Methods

Moral Hazard Matters: Measuring Relative Rates of Underinsurance Using Threshold Measures

Jean Marie Abraham, Thomas DeLeire, and Anne Beeson Royalty

Objective. To illustrate the impact of moral hazard for estimating relative rates of underinsurance and to present an adjustment method to correct for this source of bias.

Data Sources/Study Setting. Secondary data from the 2005 Medical Expenditure Panel Survey (MEPS) are used in this study. We restrict attention to households that report having employer-sponsored insurance (ESI) for all members during the entire 2005 calendar year.

Study Design. Individuals or households are often classified as underinsured if out-of-pocket spending on medical care relative to income exceeds some threshold. In this paper, we show that, without adjustment, this common threshold measure of underinsurance will underestimate the number with low levels of insurance coverage due to moral hazard. We propose an adjustment method and apply it to the specific case of estimating the difference in rates of underinsurance among small- versus large-firm workers with full-year ESI.

Data Collection/Extraction. Data were abstracted from the MEPS website. All analyses were performed in *Stata* 9.2.

Principal Findings. Applying the adjustment, we find that the underinsurance rate of small-firm households increases by approximately 20 percent with the adjustment for moral hazard and the difference in underinsurance rates between large-firm and small-firm households widens substantially.

Conclusions. Adjusting for moral hazard makes a sizeable difference in the estimated prevalence of underinsurance using a threshold measure.

Key Words. Health insurance, underinsurance, small firms, moral hazard

Health care spending in the United States has increased dramatically over the last few decades—averaging 3.7 percent real growth per year from 1995 to 2005—and rapid growth is predicted to continue (Congressional Budget Office 2008). In response to this growth, many employers are making changes to their health insurance plans to include more cost-sharing provisions, such as

higher deductibles and coinsurance. Because of these trends, there is growing concern that merely having any health insurance is insufficient and that insured households are becoming less able to afford the cost of their medical care. That is, in addition to many households not having health insurance, many may be “underinsured.”

In order to quantify the number of households that face difficulties in paying for medical expenses, researchers have defined various measures of underinsurance. Underinsurance is typically understood as health insurance failing to provide adequate protection against health care expenditures (e.g., see Bashshur, Smith, and Stiles 1993). Several measures of underinsurance have been adopted since there is no consensus on how to apply this concept. In pioneering work, Farley (1985) and Short and Banthin (1995) defined underinsurance by combining the risk of a high-expenditure illness and the adequacy of insurance coverage for this event. Others have defined underinsurance using the size of specific insurance benefits (e.g., annual deductible) relative to family income (Schoen et al. 2005) or the actuarial values of policies (Gabel et al. 2006).

The most common underinsurance measure is a threshold measure, which indicates whether a household has spent a certain percentage or more of income on out-of-pocket health care expenditures (see Shearer 2000; Merlis 2002; Schoen et al. 2005; Banthin and Bernard 2006; Ziller, Coburn, and Yousefian 2006; Banthin, Cunningham, and Bernard 2008; Schoen et al. 2008; Collins et al. 2009). Threshold measures of underinsurance are used because they are easy to compute given available data and are easy to explain. A commonly used threshold for working-age populations is 10 percent of household income.

Of course, there are normative assumptions built into this measure just as in any threshold measure of well-being.¹ Different thresholds can be applied to different populations, for example, households in poverty or elderly families. Regardless of the level of threshold used, or whether the same threshold is applied to all populations, threshold measures of underinsurance fail to take into account that households with less comprehensive coverage tend to consume less medical care than they would if they had better

Address correspondence to Jean Marie Abraham, Ph.D., Division of Health Policy and Management, University of Minnesota, 420 Delaware Street SE, MMC 729, Minneapolis, MN 55455; e-mail: abrah042@umn.edu. Thomas DeLeire, Ph.D., is with the La Follette School of Public Affairs, University of Wisconsin-Madison, Madison, WI. Anne Beeson Royalty, Ph.D., is with the Department of Economics, Indiana University, Purdue University, Indianapolis, IN.

insurance, or alternatively, that generously insured households tend to consume more medical care than they would if they had less generous insurance.

Economic theory (see Cutler and Zeckhauser 2000), nonexperimental studies (e.g., Newhouse and Phelps 1976; Bhattacharya and Vogt 1996), and experimental studies (Manning et al. 1987) all find that health insurance expenditures respond positively to the generosity of health insurance; this responsiveness is referred to as “moral hazard.”

