



State Coverage Initiatives

The Urban Institute's Microsimulation Model for Reinsurance: Model Construction and State-Specific Application

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This report describes the Urban Institute’s microsimulation model of reinsurance, which was built to simulate the impacts of various state-specific ways of using state-funded reinsurance to subsidize primary insurance premiums. The type of reinsurance modeled reimburses primary carriers at the end of a year for the insured health care spending that falls within a specified “corridor” of aggregate annual individual medical claims expense—e.g., reinsurance of 90 percent of expenses between \$30,000 and \$90,000 per person per year.

This work was done as part of the Reinsurance Institute, a project of the Robert Wood Johnson Foundation’s State Coverage Initiatives program, administered by AcademyHealth, and the Urban Institute, that provided technical assistance to competitively selected states interested in using reinsurance as an aspect of health financing reform. A companion report describes the overall project, including the qualitative elements of our work that complemented the quantitative modeling described here.¹ Results of the modeling are reported in deliverables to the participating states.²

Four Steps in Modeling the Effects of Reinsurance

Predicting the effects of reinsurance reform options within our three states of Rhode Island, Washington, and Wisconsin involved four main tasks:

Creating a baseline database that reflects each state’s distribution of health insurance coverage, demographic characteristics, individual health

expenditures, employer characteristics, and health insurance premiums paid by employer group and non-group purchasers of coverage;

Modeling the reinsurance policy and estimating the changes in premiums that would result from each particular reinsurance reform option considered;

Estimating the effects of those premium changes on employers’ health insurance offer behavior and on individuals’ take-up of group and non-group coverage; and

Computing expected changes in health care expenditures and costs to the state for each reinsurance option simulated, as well as summarizing the changes in health insurance coverage expected to result for different populations of interest.

Step 1. Creating a Baseline Database for Each State

Comprehensive modeling of the effects of reinsurance policies in a state requires individual-level data that are population-based, so that we can simulate the costs and behavior of the uninsured. Data on insurance claims alone are insufficient. A useful model also requires data that are representative of state health expenditures and coverage, demographic characteristics, and employer characteristics. Additionally, since reinsurance policies affect the composition of the risk pools for each insurance product, simulation of reinsurance requires that the baseline data also characterize the health expenditure profile and number of individuals enrolling in coverage together in each risk pool.

Finally, modeling reinsurance requires having an accurate distribution of health care expenses in the upper tail of the distribution across risk groups, because some reinsurance options can be expected to target such very high expenditures. The implication of this final requirement is that the data need to have a sufficiently large number of observations to obtain an adequate number of “extreme” cases in the health expenditure distribution.

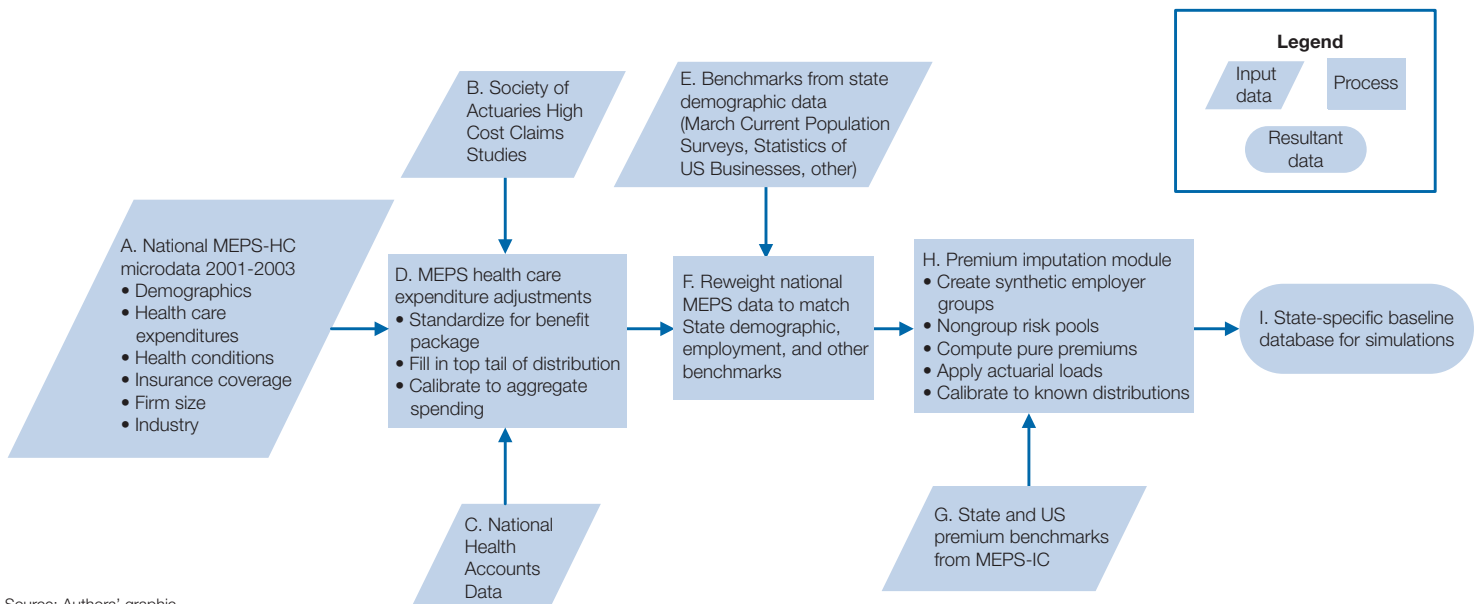
Unfortunately, there are no state-level datasets that possess all these features. Thus, this project built state-representative databases from multiple national and state-level data sources. Baseline database construction augments and adjusts national MEPS data in a number of ways (Exhibit 1). The goal of each adjustment was to augment MEPS-HC data or correct them for a known shortcoming, each time using the best available information. The end result was a baseline database for each state that well reflects known characteristics of the state.

The key steps of constructing the baseline database are labeled A through I in Exhibit 1. They are discussed in turn below.

Baseline Step A: Medical Expenditure Panel Survey-Household Component (MEPS-HC)

Our primary source of individual-level data was the MEPS-HC.³ This survey is nationally representative (of the non-institutionalized U.S. population), population-based, and covers more than 30,000 individuals in each survey year. Annual data are released approximately two

Exhibit 1. Construction of Baseline Database: Flowchart of Steps from National Spending Data to State-Specific Premiums



Source: Authors’ graphic.

