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Review: "Health Insurance for 'Humans': Information Frictions, Plan Choice, and Consumer Welfare"

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A growing body of economic research is focused on understanding how consumers choose and utilize their health benefits. This is one of a series of article reviews prepared by the Behavioral Finance Subgroup of the Health Section that will highlight substantive articles of interest to health actuaries.

CONSUMER PURCHASING DECISIONS FOR HEALTH INSURANCE

Currently, more than 80 percent [1] of large U.S. employers offer their employees, either as one of several options or as the sole medical plan option, a consumer-directed (high-deductible) health plan (CDHP or HDHP) with either an employer-funded health reimbursement account (HRA) or a health savings account (HSA). Approximately one-third of employers offer one or more HDHPs as the sole option. In the Affordable Care Act (ACA) health care exchanges, HDHPs are prominently featured as well.

Historically, when HDHPs are offered as an option along with more traditional PPO plans, enrollment in the HDHP is low. This is true despite the fact that the HDHP is priced significantly lower than the PPO plan, and would make more economic sense for most of the employees.

Researchers in the economics department at the University of California, Berkeley, and the Wharton School, University of Pennsylvania, conducted a rigorous research project in an attempt to identify some of the factors that cause consumers to make suboptimal purchasing decisions when choosing a health plan.[2]

The population studied was the employees of a large employer with more than 50,000 employees. This employer offered employees a choice between a traditional PPO plan and an HSA-qualified HDHP, both with no payroll contributions. The PPO plan covered most in-network health care costs at 100 percent with no cost sharing. For employees enrolled in the HDHP, the employer contributed the amount of the deductible to the employee's HSA account. A key difference between the plans was a 10 percent coinsurance band after the HDHP deductible, although the paper shows that the employees preferred no deductible over a deductible combined with an HSA contribution in the amount of a deductible. Cost sharing for out-of-network services was higher for both plans.

This employer intended to eliminate the PPO option in the following year. The researchers estimated the impact of that action on the overall welfare (total economic utility) of the employee population. From a public policy perspective, it is important to understand the implications of the movement to HDHPs for Americans as a whole, in order to inform the political debate over such issues as the "Cadillac tax" and the cost of government subsidies to health insurance purchasers. As actuaries, we also have a responsibility to participate in the public dialogue about these issues and to understand the possible economic welfare implications of the solutions that we propose.

The researchers conducted a survey of enrolled employees "soon after" the open enrollment period in order to gauge their understanding of plan features such as the provider network, deductibles, out-of-pocket (OOP) costs, contributions required, and perceived time and hassle costs (e.g., the amount of time dedicated to sorting out medical bills, managing the HSA account, etc.) of each option, as well as the employees' estimation of the OOP costs they would expect to pay under each plan. The survey results were combined with enrollment data, employee attribute data (age, gender, salary, etc.) and actual claims and OOP cost information from the previous year.

Researchers also used the Johns Hopkins ACG predictive medical cost model to predict the average and distribution of total medical expenditures for the upcoming year based on the past year of diagnoses, drugs and demographics. These predicted expenditures were then used to estimate the future OOP cost

expenses each individual and family would incur in the enrollment year under each of the health plans. This data was used to assess the accuracy of the employees' own estimates of their likely OOP costs and to determine which of the plans would have been the optimal choice for each employee.

The researchers are economists, so their terminology and methods will be unfamiliar to many actuaries. For example, their results are presented in terms of a "gamble interpretation," where they are estimating the amount of certain loss a consumer would consider equivalent to a specific plan choice. The cost difference between the two plan options was assumed to be the amount of HSA contribution the employee would forgo by enrolling in the PPO plan.

In addition to measuring the impact of various "information frictions" (essentially, a mistaken belief about some aspect of the HDHP) on these "gamble interpretations," the researchers also attempted to measure the impact on employee welfare of restricting the choice of plan to only the HDHP. A limitation to this calculation is that the authors don't take into account the potential of reduced medical spending with a switch to the HDHP. However, in a newer paper, they do just this.[3]

Terminology

This study is very technical in nature and uses advanced statistics and economics, which are reflected in the terminology of this review. This section is intended to provide a basic knowledge of terms that are important to the interpretation of the results presented by the authors.