Any threshold measure of underinsurance is a function of actual expenditures for out-of-pocket health care relative to household income. Coverage generosity affects out-of-pocket expenditures in two ways: directly—through coinsurance, deductibles, out-of-pocket spending limits, etc.—and indirectly—through the effect of moral hazard. The concept of underinsurance refers to the direct effect: less generous benefit designs will translate into higher out-of-pocket expenditures for a given level of total spending. However, because of the indirect effect, less generous insurance also will tend to decrease households’ medical care utilization and expenditures through a “reverse” moral hazard effect. Therefore, a threshold measure of underinsurance will underestimate the extent to which households have less generous plans. Moreover, when comparing the rate of underinsurance across two populations, the one with less generous coverage will be less likely to have high out-of-pocket spending relative to income than they would in the absence of a moral hazard effect, causing an underestimate of the difference in underinsurance between the two groups.

In this paper, we show that threshold measures of underinsurance typically will not accurately measure the degree of underinsurance in one population relative to another where insurance benefits vary and propose an adjusted threshold measure of underinsurance that takes into account moral hazard. To demonstrate this problem and how our proposed adjustment would work, we consider the specific case of estimating the difference in underinsurance rates between households who receive their insurance from small firms versus large firms.² While the adjustment method we propose would apply to any threshold measure of underinsurance, we use the 10 percent threshold measure as our baseline case and test the sensitivity of our results using alternative definitions.

We find that adjusting for moral hazard makes a noticeable difference in relative underinsurance rates. According to a 10 percent threshold measure of underinsurance, which does not account for moral hazard, the underinsurance rate among households whose policyholder is employed by a small firm is 90 percent of that among households whose policyholder is employed by a large

firm. That is, despite substantial evidence that small-firm households tend to have less generous coverage, these households appear to have lower rates of underinsurance. We show, however, that this comparison is misleading because of the moral hazard effect. After adjusting for moral hazard, the underinsurance rate among small-firm households is 33 percent greater than that among large-firm households.

INSURANCE GENEROSITY IN SMALL AND LARGE FIRMS

Small firms, when they do offer health insurance, tend to offer less generous insurance (Gabel et al. 2006). According to data from the 2005 Medical Expenditure Panel Survey (MEPS) Insurance Component List Sample (see Table 1), while there is variation in generosity within both firm-size groups, on average small firms offer insurance with higher deductibles, higher copayments, and higher out-of-pocket maximum limits than do larger firms. For example, family deductibles among small-firm plans average almost U.S.\$800 higher than deductibles among large-firm plans (U.S.\$1,875 versus U.S.\$1,076). Hospital coinsurance rates average 19 percent among small-firm plans and 17 percent among large-firm plans; drug coinsurance rates average 40 percent among small-firm plans and 24 percent among large-firm plans. Similarly, the family maximum annual out-of-pocket limit averages more than U.S.\$500 higher among small-firm plans than among large-firm plans (U.S.\$5,174 versus U.S.\$4,667).

These plan coverage provisions directly affect the out-of-pocket costs incurred by households. Since small-firm plans tend to provide less generous insurance in terms of deductibles, copayments, coinsurance, and annual out-of-pocket limits, one might expect higher rates of underinsurance among small-firm households than among large-firm households.

In contrast to what one might expect, a higher percentage (5.2 percent) of large-firm households are underinsured (using a 10 percent threshold measure) than of small-firm households (4.7 percent), according to our analysis described below. The explanation for this puzzling result is that moral hazard matters for the measurement of relative rates of underinsurance. That is, small-firm households reduce their utilization and expenditure in response to the relatively high cost-sharing they face through a “reverse” moral hazard effect. Having less generous insurance leads many small-firm households to reduce their total medical care spending by enough so that they are not counted as underinsured by a threshold measure.

Table 1: Summary Statistics on Employer-Sponsored Insurance Plan Characteristics, by Firm Size

Firm Size (No. of Employees)	Mean			25th Percentile			75th Percentile			95th Percentile		
	Small (< 50)	Large (50+)	Difference	Small (< 50)	Large (50+)	Difference	Small (< 50)	Large (50+)	Difference	Small (< 50)	Large (50+)	Difference
<i>Deductibles</i>												
Single deductible (U.S.\$)	917	543	374	500	250	250	1,000	500	500	2,500	1,500	1,000
Family deductible (U.S.\$)	1,875	1,076	799	600	500	100	2,500	1,200	1,300	6,000	3,000	3,000
<i>Copayment and coinsurance</i>												
% with office copayment	79%	76%	3%	—	—	—	—	—	—	—	—	—
Office copayment (U.S.\$)	20	18	3	15	15	0	25	20	5	35	30	5
% with office coinsurance	16	21	—5	—	—	—	—	—	—	—	—	—
Office coinsurance (%)	20	18	2	20	10	10	20	20	0	40	30	10
% with hospital copayment	32	30	2	—	—	—	—	—	—	—	—	—
Hospital copayment (U.S.\$)	584	355	229	100	100	0	500	300	200	2,000	1,250	750
% with hospital coinsurance	47	54	—7	—	—	—	—	—	—	—	—	—
Hospital coinsurance (%)	19	17	2	20	10	10	20	20	0	30	30	0
% with drug copayment	93	89	4	—	—	—	—	—	—	—	—	—
Drug copayment (U.S.\$)	13	10	2	10	8	2	15	10	5	25	20	5
% with drug coinsurance	8	13	—5	—	—	—	—	—	—	—	—	—
Drug coinsurance (%)	40	24	17	20	20	0	50	25	25	100	50	50
<i>Annual out-of-pocket limits</i>												
% with single OOP limit	68	73	—5	—	—	—	—	—	—	—	—	—
Single max OOP limit (U.S.\$)	2,380	2,102	278	1,250	1,250	0	3,000	2,500	500	5,000	5000	0
% with family OOP limit	60	70	—10	—	—	—	—	—	—	—	—	—
Family max OOP limit (U.S.\$)	5,174	4,667	507	2,600	3,000	—400	6,000	6,000	0	10,500	10,000	500