Exhibit 2. Cost-sharing Characteristics Used in Standardizing Health Expenditures

Standard “Modal” Benefit Package	Deductible (2007\$)	Coinsurance	Maximum OOP Amount (2007\$)
Washington and Wisconsin			
ESI Benefit Package	\$350 (single) \$700 (family)	20% (single) 20% (family)	\$1750 (single) \$3500 (family)
Non-group Benefit Package	\$1500 (single) \$3000 (family)	20% (single) 20% (family)	\$3000 (single) \$6000 (family)
Rhode Island			
ESI Benefit Package	\$0 (single) \$0 (family)	5% (single) 5% (family)	\$1750 (single) \$3500 (family)
Non-group Benefit Package	\$400 (single) \$800 (single)	20% (single) 20% (family)	\$3000 (single) \$6000 (family)

years after they are collected. The MEPS-HC provides detailed information on individuals’ medical spending by source of payment, insurance coverage, income, employment (industry, establishment size, hourly wage, hours worked, insurance offer at work), and health status. Not only does MEPS-HC contain information on the uninsured that are lacking in claims data, but it also contains household-level information needed to simulate how reinsurance would change insurance offers and premiums.

To build our baseline, we pooled together three years of the MEPS-HC data (2001–2003). Pooling increased the number of individuals in the database with very high medical costs, who are the focus of the reinsurance policy options that we expected to simulate. We adjusted the previous one-year weighting factors of MEPS-HC data into new weights whose application to the three-year sample yielded estimates summing to the 2003 national population as estimated in the MEPS.

MEPS-HC health expenditure dollar amounts were inflated to 2007 dollars using inflation factors from the National Health Expenditure Accounts (NHEA) of the Centers for Medicare & Medicaid Services (CMS).⁴ We made these adjustments separately by type of service. Income and wage dollar values were inflated to 2007 dollars using the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W).⁵

Baseline Step B: “Stretching” the distribution of MEPS-HC health care expenditures

The MEPS-HC is known to understate total health expenditures, as some high medical cost populations are outside the scope of the survey’s

sample (e.g., institutionalized persons). Their absence creates a downward bias in the number of high-expenditure respondents in the dataset. In order to correct for this shortfall, we adjusted the distribution of privately insured health expenditures in the MEPS-HC in order to match the distribution observed in a large claims database of privately insured expenses maintained by the Society of Actuaries (SOA). (This database is a good source on high-cost cases in the private sector.) The private claims are from 1999, and we initially inflated them to 2007 dollars.⁶

Details on Methods Used: To identify the shortfall with more precision, we compared the distribution of SOA claims per person year with those calculated from MEPS-HC for employer-sponsored insurance (ESI) coverage. Specifically, we computed the ratio of SOA to MEPS-HC for each percentile of spending from the first to the 99th. We found that in the top eight percentiles, from the 92nd to the 99th percentiles, the SOA-to-MEPS-HC ratio was greater than one, indicating an undercount of very high expenditures in the MEPS, relative to SOA. We therefore multiplied MEPS-HC private health care expenditures by the corresponding ratios for expenditure values in the top eight percentiles.

This stage of adjustment addressed the distribution of claims from low to high, not the overall amounts of spending (for which SOA is not a good source). Accordingly, we kept the SOA stretching from affecting aggregate private expenditures by multiplying each expenditure by an overall constant factor. Thus, our SOA stretching method changed the shape of the expenditure distribution, while being expenditure-neutral overall.

Baseline Step C: Adjusting for expenditures under-reported in MEPS

According to previous studies, health expenditures in the MEPS-HC routinely undercount certain expenditures, such as laboratory tests, that survey respondents find harder to recall.⁷ In order to address this discrepancy, we used these studies to compare MEPS-HC health expenditures within payers and services to the NHEA, and we applied an adjustment to each payer’s expenditure within each type of service category to be in accordance with the adjusted NHEA estimates. In contrast, the recall and reporting of out-of-pocket (OOP) spending by household survey respondents in the MEPS-HC is thought to be a relative strength of the dataset. (In fact, we found a smaller percentage difference between the MEPS-HC and the adjusted NHEA for OOP spending.) Accordingly, we did not adjust the MEPS OOP spending to reach NHEA out-of-pocket estimates.

Baseline Step D: Making other adjustments to MEPS-HC spending data

This step had two components:

1. *Estimating uninsured persons’ expenditures when insured.* If the number of uninsured people in a state is reduced, we would expect overall health expenditures in the state to increase because insured people tend to utilize more health services than otherwise identical people who are uninsured.⁸ For uninsured individuals in the baseline database, we used a statistical matching method (i.e., predictive mean matching) to impute what their health expenditures would have been if they had been insured. We drew imputed values for each uninsured individual from the set of health care expenditures of insured individuals in the baseline database who had similar demographic characteristics and health status, as summarized by a regression prediction of health care expenditures on the insured population.

2. *Standardizing health care expenditures.* Standardized health care expenditures are needed to calculate premiums accurately for individuals purchasing together in the same risk pool. The measures of total and out-of-pocket health expenditures in the MEPS-HC data, however, reflect the particular cost-sharing characteristics of the health insurance coverage that the surveyed individual/family had actually experienced as of the time of the survey. This fourth step in the construction of our baseline dataset standardized health expenditures to remove variation attributable to differences in cost-sharing.

Details on Methods Used: The standardization involved three steps as follows.

1. We first defined the cost-sharing characteristics of a standard health plan for both employer-sponsored coverage and non-group coverage. This was done in terms of a deductible, a coinsurance rate, and an out-of-pocket maximum. The standardized plan values we used for each state are shown in Exhibit 2. These values were selected after doing an environmental scan of popular coverages in each state and discussion with key informants.
2. Given the calculated per person total annual expenditures, we next adjusted OOP expenditures up or down so that they were consistent with the standard plan.
3. If step 2 resulted in a lower OOP amount than what was reported in the MEPS-HC (implying that the standard plan has less cost-sharing) we made a positive adjustment (using an induction factor) to total expenditures to reflect additional utilization that would be “induced” by the more generous coverage (i.e., with lower cost sharing). Similarly, we made a negative adjustment if step 2 resulted in a higher out-of-pocket amount. Finally, we applied step 2 again, but using the new total expenditure value after the induction factor had been applied. The standardization/induction method that we employed is the same as that used in the Health Insurance Reform Simulation Model (HIRSM) and described in its documentation.⁹ (A limitation: It was not feasible to adjust expenditures in different health plans owing to the differences in benefits or provider refunds.)