- **Information friction.** The absence or inaccuracy of data by a consumer that impedes rational decision-making
- **Time and hassle costs.** The amount of time dedicated to sorting out medical bills, managing the HSA account or health plan
- **Certainty equivalent.** A certain amount of gain or loss for which the member is indifferent relative to a specific uncertain outcome
- **Constant absolute risk aversion.** In utility theory, an individual's aversion to risk remains constant and does not depend on wealth
- **Random coefficient model.** A model where the intercept and the coefficients are allowed to vary according to a distribution for each observation rather than remain constant for all observations
- **Copula methods.** Mathematical probability functions that use multivariate distributions from independent random variables

Survey Findings

The responses to the survey will be of interest to actuaries reading this article. The study highlights the following:

1. Only 27 percent of survey respondents were able to correctly identify the deductible for the HDHP plan. A narrow majority of HDHP enrollees chose the correct response, and only 21.5 percent of PPO enrollees knew the answer.
2. Only 18.5 percent of survey respondents and fewer than one-third of HDHP enrollees knew the coinsurance rate and OOP maximum.
3. About 70 percent of HDHP enrollees knew how much the employer would contribute to the HSA, but only 22.5 percent of PPO enrollees answered this question correctly.
4. More than 75 percent of all respondents knew that they could keep the HSA funds after the end of the plan year, but few understood the tax impact of HSA contributions.
5. Fewer than half of HDHP enrollees and about one-third of PPO enrollees knew that both plans utilized the same provider network.

It may not be a surprise to readers that employees didn't understand the details of the HDHP. Particularly when you have decided not to enroll in a plan, there isn't much to gain from remembering those details. In fact, some of us don't really know the details of the plans we are enrolled in. Clearly, employers (and insurers) fall short in communicating to "customers" about their options, and HSA plans are different from what most consumers are used to.

EMPIRICAL FRAMEWORK

The authors developed a series of models that attempt to quantify the impact of information frictions, perceived hassle costs and risk preferences on the choice of health plan. They started with a baseline model that attempts to explain health plan choice using health risk, risk preferences and health plan characteristics, employing the standard expected utility model used by economists. They then added the different consumer attributes to the model. With both the baseline model and the models with added variables, they can attempt to measure how these attributes impact the conclusions made through economic analysis.

The baseline model and the full model will be summarized here. However, the authors developed several different models with which they investigated the impacts of each of the measures.

Description of the Models

The authors constructed several different utility models for this analysis:

- **Baseline model.** Uses only demographic characteristics and modeled costs. Assumes that families' beliefs about their OOP expenditures conform to the model.

- **Baseline model with inertia.** Incorporates an inertia parameter (as a cost of switching plans) into the baseline model for employees who were enrolled in the prior year.
- **Full model.** Incorporates information frictions as determinants of plan choice.
- **Types model.** Builds off the baseline model using a one-dimensional measure of the information available to the consumer.

Baseline Model

The baseline model is an application of expected utility theory, and relies on an equation of the form

$$U_{kj} = \int_0^\infty f_{kj}(s)\, u_k\big(\, x_{kj}(W_k, P_{kj}, s)\big) ds$$

This formula is a standard expected value of a consumer's utility (u_k) where the distribution of OOP costs (s) is the agent that varies (through the distribution function f_{kj}). A typical assumption in the literature assumes that the utility function inside the integral displays constant absolute risk aversion (CARA), which has a form like

$$u_k\big(\, x_{kj}(W_k, P_{kj}, s)\big) = \frac{1}{\gamma(\mathcal{X}_k^A)}\, e^{-\gamma_k(\mathcal{X}_k^A)x_{kj}}$$

Here γ_k is a family specific risk factor and is unobservable. It was modeled as a function of employee demographics $\mathcal{X}_k^A$. Consumption, x_{kj}, is modeled linearly in terms of wealth (W_k), premium (P_{kj}), OOP costs and an error term

$$x_{kj} = W_k - P_{kj} - s + \epsilon_{kj}$$

Note that in this analysis, the premium of the PPO plan is assumed to be the amount that would have been deposited in the employee's HSA had the employee chosen the HDHP.