Note: Cost-sharing amounts are conditional on benefit design including the provision.
Source: John Sommers, AHRQ based on the 2005 MEPS—Insurance Component.

THE PROBLEM AND A STYLIZED SOLUTION

In this section, we demonstrate the effect of moral hazard on the measurement of underinsurance with a simple example. We also present a stylized version of the solution we propose for the calculation of adjusted underinsurance rates that account for this moral hazard effect. Consider two households, X and Y, which are identical in all ways except in terms of plan generosity. As a consequence of moral hazard, Household X (with the generous health insurance plan) spends more on medical care than Household Y (with the stingy plan)—U.S.\$5,000 versus U.S.\$3,500 (see Table 2, Panel A). However, due to the differences in plan generosity, their out-of-pocket expenditures are nearly identical: X spends U.S.\$1,500 out-of-pocket while Y spends U.S.\$1,400 out of pocket. The income for each household is U.S.\$15,000, so that X spends 10 percent of its income, out-of-pocket, on medical care while Y spends only 9.3 percent. If we were to use a 10 percent threshold measure of underinsurance, X (with the generous plan) would be classified as underinsured while Y (with the stingy plan) would not be. We will apply our method to small- and large-firm households but as the example indicates this is a general result for any two populations with different average levels of generosity of coverage.³

How might one adjust the threshold measure of underinsurance to account for moral hazard? If we knew how much medical spending Household Y would incur if it had generous health insurance, we could use the benefit characteristics of Household Y's actual (stingy) health insurance plan to determine what its out-of-pocket spending would be, accounting for moral hazard. We demonstrate how to make such an adjustment in the context of our example (see Table 2, Panel B). In the example, we use Household X's spending as an estimate of how much medical spending Household Y would incur if it had generous health insurance since, by assumption, X and Y are identical except for the generosity of their health plans. Therefore, Y's expected total medical care spending if it had a generous plan is U.S.\$5,000. To determine the amount of out-of-pocket spending Y would incur if it spent as much as X, but if it also faced the cost-sharing rate of the stingy plan, we multiply its expected total spending by its actual average cost-sharing rate.⁴ To determine the average cost-sharing rate, recall that Y spends U.S.\$3,500 on medical care and spends U.S.\$1,400 out of pocket. Thus, the average cost sharing for Y (stingy plan) is 40 percent ($= \text{U.S.}\$1,400 / \text{U.S.}\$3,500$). Adjusted out-of-pocket spending for Y is, therefore, U.S.\$2,000 ($= 0.40 \times 5,000$). We propose basing the threshold measure of underinsurance on the ratio of adjusted out-of-pocket spending to income. In this example, this ratio is 0.133

Table 2: How Moral Hazard Matters: An Example

Panel A	Plan Type (A)	Total Expenditures (B)	Out-of-Pocket Expenditures (C)	Income (G)	Ratio of OOP to Income (C)/(G)	Threshold (10%) (H)	Underinsurance Measure (I)
Household X Household Y	Generous	5,000	1,500	15,000		0.10	Yes
	Stingy	3,500	1,400	15,000		0.093	No

Panel B	Plan Type (A)	Total Expenditures (B)	Out-of-Pocket Expenditures (C)	Cost-Sharing (C)/(B)	Expected Total Expenditures if Had a Generous Plan (E)	Expected OOP Expenditures: Spending from Generous Plan but Cost-Sharing from Own Plan (D)*(E) (F)	Income (G)	Ratio of Expected OOP to Income (F)/(G) (H) = (F)/(G)	Adjusted Threshold (10%) Underinsurance Measure (I)
Household X Household Y	Generous	5,000	1,500	0.3	5,000	1,500	15,000	0.100	Yes
	Stingy	3,500	1,400	0.4	5,000	2,000	15,000	0.133	Yes

Note: Household X and household Y are identical except for their plan type (generous; stingy). Underinsurance is defined here as having out-of-pocket expenditures that exceed 10% of household income.