Baseline Steps E and F: Reweighting the MEPS to resemble a particular state

We re-weighted the national MEPS-HC data to make the observations consistent with state-level benchmarks along a number of dimensions. To do this, we needed a population-based

micro-dataset for each state that contains variables shared in common with the MEPS and that is representative of the state’s demographic composition and health insurance coverage.

Details on Methods Used: For Rhode Island and Wisconsin, the re-weighting dataset was the Annual Social and Economic Supplement (ASEC) to the CPS.¹⁰ We used two pooled years of state data (data years 2004 and 2005) to produce the state-specific benchmark database. While the CPS nominally produces estimates of coverage for the immediately past calendar year, its estimates are more similar to point-in-time coverage estimates from other surveys.¹¹ For the reinsurance model, we followed a common convention, and interpreted the CPS yearly coverage estimates as estimates of current coverage.

Survey counts of Medicaid enrollment are also known to differ from administrative counts. A preliminary re-weighting was applied to the CPS data for Rhode Island and Wisconsin to adjust levels of Medicaid enrollment, separately for children and adults, setting the level to equal the midpoint between the CPS estimates of Medicaid coverage and state administrative counts. In most states, the CPS undercounts the number of Medicaid enrollees relative to administrative totals, but making a full adjustment to administrative totals would make the rate of uninsurance unrealistically low.¹² In adjusting the Medicaid totals in each state, we made one-third of the adjustment through shifts from uninsured to Medicaid status, and two-thirds from ESI coverage, in accordance with prior findings.¹³

For Washington, we used the 2006 Washington State Population Survey (WSPS) as the state-level benchmark file because state officials consider this survey more representative of Washington than the CPS. No initial adjustments to Medicaid coverage were needed for the benchmark database for the WSPS.

Having created a state-representing database for each state, we then transformed the national MEPS weights into sets of weights that produced means for variables also in the MEPS-HC that were nearly identical to the weighted means produced by the state-level datasets. The steps in this process were to:

- append the state database to the national MEPS database;
- estimate a probit model of the probability of being in the state database as a function of a set of common variables (we use health insur-

ance unit [HIU]¹⁴ level variables as the covariates for this regression, such as average age in the HIU, for reasons we discuss below); and

- use the predicted probability from this regression in a formula provided by Barsky et al. to adjust the weights of the national MEPS data to produce the new set of weights that reflect the state.¹⁵

We compared the distribution of variables in the re-weighted MEPS with the distribution of variables in the state-representing benchmark files to check whether they were nearly equal. If meaningful differences were present, we refined the probit model specification until the differences were acceptably small.

For each state’s resultant re-weighted MEPS file, we performed a further round of re-weighting (cell-based re-weighting) in order to simultaneously hit benchmarks for health insurance coverage and for employment totals by firm size category. The coverage benchmarks are the same as those reflected in the state-specific benchmark files. As our benchmarks for the total number of employees by firm size category, we used the midpoint between totals we calculated from two sources. The first source was the Statistics of U.S. Businesses (SUSB). We supplemented the SUSB with data from the Medical Expenditure Panel Survey Insurance Component (MEPS-IC)¹⁶ in order to align the firm size categories from the SUSB and the CPS. The second source of employment totals was the CPS, which is based on worker-reported information. We decided to use the midpoints between the two sources of estimates as our benchmarks for employment by firm size categories upon finding that they often differed by a substantial amount.

Baseline Step H: Imputing premiums for coverages

It is helpful to discuss step H (imputing of premiums) before G (comparing these imputed premiums with observed premiums in each state). The two steps were interactive, as G’s benchmarking was part of modifying H’s preliminary premium imputations to make them final. Premium imputation had two key components. First was putting our state-specific individuals into synthetic establishments based on individual’s reported employment characteristics (employer offer of health insurance, industry, firm size, and number of employer locations).¹⁷ Second was generating applicable firm-specific premiums based on their component individu-

als' known medical spending, consistent with state rules.

- *Constructing employer groups/synthetic establishments.* Group coverage premiums in the model were “built up” from the health care expenditures that underlie them. We calculated group premiums as the expected health care expenditure within a particular risk group plus an administrative loading factor that varies by firm size. In order to compute premiums in this way, we had to define employer groups that make up the risk pools.

Details on Methods Used: We created these risk pools by aggregating employees into “synthetic establishments” to simulate the current structure of the group insurance market in each state, particularly for small firms, whose insurance is of particular interest to state policymakers. We placed people together based on their reported employer characteristics previously discussed, and then partitioned them into “synthetic establishments” based on the average number of employees each of these establishments is estimated to have. For example, we placed together workers who reported employment in an agricultural firm with 1–9 employees that did offer health insurance to employees. Next, we partitioned this group of similar employees into “synthetic establishments.” Throughout this process, we used data from the SUSB to inform the number of synthetic establishments we created, and how many employees to place in them.

For the purposes of sorting individuals into synthetic firms, we needed to expand the number of individuals and HIUs in the dataset by replicating observations in order to get a sufficient number of combinations of worker-types within firm-types. In particular, we replicated observations in proportion to their weights, so that each individual had the same weight within the expanded dataset. There are several reasons for creating a dataset in which individuals' weights do not vary. Using a dataset with person-varying weights would impede the analysis, because individuals assigned to firms would then represent multiple workers within the firm (or fractions of workers). Observations representing multiple workers within a firm would make the distribution of health care expenditures within a firm “lumpier” than it actually is. Observations representing fractions of workers would make it difficult to operationalize reinsurance rules within a firm that apply to the total expenses of each person. Also, it makes better

Exhibit 3. Administrative Load Assumptions Used in Constructing Group Premiums²¹

Firm size	Administrative Load
1 – 9 employees	36%
10 – 24 employees	27%
25 – 49 employees	22%
50 – 99 employees	17%
100 or more employees	10%

Note: Firm size = number of employees at all establishment locations; Source: Actuarial Research Corporation.

intuitive sense to discuss whole individuals rather than parts of individuals who take up coverage as a result of a reinsurance reform.

Our use of a constant-weighted dataset for the assignment of workers to synthetic firms solved several problems, but it raised new challenges as well. The expanded dataset needed to preserve the correct composition of each health insurance unit. To achieve this, we made replicates of whole HIUs based on the average of the individual-level weights of the people within the HIU. For example, an HIU of three people with individual-level weights of 10, 20, and 30 would have a mean HIU weight of 20. Therefore, we made 20 replicates of each person in the HIU, creating 20 complete replicate HIUs. If instead we had made 10, 20, and 30 copies of the three individuals based on their individual-level weights, we would have only 10 complete HIUs, and 20 incomplete ones. This would prevent an accurate aggregation of health expenditures within an HIU when calculating premiums.