Full Model

The authors used a reduced form approach to model the consumer attributes, just adding them in as linear factors with coefficients in the choice model. In the reduced form model, the information frictions are incorporated into the consumption equation as follows:

$$x_{kj} = W_k - P_{kj} - s + \eta\big(\mathcal{X}_k^B\big)\mathrm{I}_{j_t = j_{t-1}} + \mathcal{Z}_k'\beta\mathrm{I}_{HDHP} + \epsilon_{kj}$$

Wealth Premium OOP Costs Inertia Behavioral Error

> Actuaries interested in public policy would do well to understand the welfare implications of the non-rational agent.

The full model includes 13 different measures of friction, so has 14 dimensions (one is the "no frictions" dimension). Here are the other 13 dimensions:

1. Two variables about the individual's knowledge of plan financial characteristics (e.g., deductibles)
2. Three variables about provider network knowledge
3. Three variables summarizing information of their own total health care expenditures
4. Two variables about knowledge of the tax benefits of an HSA
5. Three variables about the individual's expectation of and attitude toward time and hassle costs

There are many situations where actuaries are concerned with who is choosing a product or service. For example, assumptions about the risk attributes of buyers are important in pricing and network modeling. In pricing a health insurance plan, an actuary is concerned with the risk profile of people who will eventually choose to be on the plan. In building a limited network, an actuary is concerned with the health care utilization patterns of people who will select a limited network. In each situation, a discrete choice model can aid in the estimation of the pool.

Parameter Identification

Wikipedia[4] defines the parameter identification problem in the following way:

> In statistics and econometrics, the parameter identification problem is the problem of inferring the parameters of the structural equations of an econometric model from a set of observations.

In other words, what are the specific attributes or ranges of attributes that impact consumer choice? The difficulty in identifying parameters comes about when multiple variables appear to have similar impacts on results. For economists, who are trying to measure a causal relationship, this can be a difficult problem to solve. Sometimes they will use structural breaks in the data for identification; other times they will assume some sort of orthogonality within the model for identification. Actuaries are also concerned with identification when measuring or calculating drivers of experience—particularly when using estimates to project future outcomes.

In the baseline model, the authors used a similar strategy for identification as others in the literature. For the model with inertia, the authors compared the choices of new employees, who are forced to choose between the plans, with continuing employees who may just stay with the plan they enrolled in previously.

This subsequently allowed for the identification of the other variables. The authors note that new employees are of a credible size so that estimates using that group as a comparison can be relied on. Identification of the full model follows from the assumptions made regarding the friction variables. Specifically, these variables are assumed to be independent from risk preferences and inertia, conditional on demographics.

Estimation

All specifications are estimated with a random coefficient simulated maximum likelihood model (also known as a mixed model). A summary of this methodology can be found in Kenneth Train's *Discrete Choice Methods with Simulation*.[5] Actuaries should be familiar with fitting models using the maximum likelihood technique. However, an actuary would have less experience with a random coefficient model. It assumes that one or more of the coefficients in the model are randomly distributed. This is useful when subgroups behave differently from each other with respect to a given independent variable.

There are a few uses for a random coefficient model within a typical actuary's responsibilities. A random coefficient model can be used to deal with situations where credibility is a concern. Sheamus Parkes,[6] Fred Klinker[7] and James Gusczca[8] all discuss the benefits of using random coefficient models in a low-credibility environment. Second, the development of factors for pricing, such as age and sex, would benefit from a random coefficient approach. Generally, an actuary will make tables for every age/sex pair and calculate the factors for each of these pairs. However, not every 25-year-old is the same. There is a distribution of costs for each age and gender. As actuaries, it is important to estimate the underlying distribution of costs to mitigate risks unique to individual attributes, especially those risks with long tails. Klinker[9] provides an interesting exposition of pricing using a mixed model. Last, Gusczca[10] details the use of a random coefficient model for the calculation of claims reserves.

Cost Model

The models specified previously all rely on the distribution of OOP costs as an input. The authors used the Johns Hopkins ACG software package as the basis for this cost prediction and have enhanced their model as follows:

1. Incorporate individual survey information—measures accuracy of knowledge.
2. They bucket costs into four types: inpatient, outpatient, mental health and pharmacy. Each of these types is modeled separately and then aggregated into a joint distribution using copula methods.
3. Estimate OOP spending using plan characteristics. Since there are no assumptions on private information (anti-selection-type issues) or moral hazard, costs and utilization are not assumed to vary by type of plan.