(= U.S.\$2,000/U.S.\$15,000) for Household Y, meaning that this household is underinsured once we account for moral hazard. If we compare this ratio across the two households, Household Y is now correctly identified as having less generous coverage and is “more underinsured” than Household X.

By using the total health care spending of Household X (with the generous plan) in our calculation of Household Y’s adjusted out-of-pocket spending, we do not mean to imply that a generous health plan represents the optimal “standard.” We could, alternatively, adjust the out-of-pocket spending of Household X (with generous insurance) by determining how much medical spending it would have incurred if it had stingy health insurance (estimated by Household Y’s spending). Since the average cost-sharing rate for X is 30 percent, adjusted out-of-pocket spending for X using the less generous plan as the baseline amounts to U.S.\$1,050 ($= 0.30 \times \text{U.S.}\$3,500$) and the ratio of adjusted out-of-pocket spending to income is 0.07 ($= \text{U.S.}\$1,050/\text{U.S.}\$15,000$), compared with the ratio of 0.093 for Y. Thus, using either the more generous or the stingy plan as the base case leads to an adjustment that increases the relative underinsurance rate for the less generously insured household.

DATA AND MEASURES

Data

We use the 2005 MEPS, Household Component (MEPS-HC) for our analysis. The MEPS-HC sample is drawn from respondents to the National Health Interview Survey, which is a nationally representative sample of the U.S. civilian, noninstitutionalized population.

Our sample is restricted to households that report having employer-sponsored insurance (ESI) for all members during the entire 2005 calendar year.⁵ Our definition of a household is based on a relationship unit constructed to include adults plus family members who typically would be eligible for dependent coverage under private family plans. We drop households for which we cannot confirm ESI status or that do not have any active workers (e.g., early retirees or COBRA enrollees). After removing observations with missing information, we have data on 10,384 individuals in 4,642 unique households (corresponding to 119.6 million individuals residing in 55.8 million households).

Measures

The MEPS-HC contains data on medical care spending, income, employment status, establishment size, health insurance coverage, human capital and de-

mographic information, and medical conditions for individuals and households.

Medical Spending. We use information on two types of medical care spending: total and out of pocket. We aggregate individual-level spending across household members to get household-level out-of-pocket and total medical care spending. We inflate the measures to U.S.\$2007 and rescale them into thousands of dollars.

Income. We use after-tax household income in the denominator of our threshold measures of underinsurance. Pretax household income is aggregated from person-level income for the calendar year; we use *TAXSIM* (version 8⁶) to estimate after-tax income.

Small-Firm/Large-Firm Household. To designate households that obtain ESI through a small firm or through a large firm, we first identify the ESI policyholder(s) in the household. Second, we construct an indicator for whether the policyholder was employed at a small establishment (50 or fewer workers). Finally, we define small-firm households as those in which all ESI coverage (whether through one policyholder or two) was obtained through a small establishment.⁷

Human Capital and Demographic Measures. In our total spending models, we include a set of measures to capture demographic and human capital attributes of policyholder(s) in the household. In households with two policyholders, we use the higher valued outcome. In particular, we include the age of the policyholder (years), highest education (years), race (white, black, Asian/Pacific islander, other [reference category]),⁸ whether the household is married, and number of children in the household who are under 18. We also include a set of dummy variables to capture the income quartile of the household. Since there may be geographic differences in benefits, labor market conditions, and provider prices, we also include four region dummies (Northeast, Midwest, South, West [excluded]) and an indicator for whether the household resides in a metropolitan statistical area.

Medical Conditions. We control for a set of serious medical conditions that household members reported because medical care spending is positively

related to these conditions. Using the Medical Conditions file in the MEPS, we construct a set of variables corresponding to the number of household members reporting the following: cancer, diabetes, high cholesterol, hypertension, heart disease, arthritis, asthma, depression or anxiety, and back problems.

Table 3 provides variable definitions and summary statistics for the sample of households. As can be seen, the underinsurance rate (based on the 10 percent threshold) is lower among small-firm households than among large-firm households (4.72 percent versus 5.23 percent). Similarly, there is only a small difference in the underinsurance rate between the two groups—5.92 percent versus 6.01 percent—when using a graduated threshold measure of underinsurance. This latter measure classifies low-income households (<200 percent FPL) as underinsured if they spend more than 5 percent of after-tax income on medical care and applies the 10 percent threshold to all other households. These results are puzzling given the large differences in the characteristics of plans offered by small and large firms (described in Table 1), highlighting the potential importance of moral hazard.