Expanding the dataset by an average HIU-level weight when individual-level weights are heterogeneous within HIU, however, had the potential to shift the weighted characteristics of the dataset away from our already benchmarked values. Consider the HIU of two individuals with weights of 1 and 19 in the MEPS-HC, one male and one female. The average HIU-level weight here would be 10, but using the same value of 10 for both would give too much weight to the male individual and too little weight to the female individual, thereby altering benchmarked demographic estimates if these differences do not balance out over the dataset as a whole. Fortunately, the individual-level weights within the original MEPS are sufficiently homogenous within an HIU that one can obtain similar demographic esti-

mates using individual or HIU-averaged weights. We avoided creating additional intra-HIU weight heterogeneity by using only HIU-level variables in the re-weighting procedure prior to the replication of observations. Proceeding in this way, we were able to obtain demographic estimates in our re-weighted and expanded datasets that closely match our state-level benchmarks, while maintaining the structure of each HIU and enabling us to assign workers to synthetic firms.

We sorted employees into categories of firm size (i.e., 1–9 employees, 10–24 employees, 25–49 employees, 50–99 employees, and 100 or more employees¹⁸), number of locations, industry group, and whether the employee has an offer of health insurance coverage. When we assigned workers of a particular category into their synthetic firm, for those with one establishment location, we simply calculated the average number of persons per establishment within each category of establishment size, industry, and offer status; for these employees, establishment size and firm size are known to be equal. For those with more than one establishment location, we probabilistically imputed firm size based on the distribution of establishment sizes across firm sizes from the SUSB (produced by the U.S. Census Bureau).¹⁹ Within each category of firm size, industry, and offer status, employees were sorted randomly and then partitioned into synthetic firms with an average size equal to the average number of employees per firm within their cell.

Finally, we created a set of firm-level weights for use in firm-level analyses so that the weighted number of synthetic firms in the baseline database matched the state-specific targets for the number of firms within each firm size and type. We used data from Statistics

of U.S. Businesses (produced by the U.S. Census Bureau) and the Medical Expenditure Panel Survey Insurance Component (MEPS-IC) to create state-specific targets for the number of employer firms within each state by firm size, industry, number of employer locations, and whether they do or do not offer health insurance coverage.

- *Generating baseline premiums for group coverage for offering and non-offering establishments.* We computed the average, standardized covered expenditures for each establishment, the “pure premium” for each. By pure premium, we mean the average of all medical claims expenditures. We later apply overall administrative “loads” to estimate actual market premiums. Pure premium here does not include claims adjustment expense. We followed each state’s rules regulating the rating of ESI premiums in the small-group market in order to create a pure premium applicable to each firm. To create final premiums simulated for each firm, an administrative load that varies by firm size (Exhibit 3²⁰) was added to arrive at premium values for each establishment. Each person in an employed health insurance unit (HIU) was assigned a group premium for single coverage if the person is single, and family coverage if the person has a family.

Details on Methods Used: We constructed the establishment-level premiums by blending several components as follows. The first component that entered the premium blend was calculated by collapsing pure premiums for all similarly situated HIUs into a pool of shared risk across firm sizes in accordance with state regulations. Some states do not allow firm size to be used as a rating factor in the small-group market. In that case, the model’s premiums do not vary based on employer’s size among those that are small groups. For large firms and for states that allow insurers to vary premiums in the small-group market based on the employer’s size, the establishment-specific pure premium was blended with the broader pool of similarly situated risks to create a “blended pure premium.”

In states that limit the use of firm size and other characteristics as rating factors among smaller businesses, we computed a second component, a regression-predicted premium, to be used in place of the blended pure premium. We estimated a predicted premium by regressing the establishment-specific pure premium on establishment-level characteristics consistent with each state’s regulations regarding the insurers’ capacity to vary rates based on employer’s size,

claims, industry, age and gender of employees and dependents, and other factors.

In states that allow premium rates to vary by claims experience, we used a third component in the calculation of blended pure premium—the establishment’s standardized actual health expenditures for singles and for families. To summarize, an establishment’s blended pure

premium for singles and for families were a combination of the following three components, according to each state’s regulations: average standardized health expenditures of all individuals or families in the applicable risk pool; regression-predicted establishment-level health expenditures standardized for group coverage, where the regression covariates varied according to the rating rules allowed in each state, such as

A Note on Simulated Coverage Available for Small Firms and Actual State “Small-Group” Markets

The model considers all coverage to be small-firm coverage where survey respondents (and dependents) to report being insured through a small firm. (We have no way of checking the insurance regulatory status of survey respondents’ coverages.) If respondents are uninsured at baseline, they are assigned to the small-firm market if their dominant insurance connection is to a small firm. In some cases it is not clear through what size firm coverage actually comes or could come after reform. For example, this can occur where an HIU (family) has two parents working for different sized firms. If both are insured, an insured dependent might be covered under either policy. If both are uninsured, after reform, take-up might occur under either policy. The model built in the assumption that large-group coverage would always be more attractive than small-group and that, absent a large-group connection, an HIU will take up the coverage that would be primary under conventions used for coordination of coverage (normally, that head of household group coverage is primary and other coverage secondary).

The model’s small-firm market should resemble each state’s “small-group” market, but the accuracy of its simulation of reality depends upon what coverages are actually available to small firms and employees within the state. There may be some association health plans that market to small firms or individuals within small firms. There may also be non-group coverage sold on a “franchise” basis under which individuals are the policyholder, not the firm, but the firm arranges for payroll deduction.

Small firms were modeled as those with 2-49 employees (1-49 in Rhode Island). According to insurance practice and regulation, the upper limit should be 50 employees, but we were constrained to use 49 because of pre-existing survey definitions of firm size categories. For the states simulated, we estimated that only a very small percentage of firms or population would fall into firms of exactly 50 employees.

The model sets firm size by the total number of employees at all establishments, even ones outside the state, as that appears to be the predominant mode of counting employment for insurance purposes. The number of employees within the state of interest may be small, but the firm still large for insurance purposes.

