from the most recent AHIP survey.\(^{18}\) We also use the AHIP survey to estimate the number of people who would be denied access to nongroup coverage. We then impute denial of nongroup coverage for those states in which markets are not guaranteed issue, taking into account individual health status and health care expenditures.

Postreform, rating rules may change, and, as a result, postreform rating cells will change accordingly. For example, the health status rating cell would be eliminated if underwriting in the nongroup market were prohibited, age rating cells could be combined or altered depending upon new rules, and the variation across particular cells might be constrained.

**Stage 2: Employers’ decisions to offer health insurance**

In HIPSM, employers take into account their employees’ gains or losses from having a health insurance offer and perceived offering costs to decide whether to make an offer. The costs of offering coverage are calculated as:

- The employers’ premium contributions;

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- Plus any assessments to which the employer is liable under reform based on whether or not it offers coverage deemed affordable to its workers;
- Plus a fixed administrative cost to employers of offering ESI;
- Minus any tax incentives due to employers’ tax exclusions; and
- Minus any employer tax credits under reform.

Employers (HIPSM’s synthetic firms) will make an offer when they anticipate that (i) the employees’ combined value of the offer exceeds the offering costs, and (ii) there are enough employees who gain from having the offer. By an individual worker’s value of the offer, we mean the difference in his or her family’s expected utility with and without an offer. The utility function is described in Stage 3 below. Our utility is dollar-valued, so it can be summed over workers. We assume that employers distribute offering costs back to their employees in the form of wage offsets. That is, employees’ cash wages are lower when they have an employer-provided health insurance offer. This wage change is not individual; employer costs and savings are distributed across the wages of all workers.

*Choice between exchange and nonexchange plans.* Under the ACA, small employers will have the choice of offering coverage through the Small Business Health Options Program (SHOP) exchange or through coverage offered outside it. The same benefit tiers and essential benefits are required across the exchange and nonexchange markets, and risk adjustment across them is required. The default value of the exchange administrative load is 15 percent in our simulations. Administrative loads outside the exchange vary in our model by firm size and industry. Under the ACA, we apply the new 80 percent Medical Loss Ratio requirement, so loads are capped at 20 percent. Loads are generally above 15 percent for firms below 50 and less than that for firms above 50 outside the exchange. Choice between nongroup coverage inside and outside the exchange is governed by the difference in expected utility between the plans and a latent preference term whose distribution can be set to simulate behavior such as inertia, making individuals already purchasing coverage in the pre-exchange nongroup market less likely to switch to the exchange. Subsidies for premiums (nongroup market and small group market, and cost sharing in the nongroup market) are available only in the exchange, and eligibility for these will change the costs facing potential purchasers. Note that, absent subsidies, we assume administrative costs create the only difference in expected utility between the exchange and nonexchange plans, assuming perfect risk adjustment. By default, we assume full risk adjustment, as that is the intent of the law. When more regulatory guidance is available on exactly which risk adjustment methodologies will be used and their effectiveness is assessed, we will implement less than full adjustment between the exchange and nonexchange plans as an option.

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19 We built in an inertia factor that can be switched on to slow down changes in offering decisions.
20 We also built in an inertia factor that can be switched on to slow down wage-offset adjustments.
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**Stage 3: Individuals’ optimal health insurance decisions**

We adopted a utility-based approach to modeling individual and family demand for health insurance coverage. With this approach, workers value different insurance options based on premiums, expected out-of-pocket payments, risk of high out-of-pocket expenditures, and how much they value health care. Workers convey their valuation to employers, who decide whether and what to offer their workers based on whether the sum of the workers’ valuations for an option is greater than its cost. We model individuals as being in one of four possible insurance coverage states—ESI, nongroup coverage, public coverage, or uninsured. We allow both high-deductible plans and more comprehensive coverage under the ESI and nongroup options.