RESULTS

The results aren't surprising. However, they do give us some intuition into how much variation there can be in member choice due to information frictions.

Parameter Estimates

From the development of these series of models, the authors produced a set of coefficient estimates for each model. Each of these models is very detailed and is characterized using many parameters to define how each consumer's underlying knowledge and perceptions about their health plan options will affect their choice. We note the following parameters that are of significant interest in the "full model":

- The full model predicts a mean CARA coefficient of $8.6 \cdot 10^{-5}$. This coefficient translates to an individual being risk-indifferent between not taking any action and taking on a gamble in which he gains $1,000 with a 50 percent chance and loses $920.47 with a 50 percent chance.

- Those who answered "not sure" to any of the primary questions regarding financial characteristics of the HDHP valued the HDHP by $467.48 less than the value of the HDHP for those who answered all of these questions correctly.

- Consumers who thought that the PPO network was larger compared to the HDHP network valued the HDHP $2,362.85 less than those who correctly answered that the PPO and HDHP have the same size network.

- Consumers who are concerned about the time and hassle costs associated with the billing, administration and logistics of managing their health plan value the HDHP $127.87 less for each hour they expect to spend managing it. Consumers with a strong dislike for the time and hassle costs valued the HDHP at $138.70 less per hour.

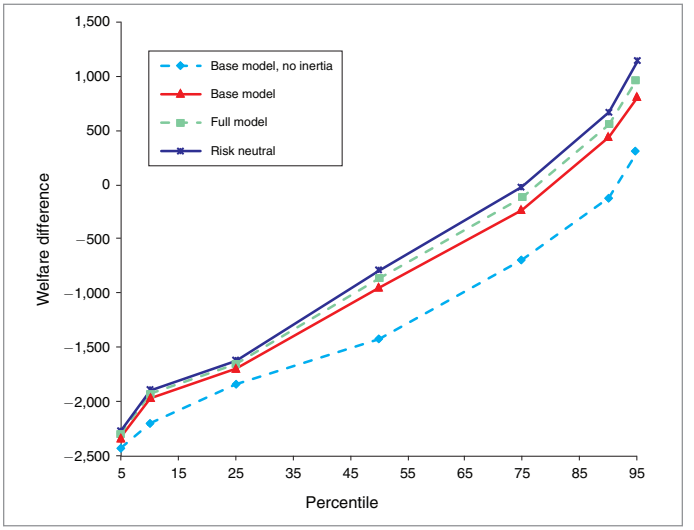
The results of these parameter estimates met our common expectations of how consumers' knowledge and perceptions would change their decision of whether or not to choose an HDHP. In general, consumers who know more about the characteristics of their health plan will value their health plan more accurately. Consumers will also be worried about the overall time spent managing their health plan and will place a lower value on an HDHP if they perceive they will have to spend a lot of time managing it.

Welfare Impact Analysis

The authors proceed with a case study analyzing the theoretical welfare impact of forcing all consumers into the HDHP and the effects of exposing consumers to additional risk of an HDHP plan as opposed to a PPO plan. This type of analysis is very relevant to the current health care climate, as many employers are encouraging employees to use HDHPs as a way of lowering costs. In 2015, 24 percent of workers who had health insurance were covered by an HDHP.[11]

The consumer welfare loss is defined as the average difference between the certainty equivalent loss under the PPO plan and the newly calculated certainty equivalent loss under the HDHP across all members. Using the total study population, the full model predicted an average consumer welfare loss of $789 with a member standard deviation of $1,021. At least 75 percent of these consumers incurred an increase in their certainty equivalent loss when they switched from the PPO to the HDHP. So for the majority of members, their overall uncertainty regarding their plan increased. Figure 1, taken directly from the paper, shows the distribution in the welfare difference among consumers under the different models.

Figure 1
Welfare Effects of Forcing Employees into HDHP



Source: Reproduced from "Health Insurance for 'Humans': Information Frictions, Plan Choice, and Consumer Welfare" by Benjamin R. Handel and Jonathan T. Kolstad, *American Economic Review*, 2015, 105(8): 2449–2500.