For Washington only, we partitioned the population within small firms into two groups. In one set of simulations, the population to be reinsured were people assumed to have conventional small-group coverage (that is, coverages subject to modified community premium rating rules that ban use of health status as a factor in premiums). The other group was assumed to get coverage from their small firm through an association health plan (AHP). AHPs are regulated differently and may use medical underwriting in rating applicants for coverage.

industry, age, and gender; and the establishment's standardized actual health expenditures for singles and for families. We then applied the administrative load amounts in Exhibit A-3 to these "blended pure premiums" by firm size category. The final result is a reasonable approximation of reality in each state (box).

- *Constructing non-group risk pools.* We assigned individuals reporting non-group health insurance coverage (i.e., individual/direct pay/self pay coverage) to non-group risk pools according to state-specific rating regulations.
- *Generating baseline premiums for non-group coverage.* Non-group premiums were calculated for each single and family. We started by calculating a non-group "pure premium" for singles and for families as a blend of the following components:
 - Average standardized health expenditures of all individuals or families in the non-group rating cell;²²
 - Regression-predicted health expenditures standardized for non-group coverage, where the regression covariates vary according to the rating rules allowed in each state such as age and gender; and
 - The individual or family's standardized actual health expenditures.

The first component was intended to capture the overall risk pooling in the non-group market across individuals within a rating cell. The first component was too unstable to reflect the expected differences across cells in all cases. Therefore, we blended in the second component, which produces more stable differences in the rating cells. The third component was used to build in additional individual-level underwriting. Estimates of non-group health insurance premiums obtained from ehealthinsurance.com, as well as our discussions with the states, guided our choice to blend of these components (60, 10, and 30 percent of total, respectively). An administrative load of 50 percent was added to the pure premium to arrive at a final premium for non-group coverage in each non-group rating cell.

Baseline Step G: Comparing initially simulated premiums with known premium benchmarks

After we had "built up" preliminary estimates of premiums for group and non-group buyers through the steps above, we compared the resultant estimates to estimates of single

Field Testing the Model's Simulated Baseline Premiums for Each State

For completeness and on-the-ground credibility, we compared the MEPS-IC data on premiums with information obtained from several sources in each of the three participating states about currently or recently prevailing premiums. The goal here was to ensure that state-level information is not inconsistent with MEPS and the adjusted model estimates.

Information on average or typical premiums was sought for four market segments: non-group, small-group, large-group, and state employees. We focused most heavily on small-group and non-group information, as those sectors are the ones of interest for state reforms. Non-group was particularly important, as MEPS-IC applies directly only to employment groups. Policy year premiums and demographic attributes where relevant were noted. If broad-based information was unavailable, we obtained premiums for a proxy population. Sources included state and insurer Web pages, private and state reports, and surveys done within the states. Finally, we conducted telephone interviews with key informants among insurers, state officials, and consulting actuaries during December 2006 and April-May 2007.

We found reasonable consistency of these state-level data with workplace premiums as reported by the MEPS-IC survey. Non-group levels were also found to be most like those for very small workplace groups, as expected. The field testing, as intended, improved our confidence in the final fine tuning for each state's baseline data set. Side benefits of this process included that it enriched project understanding of each state's market, regulatory, and political environments, raised our project's visibility and credibility at the state level, and helped solidify relationships with key actors within each state.

and family group premiums for each state and by firm size for the nation as reported in the MEPS-IC. We expected average non-group premiums to be similar to but higher than those for very small groups, and we also made comparisons with online quotations of non-group premiums, which we expected to be the lower bound, as they apply to healthy buyers and actual offers may include coverage exclusions for existing health conditions.

After these comparisons, we made further adjustments to the levels of health insurance expenditures so that the model's baseline premiums would be comparable to the MEPS-IC and other benchmarks. Due to the standardization of health expenditures to capture a modal benefit package for ESI coverage, premiums in the smaller firm sizes were somewhat higher than those reported in the MEPS-IC. They remained consistent with information gathered during a qualitative "field test" of our benchmarked model premiums (box).

Baseline Step I: Arriving at the final state-specific baselines

Going through all the steps from A through H created the final baseline of microdata on individuals and families in each state. These baselines included premiums for everyone in each state's population, by firm for those with access to ESI and for individuals and families in the non-group market. (The model contains information on people with public and large-group coverages as well, but they were not a focus of this project.)

Step 2. Modeling reinsurance reform options

Specifying states' reinsurance provisions to be modeled

The modeling focused on excess-of-loss reinsurance, also called corridor coverage, which is the type of reinsurance used in the Healthy NY program. This type of program reimburses the insurer for a specified percentage of spending per individual for the year in a specified corridor; the model used the calendar year, as

in Healthy NY. Participating states specified alternative values for the lower limit of the reinsurance corridor, upper limit of the reinsurance corridor (we also examined policies with no upper limit), and the coinsurance rate retained by the original insurer (also called the “carrier retention percentage”). The retention was typically either 10 percent or 20 percent.

States also specified the eligibility rules for reinsurance reimbursement, that is, what types of coverage were eligible for claims reimbursement. They all chose to target insurance either bought by small firms, in the non-group market, or both. Income level of covered enrollees could also be specified, and Rhode Island asked for some simulation based on incomes.

Applying reinsurance rules and computing change in premiums by risk group

For each specification of reinsurance provisions, we computed the reinsurance-reimbursable health care spending under that option’s rules. To the extent that states subsidize the costs of insured expenses within the reinsurance corridor, insurers are able to reduce the premiums they charge to enrollees. The model assumes that insurers will fully pass on the value of the subsidy they receive in the form of lower premiums.²³

For each specification, we then computed the changes in premiums expected to occur by employer and within the non-group risk pool. We expected larger decreases in premiums to occur within risk pools that have a higher concentration of insured people with expenditures falling within the reinsurance corridor. For employees in non-offering firms whose coverage is eligible for the reinsurance subsidy, we applied the reinsurance rules to the distribution of expenditures that we estimated would occur if each employee in the non-offering firms were covered by employer-sponsored coverage. For example, we accounted for an increase in expected expenditures for the uninsured if they were to obtain ESI.