*Health insurance units.* A health insurance unit is defined as a collection of individuals whose health insurance decisions are interrelated and cannot be separated distinctly. A health insurance unit is classified into one of the following four types: (i) single without dependents, (ii) single with dependents, (iii) married couple without dependents, and (iv) married couple with dependents. Dependents are defined as individuals who can obtain health insurance coverage through a parent’s policy.22

*Utility functions.* The utility functions are the metric for valuing different insurance options available to individuals and health insurance units. The value of each type of coverage takes into account (1) out-of-pocket health care expenses; (2) premiums; (3) the uncertainty of out-of-pocket health care expenses; and (4) the value of differences in the amount of health care consumed when insured vs. uninsured, and the comprehensiveness of coverage a plan provides. The utility functions also capture aspects of family preferences including aversion to public program participation (e.g., due to welfare stigma) and sociodemographic characteristics. Key inputs to the utility calculations include the expected total and out-of-pocket health care spending that individuals and health insurance units would incur under each of the health insurance options, as well as the variance of expenditure under each option. Our utility \( u \) is a function of disposable income \( (C) \), health care spending paid out-of-pocket \( (m) \), and health care spending paid for by insurers, the government, or uncompensated care \( (s) \). The function has the following mathematical and economic properties:

1. Utility is additively separable into a function of disposable income and a function of health care spending, whether out of pocket or other.

2. Both individuals and firms exhibit constant relative risk aversion (CRRA). Whereas several papers in the literature use absolute risk aversion (ARA), HIPS M uses CRRA in order to achieve decreasing absolute risk aversion (DARA).23 24 25 We chose this for the following reasons:

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22 For example, a married couple with children who are all under 19 is considered a health insurance unit. Prior to implementation of the ACA in 2010, only adult children who were full-time students between the ages of 18 and 23 could obtain private health insurance through a parent’s policy. Today, adult children under age 26 can obtain coverage as dependents, regardless of student status. Because the CPS is a household survey, only those dependents living in the home are included; consequently, HIPS M’s health insurance units only include children living in the home.

As is well known in the literature, DARA incorporates two theoretically desirable behaviors. First, not only does the marginal utility of wealth decrease with wealth, but the percentage decrease also decreases. Second, the willingness to tolerate risk varies directly with wealth.

Many of the studies that chose constant ARA were based on data from a limited income range (e.g., the Rand Health Insurance Experiment). HIPSM uses income and wages adjusted to match SOI data from tax returns in its utility computations. The resulting amounts are not top-coded. We therefore model a much larger range of wealth.

The utility model in HIPSM is not used only for individual health insurance units. Sums of health insurance unit utility are the basis of the utility functions for firms. With constant ARA, there is no benefit to the pooling of risks. This is why DARA utility functions are generally chosen for modeling insurer behavior.\(^2^6\)

Beyond DARA, there is significant empirical evidence in support of CRRA.\(^2^7\)\(^2^8\)

3. We use the standard form of a CRRA utility function for risk aversion constant \(\sigma \neq 1\), which is generally set to 2, e.g.,

\[
u(C) = \frac{C^{1-\sigma}}{1-\sigma}
\]

4. The following elasticities are constant:

\[
\frac{\partial u}{\partial C} \equiv \gamma_m \quad \frac{\partial u}{\partial m} \equiv \gamma_s
\]

Further, these do not depend on the health insurance option under consideration. This is fairly standard in the literature.

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5. Out-of-pocket and insured costs are valued differently, i.e. \( \gamma_m \neq \gamma_s \). This is an important component of some models in the literature, \(^{29}\) but is absent from others. \(^{30}\) We believe the difference in valuation between costs paid directly by the health insurance unit and those paid on its behalf to be important. Based on a review of the literature, we set the out-of-pocket elasticity to 1 and the insured cost elasticity to 0.5.

6. The coefficients of relative risk aversion are the same for \( C, m, \text{ and } s \). Different estimates of this coefficient in different papers were done for different types of risk with comparable results. \(^{31}^{32}\) Our choice of coefficient is within the ranges estimated. Empirical estimates of the coefficients for \( m \) and \( s \) would be very difficult, and there is no a priori reason why they should be substantially different from the coefficient for \( S \).

7. We must be able to aggregate measures of individuals’ utility to a group utility for purposes of computing the best available option for health insurance units and for employer groups. In particular, the utility of a firm can be represented by either the mean or median of the utilities of its workers modified by the overall costs of offering coverage.