METHOD OF ADJUSTING THE UNDERINSURANCE MEASURE TO ACCOUNT FOR MORAL HAZARD

In this section, we present our method of adjusting for moral hazard when calculating the relative underinsurance rates between two populations that differ in their average generosity of health insurance. Our method requires five steps. First, we estimate the conditional distribution of total household medical care spending separately for large-firm households (that have, on average, more generous plans) and small-firm households (that have, on average, less generous plans). We estimate the distribution of spending by estimating quantile regressions at the 10th, 30th, 50th, 70th, and 90th quantiles.⁹ We use quantile rather than mean regression because the relationship between household characteristics and spending varies at different points of the spending distribution. Specifically, the model is a quantile regression model of total spending on age of oldest policyholder in household, highest education years of policyholders in household, race, marital status, number of children younger than 18, income quartile, MSA, region, and medical conditions.

Second, for each household type, we generate two predicted values of total spending. The first measure (predicted) is predicted total spending using

Table 3: Descriptive Statistics

<i>Variable</i>	<i>Mean</i>	<i>Standard Deviation</i>
Underinsurance rate (%) (10% threshold) for small-firm households	4.72	21.2
Underinsurance rate (%) (10% threshold) for large-firm households	5.23	22.3
Underinsurance rate (5% threshold <200% FPL, 10% above 200% FPL) for small-firm households	5.92	23.6
Underinsurance rate (5% threshold <200% FPL, 10% above 200% FPL) for large-firm households	6.01	2.38
Household total medical expenditures (1,000s, \$2007) for small-firm households	6.264	12.964
Household total medical expenditures (1,000s, \$2007) for large-firm households	7.212	15.450
Household out-of-pocket spending (1,000s, \$2007) for small-firm households	1.407	2.051
Household out-of-pocket spending (1,000s, \$2007) for large-firm households	1.330	2.209
Small-establishment household	0.366	0.482
Age of policyholder	43.977	12.256
Education of policyholder	14.038	2.413
White	0.830	0.376
Black	0.108	0.310
Asian	0.043	0.204
Hispanic	0.087	0.281
Married	0.530	0.499
Number of children < 18	0.560	0.946
Household after tax income (1,000s, \$2007)	57.738	37.027
First income quartile (U.S. < \$32.0)	0.250	0.433
Second income quartile (U.S.\$32.0, U.S.\$48.89)	0.250	0.433
Third income quartile (U.S.\$48.90, U.S.\$73.32)	0.250	0.433
Fourth income quartile (U.S. > \$73.32)	0.250	0.433
MSA	0.859	0.348
Northeast	0.207	0.405
Midwest	0.240	0.427
South	0.329	0.470
Policyholder is a union member	0.212	0.409
Number of household members with cancer	0.068	0.267
Number of household members with diabetes	0.094	0.308
Number of household members with high cholesterol	0.212	0.474
Number of household members with hypertension	0.296	0.535
Number of household members with heart disease	0.088	0.292
Number of household members with arthritis	0.025	0.165
Number of household members with asthma	0.107	0.346
Number of household members with mental health condition	0.295	0.584
Number of household members with back problems	0.212	0.467

each household's characteristics and the parameter estimates from the quantile regressions for their own household type (small firm or large firm). The second measure (adjusted) captures what total medical care spending of small-firm (large-firm) households would have been had they had the more (less) generous health plans. That is, we predict total spending for each household based on each household's characteristics but using the estimated coefficients from the quantile regressions from the other household type.¹⁰ We thus have four unique distributions of predicted spending: (i) predicted small-firm household spending based on small-firm household characteristics and coefficients from the small-firm household models, (ii) adjusted small-firm household spending based on small-firm household characteristics and coefficients from the large-firm household models, (iii) predicted large-firm household spending based on large-firm household characteristics and coefficients from the large-firm household models, and (iv) adjusted large-firm household spending based on large-firm household characteristics and coefficients from the small-firm household models.

Since small-firm households tend to have less generous insurance and, as a result, likely reduce their spending (due to "reverse" moral hazard), we would expect their adjusted spending distribution to be right shifted (i.e., to yield higher predicted spending levels) relative to their predicted actual spending.¹¹ Similarly, since large-firm households tend to have more generous insurance and likely increase their spending due to moral hazard, we would expect their adjusted spending distribution to be left shifted (i.e., to yield lower predicted spending levels) relative to their predicted actual spending.

While the predicted spending measure does not capture unobservable differences between small- and large-firm households, given that we have a rich set of explanatory variables, including a large set of medical conditions, we believe we have captured most of the critical characteristics that determine health care spending and which might differ by firm size. Our predicted spending measures also do not account for adverse selection in the choice of health plan. Future applications of this method could yield improved estimates of predicted spending and adjusted predicted spending with an even more complete set of controls.