In addition to producing these consumer spending relativities, the authors continued with their analysis by examining the concept that the HDHP will incentivize consumers to reduce any wasteful medical expenditures. As consumers are responsible for more risk with an HDHP, it naturally follows that they will do more to reduce any unnecessary spending they may have incurred under their PPO. The authors present an upper and

lower bound on the minimum elasticity factors such that any elasticity above this factor would be socially optimal for everyone switching to the HDHP. For the full model, the elasticity lower and upper bound necessary to justify the switch to an HDHP is 0.178 and 0.258, respectively. Another way to interpret this factor is that in order for the HDHP to be socially optimal, it would require that the average consumer lower their total medical spend by at least 17.8 to 25.8 percent. This is in contrast to the current estimates of savings in the literature, which are from 5 to 15 percent.

APPLICATIONS AND CRITICAL ANALYSIS

Health plan choice is a central assumption for actuaries pricing health insurance plans. Often these assumptions are implicit in actuarial modeling and reflect rational decision-making by consumers. This research project, along with myriad others, shows that indeed consumers don't act rationally. Actuaries interested in developing a better understanding of this concept, or implicitly accounting for it in their modeling, would do well to understand the methods and outcomes of this paper. The methods provide examples to explicitly model consumer choice. The outcomes are estimates of the parameters of interest. At a minimum, the results of the study can drive applications of actuarial judgment. Actuaries interested in public policy would do well to understand the welfare implications of the non-rational agent.

We know that adverse selection does occur, despite the fact that consumers neither have perfect information about their own risks nor understand perfectly the coverage that they are purchasing. This analysis confirms that consumers are risk-averse, and that they have a bias toward overestimating their own health care costs. Similar evidence can be found throughout the literature. A 2014 survey[12] by the Kaiser Family Foundation

attempted to measure how well consumers understand the language of health insurance terms such as premium, deductible, coinsurance and out-of-pocket maximum. The multiple-choice survey found that fairly high percentages of American adults understood these terms. For example, 76 percent could correctly identify the definitions of "premium" and "provider network." Another 72 percent chose the correct definition of "deductible" and 67 percent could identify "out-of-pocket limit" correctly. But when they were asked to calculate how much they would pay out of pocket for a specific medical expense and plan design, only 51 percent could do the calculation correctly. The results were much better for insured individuals than for the uninsured.

The paper gives actuaries the framework to explicitly model consumer choice. A pricing actuary can use the modeling for renewal calculations, answering the question, "Who is going to pick which plan?" The results also provide a numeric estimate of the inertia members have when renewing a plan. This has always been of interest to a pricing actuary. Actuaries involved in the valuation of limited provider networks can use the results as an estimate of how much consumers value limited networks. They can also view the results of this study with others[13] to gain a better understanding of the value consumers place on these networks.

The researchers estimated an average welfare loss of $62 per person as a result of eliminating the PPO option, considering they modeled OOP costs from both plans. When information frictions are added to the equation, the welfare loss increases more than 8 times, to $511. Clearly communicating plan features to employees, as well as providing information on their own risk of incurring significant costs, could go a long way toward improving overall welfare. It should be noted that this welfare loss didn't consider the potential of reduction of wasteful medical spending. In a subsequent paper, the authors go on to show that the switch to a HDHP plan does result in reduced medical spending, and this reduction isn't entirely from the reduction of waste.[14] It was shown that consumers simply reduced all types of medical spending, even necessary or preventive medical spending.

However, there are limitations to this study. Confirmation bias, where respondents are more likely to choose responses in favor of the attractiveness of the plan, can distort results. Also, the authors made generous use of assumptions for unknown parameters in their analysis. Any actuary looking to consume and implement the results of this survey is well advised to thoroughly examine the methods employed and assumptions adopted to understand the study's limitations. With continued monitoring and improved communications of health plan options, health plans can better "nudge" consumers toward options that optimize their long-run health outcomes and minimize the expense to health plans. ■

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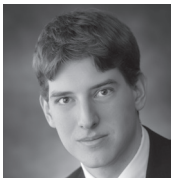

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