Step 3. Simulating changes in employer offer and individual take-up of coverage

Elasticity assumptions in the model

To simulate changes in behavior due to reinsurance-reduced prices, the model builds in “elasticity” figures, which estimate how much consumption of an item will change in response to a price change. The elasticities capture both how responsive is an employer’s decision to offer health insurance to health insurance costs

Exhibit 4. Premium Elasticities Used in Reinsurance Model

Targeted Beneficiary of Reinsurance	Premium Elasticity
Employer Offer Rate by Size of Firm	
1 to 9 employees	-1.16
10 to 24 employees	-0.45
25 to 50 employees	-0.4
Employee Take-Up Rate, once Given Offer	
Single Coverage	-0.015
Family Coverage	-0.03
Non-Group Buyers	
Single Coverage	-0.6
Family Coverage	-0.3

Source: Urban Institute review of multiple studies estimating premium elasticities of insurance coverage.

faced by the firm and how responsive is an individual’s take-up of health insurance to the premium faced by the individual. The elasticities used come from a review of numerous empirical analyses (Exhibit 4)²⁴.

The premium elasticity for non-group, single coverage is -0.6, for example. A negative elasticity indicates that consumption increases when price decreases, so -0.6 means that a 10 percent decrease in non-group single premiums is expected to result in a 6.0 percent increase in the probability of single individuals’ taking up such coverage. Smaller firms are more responsive to price changes than are larger ones, and among non-group buyers, those considering single coverage are more responsive than those seeking family coverage.

Details of method for applying elasticities: In some applications, it is reasonable to assume that elasticities are constant within a broad range of prices. Assuming constant elasticities for probabilistic outcomes like insurance choice, however, is likely to be a poor approximation of individual behavior, especially as baseline probabilities approach 0 or 1 or when the baseline probability of a particular individual or subgroup is far from the average baseline probability.²⁵ The same concern would apply if we were to assume a constant percentage point change in probability. Because we were interested in the distribution of effects and not simply average effects, our method needed to adequately handle heterogeneous effects.

We also faced the methodological problem that it is preferable to apply elasticities from external studies to populations comparable to those from which those elasticities were estimated, but we needed elasticity estimates for different

individuals and subpopulations than those of prior studies.

Our solution was to incorporate heterogeneous effects into the application of elasticities. We used the same methodological approach when applying the technique to employer offer behavior and to individuals’ take-up behavior of ESI or non-group health insurance. Our method had four general steps:

In the first step, we computed the predicted probability of a firm’s offering ESI, of an employee or dependent’s having ESI if they receive an offer, and of having non-group coverage.

In the second step, we computed the value of a hypothetical probit coefficient on the premium covariate that would make the average probit marginal effect consistent with the change in probability implied by the target elasticity.

In the third step, we computed a firm-specific or person-specific new predicted probability of offer or of coverage, and the change in the probability of offer or of taking-up coverage, which was dependent upon three components:

- The initial predicted probabilities;
- The percentage change in premium in the risk group; and
- The value that makes the average marginal effect of the premium consistent with the target elasticity.

In the fourth and final step, we compared the change in the probability of coverage to a person-specific threshold for ESI take-up, where the threshold is a function of a random variable and the predicted probability of coverage. If the threshold was below the predicted probability, the firm was deemed to offer or the individual was deemed to take up coverage.

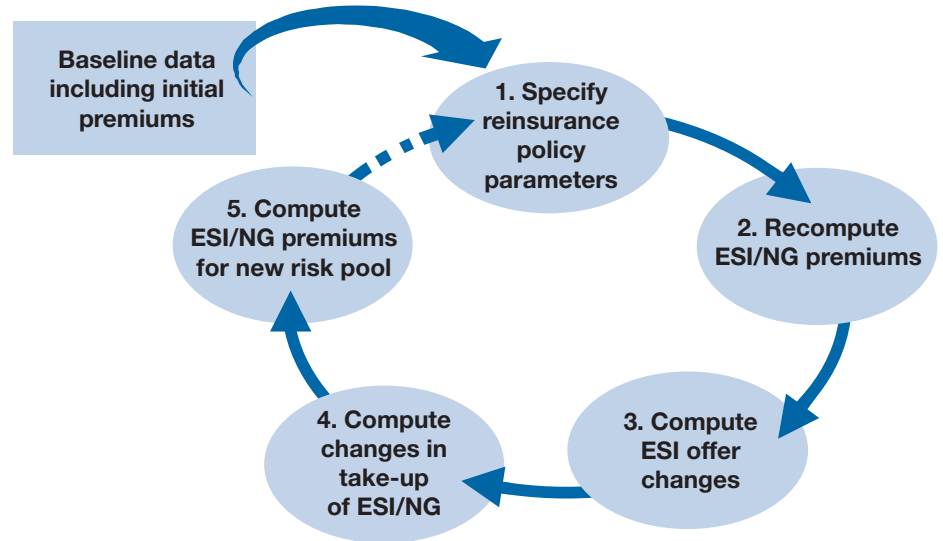
Our method used the probit equation as its central step, which enabled us to estimate individual- or employer-specific changes in the probability of taking/offering coverage that are consistent overall with our target elasticities; extrapolate well to individuals/employers with different conditional/baseline probabilities of take-up/offer and cases where changes in premiums may be large; and generate reasonable individual-/employer-level heterogeneity in response probabilities. Specifics of the application of this method to simulation of changes in employer offer or individual take-up are discussed below.

Simulating changes in employer offer, employee take-up, and non-group purchase

The elasticities were then applied within each aspect of insurance purchase where price change matters: first, to employers' decisions to offer coverage, then to employees' (and dependents') decisions to accept the offers, then to decisions of individuals and households (HIUs) whether to buy non-group coverage. All of these responses to changes in price can vary by firms' and individuals' preferences, as noted above. Therefore, we wanted to approximate the distribution of firms' and individuals' responses to a reinsurance subsidy observed in the real world by including a random component in our application of elasticities, while preserving the overall average value reported in economics literature.²⁶

To estimate changes in establishments' offers of ESI, we generated a single percentage change in premiums for each establishment, computed as a weighted average of the percentage changes in premiums for single coverage and family coverage. We then computed a percentage point change in the probability of offer based on the calibrated probit function of offer for establishments. Employers whose insured claims are not eligible for reinsurance will have no change in premiums. Those eligible for reinsurance will shift from not offering to offering if their new predicted probability of offer is greater than their fixed threshold.

Exhibit 5. Modeling the Dynamics of Reinsurance: Iterative Flow of Simulated Impacts



Source: Authors' graphic. Note: ESI is employer-sponsored insurance; NG is non-group insurance (also called "individual" or "direct-pay" coverage).

With respect to individual take-up of ESI, we proceeded as follows. For employees in establishments that offered coverage at baseline, we assigned a random threshold for taking up coverage in a manner analogous to the way we generated thresholds to determine employer offer. For employees in establishments that do not offer coverage at baseline, we assign thresholds simply as a random draw from a uniform distribution between 0 and 1.