Our third step is to estimate cost-sharing parameters for the small-firm and large-firm households in our data. Cost sharing differs across the total spending distribution due to differences in benefit design features such as deductibles and out-of-pocket maximums. To capture this variation, we calculate the average ratio of out-of-pocket spending to total spending by households' reported total spending decile (separately for small-firm and large-firm

households). Among small-firm households, these cost-sharing parameters range from 0.533 among households in the first decile of total spending to 0.166 among households in the tenth decile. The range is somewhat narrower for large-firm households: 0.379 among households in the first decile to 0.141 among households in the tenth decile. Each household is assigned the cost-sharing parameter that corresponds to its firm size and its decile of predicted total spending.¹² So, for example, a small-firm household in the first decile of the predicted total spending distribution (among small-firm households) would be assigned a cost-sharing parameter of 0.533 since that is the average cost-sharing in the first decile of the actual total spending distribution of small-firm households.

The fourth step is to compute the expected out-of-pocket medical spending for each household. To do this, we multiply the value of the household's predicted and adjusted total medical spending values by their cost-sharing parameter.

Finally, we calculate the ratio of expected out-of-pocket spending to actual after-tax income. This ratio is then compared with the threshold relevant to the particular measure of underinsurance being used. For example, under a 10 percent threshold measure, if this ratio exceeds 0.10, a household would be classified as underinsured under the adjusted measure.¹³

RESULTS

We calculate observed rates of underinsurance and, using the method described in the previous section, rates of underinsurance for small-firm and large-firm households that take into account the effects of moral hazard. We present two sets of estimates: "predicted" and "adjusted."¹⁴ Predicted rates are based on households' predicted out-of-pocket spending relative to their own income; adjusted rates for small-firm (large-firm) households are based on households' predicted out-of-pocket spending estimated using large-firm (small-firm) model parameters as the baseline. We calculate two measures of underinsurance: (1) a straight 10 percent threshold and (2) a graduated threshold based on FPL.

Based on their predicted spending, only a slightly larger percentage of small-firm households are underinsured than are large-firm households, using either the 10 percent threshold measure (4.3 percent versus 3.9 percent) or the graduated threshold (5.9 percent versus 5.5 percent); see Table 4.¹⁵ However,

Table 4: Predicted and Adjusted Medical Care Spending and Underinsurance, Small-Firm Households

	Predicted for Small-Firm HHs*	Adjusted for Moral Hazard Using Large- Firm Spending as the Baseline†	Percentage Difference between Small Firm Predicted and Adjusted	Predicted for Large-Firm HHs*	Difference between Predicted Underinsurance Rates between Small-Firm and Large-Firm Households	Difference in Underinsurance Rates between Small-Firm and Large-Firm Households Adjusting for Moral Hazard Using Large- Firm Spending as the Baseline (Adjusted Small- Firm versus Predicted Large-Firm)	Percentage Increase in Small-Firm versus Large-Firm Difference in Underinsurance Due to Adjustment for Moral Hazard
Mean, total medical care spending (U.S.\$)	5,499	5,813	5.7	5,961			
Mean, out-of-pocket medical care spending (U.S.\$)	1,371	1,444	5.3	1,286			
Underinsurance rate (10% threshold)	0.043	0.052	21	0.039	0.004	0.013	225
Underinsurance rate (5% for <200% FPL; 10% others)	0.059	0.068	15	0.055	0.004	0.013	225

*Predicted values of total medical care spending from the quantile regression model of total spending. Predicted for small-firm households uses both small-firm characteristics and estimated coefficients from small-firm regressions. Predicted for large-firm households uses both large-firm characteristics and estimated coefficients from large-firm regressions. Predicted out-of-pocket spending uses predicted total spending multiplied by estimated cost-sharing. Estimated cost-sharing is the average fraction of out-of-pocket spending to total spending by households' reported total spending decile (separately for small-firm and large-firm households). Predicted underinsurance is based on the ratio of predicted out-of-pocket spending to actual income.

† Adjusted values are predictions of total medical care spending using small-firm household characteristics and estimates from the large-firm quantile regression model.
HHs, households.

because moral hazard leads households with less generous coverage to cut back on their spending relative to households with more generous coverage, the differences in predicted underinsurance are misleading.

Adjusting for moral hazard leads to a 5.7 percent increase in predicted total spending for small-firm households (U.S.\$5,813 versus U.S.\$5,499), consistent with our expectation that these households respond to their less generous coverage by reducing spending.¹⁶ Moral hazard also reduces out-of-pocket spending among small-firm households. Adjusting for moral hazard leads to a 5.3 percent increase in predicted out-of-pocket spending among small-firm households.

Adjusting for moral hazard leads to a 21 percent increase in the underinsurance rate among small-firm households (using large-firm household spending as a baseline) using the 10 percent threshold measure (Table 4). This adjustment also substantially affects the graduated threshold measure of underinsurance, increasing it by 15 percent.