Refinement of utility measures and benchmarking to behavioral parameters from the literature. Because our method converts utilities to dollar values, we can examine whether the valuations that families have for various insurance options are reasonable. We adjust the utility values for individuals by adding a latent preference term so that the baseline insurance coverage choice that they make in a HIPSM simulation is consistent with what they are observed to have chosen in the core data. This adjustment captures unobserved reasons why people might not choose the coverage type that appears to be their best option given what we can observe. We continue to refine our utility parameters and components so that the model will reflect what is known about the sensitivity of workers’ behavior to different incentives such as price responsiveness to changes in premium.

**ESI price elasticity.** We use the following elasticity targets by firm size, drawn from the literature. \(^{33}\)

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\(^{29}\) Glied, 2003.

\(^{30}\) Zabinsky, Selden, Moeller, and Banthin, 1999.

\(^{31}\) Szpiro, 1986.


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<table>
<thead>
<tr>
<th>Firm size</th>
<th>Elasticity</th>
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</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>-1.16</td>
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<tr>
<td>10–25</td>
<td>-0.45</td>
</tr>
<tr>
<td>25–50</td>
<td>-0.4</td>
</tr>
<tr>
<td>50–100</td>
<td>-0.3</td>
</tr>
<tr>
<td>100–500</td>
<td>-0.21</td>
</tr>
<tr>
<td>500–1,000</td>
<td>-0.047</td>
</tr>
<tr>
<td>1,000+</td>
<td>Not available from the literature.</td>
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**Nongroup price elasticity.** For the price responsiveness of nongroup coverage, we use calculations and targets introduced by CBO.\(^\text{34}\) We separately calibrate single and family coverage by income group.

**Public coverage expansions.** HIPSM models the effects of additional outreach and the stigma of public coverage on enrollment for Medicaid and CHIP. Expansions of public programs have often led to additional enrollment from those who were already eligible. Large expansions, such as CHIP or health reform in Massachusetts, are often accompanied by major outreach efforts that alter societal attitudes toward public coverage. Expansions of coverage in HIPSM boost take-up rates for those previously eligible for public programs, and our modeling is calibrated to three policy simulations. First is an expansion of Medicaid to 400 percent of the federal poverty level. We have targets for take-up of both those newly made eligible and those eligible under prereform rules but not enrolled; these are distilled from the literature and expert consensus within the Health Policy Center. Second is a Massachusetts-like reform, duplicating the gains in coverage that were observed in that state. Third is a simulation of opening Medicaid eligibility to all, but without an individual mandate. This third simulation is an extreme one, in which essentially free, comprehensive coverage is open to all. No social stigma attaches to such coverage, so take-up rates should be very high. These are three points on a continuum of expansions that can be modeled.

**Public coverage take-up.** We calibrate the behavior of our model so that a standard expansion of Medicaid and CHIP achieves take-up rates consistent with the empirical literature.\(^\text{35}\) These baseline take-up rates for the uninsured are between 60 and 70 percent, depending on person type and income group. The ACA contains important provisions that would increase take-up. States are required to establish a web site capable of determining eligibility for Medicaid and automatically enrolling eligibles. Hospitals would be able to make presumptive eligibility determinations. There would be other new requirements for simplifying enrollment and renewal of Medicaid and CHIP. We estimate a take-up rate of about 73 percent for the uninsured who become newly eligible under the ACA. This rate is higher than the baseline rate due to outreach and enrollment simplification provisions in the law, as well as a modest indirect effect of the individual mandate as observed in health reform in Massachusetts.


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**Crowd-out.** To ensure reasonable levels of displacement of private coverage by expanded public insurance (a.k.a. crowd-out), we calibrate the decrease in private coverage as a share of total increase in Medicaid enrollment at 22 percent, following the literature.\(^\text{36}\)

**Individual mandates.** To model the individual mandate, we begin with the baseline HIPSM model, in which behavior is calibrated to agree with results from the empirical health economics literature. The resulting model behavior is applicable for a voluntary health insurance regime. To model behavior under an individual requirement to obtain insurance, we rely heavily on empirical evidence from the only similar requirement already implemented, the Massachusetts reforms.\(^\text{37}\) Our simulation of how behavior would change under the mandate has three components:

1. **The applicable financial penalty.** A computation of whether the penalty is applicable and the amount of the penalty as defined by the law (i.e., the fully phased in amount discounted to present dollars).