We computed the percentage change in the full single and family premiums after reinsurance. We assumed that employers will not adjust the share of the full premium that they pay, so that the percent change in the share of premium that the worker pays will be the same as the percentage change in the full premium. Employees in establishments that offer coverage at baseline but who did not take up the coverage will change to taking up the coverage if their new predicted probability of take-up is above their threshold value. These effects will tend to be small because the target elasticities are small.

Employees in establishments that do not offer coverage at baseline but do offer coverage after reinsurance will take up coverage if the predicted probability of take-up is greater than their threshold value. These effects will tend to be larger because expected ESI take-up rates are generally high.

With respect to individual take-up of non-group coverage, we assume that individuals with ESI will not switch to non-group coverage. For the

uninsured and those with non-group coverage at baseline, we assigned thresholds for taking up non-group coverage analogous to the thresholds for employer offer of group coverage. We computed the change in the probability of taking up non-group single coverage or family coverage, based on changes in the premium for each product and our probit equations. Individuals whose new predicted probability of having non-group coverage exceeded these thresholds; they and their dependents were assigned to non-group coverage.

Final recomputation of effects on premiums and on insurance purchase

Through this initial round of simulations, the model proceeded as follows: Starting with the baseline data, which included our initial premium estimates for group and non-group premiums, we applied a particular reinsurance specification and recomputed group and non-group premiums given the reinsurance subsidies, but before any changes in the behavior of employers or individuals. The model then allowed our simulated employers to respond to these changes in premiums by switching their offer status from non-offering to offering. Next, individuals and their dependents are allowed to change their coverage status based on changes in premiums and the actions of employers.

This initial cycle of subsidy and response simulated changes in the baseline composition of employer groups and non-group risk pools. Accordingly, we next recomputed the changes in premiums from their baseline levels. In so

doing, we account for the fact that the newly insured will have higher levels of health expenditures than they did when uninsured (Exhibit 5). Because these second-order changes in premiums are small, further iterations of the model were unnecessary.

Step 4. Computing overall costs of reinsurance policy and tabulating the model's results

The final step in the reinsurance modeling was to tally and report the estimated policy effects of each reinsurance option simulated. We totaled the program costs to the state. These included the costs of reinsuring health expenditures for the eligible population who were already insured at baseline as well as the cost of reinsuring those who gained insurance coverage as a result of the policy.

We reported to states the aggregate estimated reduction in the number of uninsured and the change in the number of uninsured by type of coverage. Beyond net coverage changes, we cross-tabulated coverage post-reform against baseline coverage to show the full extent of the coverage transitions that are estimated to occur. We also reported policy effects by subgroups of interest such as by family income as a percent of the federal poverty level and establishment size categories.

The state-specific outputs are presented in separate deliverables, one for each participating state.²⁷

Strengths and Limitations of the Reinsurance Model

Modeling abstracts from reality, sufficiently simplifying complexities to clarify overall relationships and effects. Substantial efforts were made to benchmark the models' components to state characteristics, to prevailing premiums, and to documented employer and consumer responses to price change. The model can assess overall effect of reinsurance alternatives on premiums, coverage, and costs; which firms offer coverage and which people take up what coverage, when the benefits of reduced premiums are distributed in alternative ways; how the composition of insured risk pools change, with secondary impacts on premiums; and changes in the composition of the uninsured population. While the model has data on out-of-pocket and insured costs to enrollees, we must simulate potential health spending under insurance to those who are currently uninsured. A strength of the model already noted is that it contains

good information on the uninsured and their circumstances—unlike insurance claims data, for example—which substantially increases the validity of estimates of expected reinsurance costs.

However, some uncertainty remains about the model's findings on the magnitude of employers' and individuals' behavioral effects from reinsurance. Moreover, the simulation results are not budgetary estimates, as actual program spending would also depend upon many design and implementation choices. The model simulates employers' and individuals' behavior, not insurers' behavior. In a sense, it estimates premiums for each market segment (here, non-group and small-group) as though there were competing insurers that act the same, and all coverage follows state rules. It is not possible to simulate every player in the insurance market that provides coverage to small firms or their employees. The model does not address issues of insurance market competitiveness or estimate possible entry or exit from the markets, nor does it include variations in insurance benefits across carriers or market segments. In order to better estimate consumer response to premium change, it holds benefit design constant.

Finally, insurers' different underwriting and pricing behaviors are not modeled, and results accordingly do not include how different insurers might respond differently to reinsurance in marketing and pricing. The model assumes that carriers pass through 100 percent of the reinsurance subsidy into lower premiums, and continue to manage high-cost claims as before. Different assumptions could increase estimated government spending on reinsurance and/or reduce the impacts on coverage.

Model construction lacked information from which to simulate insurer underwriting; it assumed open enrollment into all available coverages (which is required by federal law for small-group coverage, but not for non-group insurance). Variations of premiums across subpopulations of people that arise from coverage through different insurers are not simulated, nor are differences across separate blocks of coverage that an insurer may price separately based on factors other than underlying expenditures. The model for each state was constructed, however, to accurately reflect the average premium for all small firms as well as the variation in premiums by firm size observed among all small firms.

Conclusion

The Reinsurance Institute's microsimulation model was designed to assess the overall effects of reinsurance alternatives on premiums, coverage, and costs. Further, it estimates which firms will begin to offer coverage as a result of reforms and which people take up what coverage when the benefits of reduced premiums are distributed in alternative ways. The model estimates how the composition of insured risk pools change, and the secondary impacts on premiums that result, as well as changes in the composition of the uninsured population. Our experience testing, refining, and then applying the reinsurance microsimulation model in three states confirmed both the reasonableness of its outputs as well as its utility in analyzing alternative policies.