Moral hazard leads to a highly misleading picture of the difference in underinsurance rates between small- and large-firm households. The differences in predicted underinsurance rates between small-firm and large-firm households are very small—0.004 based on either threshold measure. Adjusting for moral hazard, however, leads to a 225 percent increase in this difference (from 0.004 to 0.013) when using large-firm spending as the baseline.

Our adjustment methods illustrate that the puzzle of relatively greater underinsurance rates among large-firm households is explained by small-firm households' reducing care in response to less generous coverage. Not accounting for the reverse moral hazard associated with less generous coverage reduces the relative underinsurance rates among groups with less generous coverage. We also find the corresponding but opposite effect when examining the issue from the large-firm household's perspective. That is, underinsurance rates of large-firm households fall when the effect of moral hazard is taken into account (see Table SA3.)

CONCLUSIONS

Underinsurance, the phenomenon of insured households being unable to afford the out-of-pocket cost of medical care, is a growing policy concern. In this paper, we show that moral hazard matters for measures of underinsurance. That is, the fact that people with more extensive health insurance coverage tend to increase their health care expenditures can impact measures of

underinsurance. Adjusting for this moral hazard effect is necessary when estimating the relative rates of underinsurance across groups. We show that in the absence of this adjustment, roughly the same percentage of households who obtain their insurance coverage from a large firm are underinsured as the percentage of households who obtain their insurance coverage from a small firm. This result would be puzzling because small firms typically offer less generous insurance in terms of deductibles, coinsurance rates, and annual out-of-pocket limits. Adjusting for the effects of moral hazard, we find that our estimate of the percentage of small-firm households who are underinsured increases substantially—by roughly 20 percent. Moreover, the difference in underinsurance rates between small-firm and large-firm households under our corrected measure is 225 percent larger than the unadjusted difference.

Our application addresses the measurement of disparities in coverage of small- versus large-firm workers but both the problem and our method to correct it are more general. Moral hazard could affect comparisons between any groups with differing levels of coverage generosity. Our application shows that adjusting for moral hazard can make a substantial difference in the number of households identified as underinsured and in the relative rates of underinsurance across groups.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: We thank Jay Bhattacharya and seminar participants at the 2008 Academy Health meetings for comments and especially thank John Sommers for generously provided us with tabulations of health insurance plan characteristics by establishment size. The authors received financial support from the Commonwealth Fund. The views in this paper are those of the authors alone and do not represent the views of the Commonwealth Fund.

Disclosures: None.

NOTES

1. For example, the poverty guidelines similarly imply a threshold level of well-being (Federal Register, January 23, 2008, pp. 3971–3972).
2. Another application of this method would be to a comparison of underinsurance rates between persons with individual coverage and persons with group coverage. It also would be possible to use a related method to compare everyone to a

particular defined standard benefit package—however, this comparison would be challenging because of the need to predict everyone’s total spending under that standard benefit package.

3. While in our simple example we assume that there are only two plans, one for small firms and one for large firms, there is substantial heterogeneity in plans within both types of firms. Our method does not rely on there being only one type of plan for each group. Rather it applies to a comparison of two groups (or more) whose generosity of plans differs on average.
4. Here we are assuming a constant cost-sharing rate across all spending levels. In our empirical application, we allow for the cost-sharing rate to vary by decile of total spending.
5. We do not include households with part-year coverage because it is difficult to distinguish households that are uninsured part year and underinsured part year from households who are uninsured part year and “fully” insured part year. Also, we do not include households that have multiple sources of coverage (e.g., ESI for parents, public for children) for a similar reason. These restrictions may be why our estimates of underinsurance rates may differ from other recent studies.
6. The public-use version of the MEPS does not contain state identifiers. As a result, we were not able to simulate state income tax burden on households meaning that we overestimate after-tax income, leading to more conservative estimates of underinsurance.
7. We use “establishment” and “firm” interchangeably. The data measure establishment size.
8. We recoded multi-race households to reflect the less prevalent race in the population.
9. All analyses are estimated using sampling weights. We have tested the sensitivity of our results to estimating these models at other quantiles and, in our application, the results were robust. It is possible that in other applications the choice of quantiles could matter.
10. We generate predicted total spending values using each of the five-quantile regression models, yielding five observations per household. The predicted distribution of total spending thus depends on estimates from each of the quantile regression models (see Machado and Mata 2005 and Autor, Katz, and Kearney 2005).
11. This corresponds to Column (E) of Table 2, Panel B of the stylized example.
12. Our method does not attempt to differentiate cost sharing by type of service. As a result, we are implicitly assuming that the types of medical services that are affected on the margin by moral hazard have average rates of cost sharing. If these marginal services have lower than average cost-sharing rates, we would expect to see an even larger increase in OOP spending among small firm households when we adjust for moral hazard. To the extent this is the case, our adjustments are conservative.
13. The ratio corresponds to Column (H) of Table 3 and the underinsurance indicator corresponds to Column (I).
14. Actual underinsurance rates are presented in Table 3. Actual underinsurance rates are not comparable with “adjusted” rates.