2. **An additional “disutility” of not complying with the mandate.** The mandate is more than a dollar amount, it is a legal requirement. Desire to comply with the law, or at least to avoid enforcement and the stigma of noncompliance, can lead to behavioral responses much stronger than the amount that the nominal penalty would suggest, as appears to be the case in Massachusetts. The mandate has the effect of making being uninsured less desirable. We operationalize this in the model by applying an additional “psychic penalty” to being uninsured.\(^\text{38}\)

3. **A relatively small “spillover” disutility of being uninsured on populations not bound by the mandate.** The mandate in Massachusetts was also associated with an increase in coverage among those not actually bound by the mandate (those for whom no penalty for noncompliance would apply). We assume that this association was driven, in part, by a spillover effect of the mandate by those who either mistakenly assumed they were subject to a penalty, or who reacted to a new social norm to have coverage. People may make judgments about whether they will lose their mandate exemption in the future due to rising income during the course of a year. However, for those exempt from the mandate, the amount of additional disutility of being uninsured is far smaller than for those bound by the mandate.

**Individual and family decisions.** Once each coverage option (including being uninsured) for each individual and family has been valued, HIPSM can make enrollment decisions among the coverage


\(^\text{38}\) Behavior in HIPSM is modeled using an expected utility framework. This “penalty” is thus the disutility of not complying with the law.
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options available to them. For example, in our simulation of the ACA, a single adult can choose among the following:

- No insurance
- Medicaid/CHIP (if eligible)
- ESI (if offered), may be in exchange or outside of exchange, depending upon employer decisions
- Nongroup
  - Exchange
    - Subsidized coverage (if eligible)
    - Benefit tiers: bronze, silver, gold, platinum.
  - Outside the exchange
    - Benefit tiers: bronze, silver, gold, platinum

Coverage decisions for families are more complicated. HIPSM does not model all possible combinations, but the following are modeled:

- All family members either uninsured or enrolled in public coverage
- Family policy purchased
  - ESI and nongroup options as shown above
  - Some family members may enroll in Medicaid or CHIP
- One or two single policies purchased by adults
  - ESI and nongroup options as shown above
  - The remainder of the family is either uninsured or enrolled in public coverage

*Choice between exchange and nonexchange plans.* This choice is governed by the same factors as the choice between exchange and nonexchange in the small group market discussed above.

**Limitations**

While behavior within HIPSM is calibrated to the best empirical economic literature on employer and household responses to price changes and the availability of new coverage options, some behavioral decisions are more uncertain than others. The split between exchange and nonexchange enrollment in small group coverage carries particular uncertainty. Although it is modeled here as if eligible employers are essentially neutral between exchange and nonexchange coverage at the same price, the actual decision by small employers will depend upon a number of unknowns. These include how small group plans will differentiate their offerings inside and outside the exchanges (states can require that the offerings be uniform, but this is not required by the ACA), whether states will make all regulatory rules in and out of the exchange uniform in this market, the effectiveness of the risk adjustment methodology, the role of brokers, and so on.

At this time, HIPSM does not model changes in employer contributions to workers’ coverage or an employee choice option in the SHOP exchange. In addition, the simulations of health reform assume a
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fully effective risk adjustment system, while the actual system is likely to fall short of that ideal. Also, the national model of HIPSM does not model state-specific benefit mandates, if any, or state differences in typical benefits and plan design in the employer and nongroup markets. For example, nearly all nongroup plans in state A may exclude maternity benefits, while they are required in state B.

As the regulations associated with the ACA are being released on a rolling basis, some uncertainties about the final rules remain. To the extent that rules emerge that are different than expected, the results could be affected. One example is the final treatment of affordability computations, subsidy eligibility, and penalty exemptions for family members of workers with affordable employer-based insurance offers. Here we have simulated results using the interpretation of the Joint Committee on Taxation that affordability is based on single coverage.39