Endnotes

- 1 Bovbjerg, R., et al. *Reinsurance in State Health Reform*, Washington, DC: The Urban Institute, a report to the Robert Wood Johnson Foundation's State Coverage Initiatives program, administered by AcademyHealth, May 2008.
- 2 Details appear in Masi, P., et al. "Summary of Reinsurance Institute Work with Rhode Island and Final Modeling Results," Memorandum to Office of the Health Insurance Commissioner, November 28, 2007; Bovbjerg, R., et al. *Reinsurance in Washington State*, Report to the Washington Office of Financial Management and Office of the Insurance Commissioner, February 2008; and Garrett, A.B., et al. "Summary of Reinsurance Institute Work with Wisconsin and Final Modeling Results," Memorandum to Wisconsin Department of Health and Family Services, December 26, 2007.
- 3 The MEPS household survey is conducted annually by the federal Agency for Healthcare Policy and Research [now the Agency for Healthcare Research and Quality (AHRQ)]. See J.W. Cohen. "Design and Methods of the Medical Expenditure Panel Survey Household Component," Rockville, MD: Agency for Health Care Policy and Research (now AHRQ), MEPS Methodology Report No. 1, AHCPR Pub. No. 97-0026, 1997, accessible at http://www.meps.ahrq.gov/mepsweb/data_files/publications/mr1/mr1.shtml.
- 4 National Health Expenditure Data are explained at and accessible from <http://www.cms.hhs.gov/NationalHealthExpendData/>.
- 5 The Consumer Price Indexes (CPI) program of the U.S. Labor Department's Bureau of Labor Statistics produces monthly data accessible from <http://www.bls.gov/cpi/home.htm>.
- 6 See Society of Actuaries, "Group Medical Insurance Large Claims Database Collection And Analysis," materials accessible at <http://www.soa.org/news-and-publications/publications/other-publications/monographs/m-hb97-1-toc.aspx>.
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- 8 It is an empirical reality that insured people spend more per year than otherwise similar uninsured people. They may be less likely to rely on expensive emergency room care for routine services and less likely to delay treatment until hospitalization is needed, but overall, their use of

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- 9 Blumberg, L. J., et al. *The Health Insurance Reform Simulation Model (HIRSM): Methodological Detail and Prototypical Simulation Results*, Urban Institute. 2003, retrieved October 23, 2007, http://www.urban.org/UploadedPDF/410867_HIRSM_Report.pdf.
 - 10 The Current Population Survey (CPS) is a national in-person survey that provides state representative data on insurance coverage.
 - 11 State Health Access Data Assistance Center (SHADAC), "State Health Insurance Coverage Estimates: A Fresh Look at Why State Survey Estimates Differ from CPS," Minneapolis, MN: University of Minnesota, SHADAC Issue Brief No. 12, November 2007, <http://www.sph.umn.edu/img/assets/18528/IssueBrief12.pdf>.
 - 12 Dubay, L., J. Holahan, and A. Cook. "The Uninsured and the Affordability of Health Insurance Coverage," *Health Affairs*, 26(1): w22-w30, 2007.
 - 13 Call, K.T., et al. "Final Report Administrative Data Case Study Report: Sources of Discrepancy between Survey-based Estimates of Medicaid Coverage and State Administrative Counts." State Health Access Data Assistance Center, July 2006; Call, K.T., M. Davern, and L. Blewett, "Estimates of Health Insurance Coverage: Comparing State Surveys with the Current Population Survey," *Health Affairs* 26(1):269-78, 2007.
 - 14 We use the MEPS concept of HIUs (health insurance units), defined as sub-family relationship units including adults plus those family members who would typically be eligible for coverage under the adults' private health insurance family plans. HIUs typically include adults, their spouses, and their unmarried natural/adoptive children age 18 and under. We also include children under age 24 who are full-time students. For more information on MEPS HIU construction, http://www.meps.ahrq.gov/mepsweb/data_stats/download_data/pufs/h79/h79doc.shtml.
 - 15 The re-weighting procedure we employ here is described by Barsky, R., et al. "Accounting for the Black-White Wealth Gap: A Nonparametric Approach," *Journal of the American Statistical Association*, 97.459:663-73, 2002. That paper extended an approach developed by Rosenbaum, P., and D. Rubin. "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika* 70(1):41-55. 1983, and "Reducing Bias in Observational Studies Using Subclassification on the Propensity Score," *Journal of the American Statistical Association* 79.387:516-24, 1984.
 - 16 The MEPS-IC is an annual survey of employer health insurance data conducted for the Agency for Healthcare Research and Quality (AHRQ), <http://meps.ahrq.gov>.
 - 17 Establishments are site-specific operations, whereas a firm is a legal entity that may operate in multiple locations, including multiple states. The model assumes that the state in which people work affects the applicable pooling and rate making rules for the establishments in that state. However, the size of the firm is assumed to govern whether the firm's coverage is regulated as a small group or a large one and also the administrative loading added to the expected medical spending to develop the firm's premiums.
 - 18 We are aware that the upper limit of what insurers and regulators consider a "small-group" is 50, not 49. However, the survey categories go through 49, not 50, and we lacked a credible basis for estimating which individuals reporting employers of size 50-99 in fact worked within a 50 person group. We estimate that the number of people working in firms of exactly size 50 is less than one percent of the 2-49 total generally analyzed here. For Rhode Island only, we used 1-49 as the size of a small firm, as its rules allow groups of size one.
 - 19 As a practical matter, consistent with SUSB data, nearly all individuals reporting more than one establishment location were assigned the largest firm size category.
 - 20 The Actuarial Research Corporation estimates are based on an ARC loading rate partition of NHE-consistent net cost of insurance levels, using modifications of estimates by Hay/Huggins (now Hay Group) for the House Committee on Education & Labor. "Costs and Effects of Extending Insurance Coverage," Committee Print 100-EE, Library of Congress, Congressional Research Service, October 1988.
 - 21 *ibid.*
 - 22 For Rhode Island, to reflect state non-group rating rules, we estimate non-group premiums for those in poor or fair health coverage separately, as a function of non-group premiums among those in better health.
 - 23 It has been noted that state oversight may be appropriate to check whether the pass through actually happens in practice. See discussion in limitations section of text.
 - 24 For example, Blumberg, L., L.M. Nichols, and J.S. Bantlin. "Worker Decisions to Purchase Health Insurance," *International Journal of Health Care Finance and Economics*, 1(3-4):305-325, 2001 (ESI), and "The Price Sensitivity of Demand for Non-group Health Insurance," Congressional Budget Office, Background Paper (non-group), August 2005.
 - 25 For example, previous studies have found that those with lower incomes have larger elasticities, whereas those in worse health are relatively inelastic with respect to price (CBO, 2005; Marquis et al. 2004; Blumberg et al. 2001).
 - 26 To achieve this distribution, we predicted the likelihood that a firm or individual would want to change behavior under a reinsurance subsidy, and compared this to an assigned random variable between 0 and 1 to determine whether the firm or individual indeed would change behavior (that is, decide to offer or take-up an offer of insurance). Modeling of this decision incorporated a degree of randomness that served to approximate the distribution of behavioral responses observed in the real world.
 - 27 See documents cited in note 2 above.