15. The quantile regression results are presented in supporting information Tables SA1 and SA2.
16. Similarly, adjusting for moral hazard leads to a 5.6 percent decrease in predicted total spending for large-firm households (U.S.\$5,629 versus U.S.\$5,961), consistent with households' spending more in response to generous coverage (see Table SA3).

REFERENCES

- Autor, D. H., L. F. Katz, and M. S. Kearney. 2005 *Rising Wage Inequality: The Role of Composition and Prices*. National Bureau of Economic Research Working Paper No. 11628.
- Banthin, J., and D. Bernard. 2006. "Changes in Financial Burdens for Health Care: National Estimates for the Population Younger Than 65 Years, 1996 to 2003." *Journal of American Medical Association* 296 (22): 2712–9.
- Banthin, J., P. Cunningham, and D. Bernard. 2008. "Financial Burden of Health Care, 2001–2004." *Health Affairs* 27 (1): 188–95.
- Bashshur, R., D. Smith, and R. Stiles. 1993. "Defining Underinsurance: A Conceptual Framework for Policy and Empirical Analysis." *Medical Care Review* 50 (2): 199–218.
- Bhattacharya, J., and W. B. Vogt. 1996. "The Utilization of Outpatient Medical Services in Japan." *Journal of Human Resources* 31 (2): 450–76.
- Collins, S., J. Kriss, M. Doty, and S. Rustgi "Losing Ground: How the Loss of Adequate Health Insurance Is Burdening Working Families." Commonwealth Fund Publication 1163 [accessed August 2009]. Available at <http://www.cmwf.org>
- Congressional Budget Office. "Technological Change and the Growth of Health Care Spending" [accessed on August 2008]. Available at <http://www.cbo.gov>
- Cutler, D., and R. Zeckhauser. 2000. "The Anatomy of Health Insurance." In *Handbook of Health Economics*, edited by A. J. Culyer and J. P. Newhouse, pp. 563–644. New York: Elsevier.
- Farley, P. 1985. "Who Are the Underinsured?" *Milbank Memorial Fund Quarterly* 63 (3): 476–503.
- Gabel, J., R. McDevitt, L. Gandolfo, J. Pickreign, S. Hawkins, and C. Fahlman. 2006. "Generosity and Adjusted Premiums in Job-Based Insurance: Hawaii Is Up, Wyoming Is Down." *Health Affairs* 25 (3): 832–43.
- Machado, J. A., and J. Mata. 2005. "Counterfactual Decomposition of Changes in Wage Distributions Using Quantile Regression." *Journal of Applied Econometrics* 20 (4): 445–65.
- Manning, W., J. Newhouse, N. Duan, E. Keeler, A. Leibowitz, and M. Marquis. 1987. "Health Insurance and the Demand for Medical Care: Evidence from a Randomized Experiment." *American Economic Review* 77 (3): 251–77.
- Merlis, M. "Family Out-of-Pocket Spending for Health Services: A Continuing Source of Financial Insecurity." Commonwealth Fund Report, June 2002 [accessed 2008]. Available at <http://www.cmwf.org>

- Newhouse, J. P., and C. E. Phelps. 1976. "New Estimates of Price and Income Elasticities of Medical Care Services." In *The Role of Health Insurance in the Health Services Sector*, edited by R. N. Rossett, pp. 261–320. New York: National Bureau of Economic Research.
- Schoen, C., S. Collins, J. Kriss, and M. Doty. 2008. "How Many Are Underinsured? Trends Among U.S. Adults, 2003 and 2007." *Health Affairs* 27 (4): w298–309.
- Schoen, C., M. Doty, S. Collins, and A. Holmgren. 2005. "Insured but Not Protected: How Many Adults Are Underinsured?" *Health Affairs*: W5-289–302.
- Shearer, G. "The Health Care Divide: Unfair Financial Burdens," Consumers Union, 2000. Available at <http://www.consumersunion.org/pdf/divide.pdf>
- Short, P., and J. Banthin. 1995. "New Estimates of the Underinsured Younger Than 65 Years." *Journal of American Medical Association* 274 (16): 1302–6.
- Ziller, E., A. Coburn, and A. Yousefian. 2006. "Out-of-Pocket Health Spending and the Rural Underinsured." *Health Affairs* 25 (6): 1688–99.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Table SA1. Quantile Regressions of Total Medical Care Spending, Large Firm Households.

Table SA2. Quantile Regressions of Total Medical Spending, Small-Firm Households.

Table SA3. Predicted and Adjusted Medical Care Spending and Underinsurance, Large-Firm Households.

Please note: Wiley-Blackwell is not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.