American Economic Review 2015, 105(8): 2449–2500
http://dx.doi.org/10.1257/aer.20131126

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

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Traditional models of insurance choice are predicated on fully informed and rational consumers protecting themselves from exposure to financial risk. In practice, choosing an insurance plan is a complicated decision often made without full information. In this paper we combine new administrative data on health plan choices and claims with unique survey data on consumer information to identify risk preferences, information frictions, and hassle costs. Our additional friction measures are important predictors of choices and meaningfully impact risk preference estimates. We study the implications of counterfactual insurance allocations to illustrate the importance of distinguishing between these micro-foundations for welfare analysis. (*JEL* D81, D83, G22, I13)

In both employer-sponsored health insurance markets and the health insurance exchanges introduced as a part of national health reform, consumers grapple with how to choose an insurance plan from a menu of options. As in the markets for other complex products, such as, e.g., cellular phone plans or financial investment vehicles, in health insurance markets real-world consumers may struggle to either obtain or process information in a way consistent with the *homo economicus* model typically used to study behavior in these settings. How consumers value different product attributes, what consumers know about those attributes, and how these preferences and information translate into choices is fundamental to market design and regulation, for health insurance and beyond. Without detailed knowledge of these micro-foundations it is difficult to precisely answer key policy questions such as

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† Go to http://dx.doi.org/10.1257/aer.20131126 to visit the article page for additional materials and author disclosure statement(s).

which type of plans to allow insurers to offer and how those plans should be presented and priced.

Accordingly, there has been much recent empirical work that seeks to estimate micro-founded models of consumer insurance plan choice and then use those estimates for welfare analysis, in some cases for counterfactual market policies (see, e.g., Cardon and Hendel 2001; Cohen and Einav 2007; Carlin and Town 2010; Bundorf, Levin, and Mahoney 2012; Einav et al. 2013; Abaluck and Gruber 2011; and Handel 2013). One common aspect across these studies is their use of detailed administrative data on plan choices and risk realizations to identify demand factors such as risk preferences and risk expectations. These studies are typically unable to identify multiple unobserved preference factors apart from risk preferences because of the limitations of administrative data: the choices that consumers make, conditional on their risk expectations, are the primary instrument available. As a result, researchers use these observed choices to identify risk preferences, under assumptions that directly specify the roles of other unobserved choice factors, such as the information consumers have about available plan options.

While such assumptions are necessary given the data available in past work, there are many potential unobserved preference elements besides risk preferences that can impact demand for distinct insurance plans. Given that health insurance plans are complex financial objects, it is likely that many consumers are not fully informed about key plan design aspects or even their own medical expenditure risk (see, e.g., Kling et al. 2012; Ketcham et al. 2012; or Fang, Keane, and Silverman 2008). In addition, prior work such as Abaluck and Gruber (2011) and Barseghyan et al. (2013) has shown that consumers may exhibit decision-making biases even conditional on their information sets.[1] Finally, potentially important plan attributes such as time and hassle costs of actually using an insurance plan can differentiate even actuarially identical options but are typically unobserved.

If these foundations matter and are assumed away there are several key implications. First, in structural analyses where researchers are interested in quantifying specific choice foundations, (e.g., risk preferences) and using those estimates for counterfactual choice predictions, omitting relevant unobserved factors will bias the conclusions drawn. Second, distinguishing between such choice factors can be important for welfare analysis, even in nonstructural analyses such as Einav, Finkelstein, and Cullen (2010) that model demand without specific assumptions on choice micro-foundations. In such frameworks, if unobserved preference factors are "welfare-relevant" in the sense that they directly impact consumer welfare conditional on enrollment, then estimating demand is sufficient to conduct some policy analyses; observed choices directly reflect relative "ex post" plan valuations. If, however, unobserved factors such as consumer information or beliefs impact consumers choices, but not consumer welfare once enrolled, then neither reduced form demand curves nor structural analyses that omit such factors provide sufficient measures to conduct welfare analysis. This distinction has been demonstrated

[1] Grubb and Osborne (2015) find similar behavior in cellular phone markets, where consumers also chose from menus of potentially complex nonlinear contracts. That paper, as well as the Barseghyan et al. (2013) paper, use complementary approaches (relative to this paper) based on the combination of careful modeling, assumptions on the choice process, and administrative data alone.

theoretically (e.g., Spinnewijn 2012 and Bernheim and Rangel 2009) though, to our knowledge, there is limited empirical work that makes the distinction between welfare-relevant and non-welfare-relevant choice factors.[2] This is due, at least in part, to the challenges to gathering data that identify choice foundations beyond the standard model.

To overcome this empirical challenge, we leverage new proprietary data from a large firm with over 50,000 employees to separately identify consumer risk preferences from a variety of information frictions as well as other typically unobserved demand factors such as plan time and hassle costs. Our approach combines the type of detailed administrative data common to the literature with a comprehensive, economically motivated, survey where consumers' answers are linked to the administrative data at the individual level. The administrative data we collect is a detailed individual-level panel of consumer insurance plan choices from a menu of two plans, subsequent medical claims, demographics, and employment characteristics. The survey, administered electronically to a random sample of 4,500 employees soon after the open enrollment period, asks consumers simple questions designed to measure the information they possess on plan financial characteristics (e.g., deductible, co-insurance, out-of-pocket (OOP) maximum), nonfinancial plan characteristics (e.g., provider network differences), and beliefs about their own total medical expenditure risk. In addition, we ask about the time and hassle costs of plan use that consumers have experienced and that consumers perceive for each plan option. The addition of rich individually-linked survey data to detailed administrative data adds multiple instruments that can be used to distinguish between risk preferences and other potentially important unobserved choice factors.

We present several model-free descriptive analyses to illustrate the importance of information frictions and hassle costs for consumer choices. In our setting, consumers choose between two plan options: a Preferred Provider Option (PPO) with comprehensive risk protection and a high-deductible health plan (HDHP) option with the same medical providers and treatments as the PPO, lower relative upfront premiums, and larger relative risk exposure. First, before incorporating the linked survey data, we show that the choices consumers make suggest substantial risk aversion if risk aversion is the primary unobservable preference factor. Second, we investigate the correlations between answers to information-related survey questions and plan choices, conditional on realized costs, to illustrate that consumers who are relatively less informed about the HDHP option are less likely to choose that plan. For example, consumers were asked whether they can access the same medical providers and treatments in the two plans (they can). Approximately 20 percent of consumers incorrectly believe that the more financially comprehensive PPO plan grants greater medical access while 30 percent answer that they are "not sure" about relative provider access. We show that these consumers are much more likely to choose the PPO relative to individuals who know that the plans grant exactly the same access. We present similar analyses, with similar conclusions, for other information frictions as

[2] Beshears et al. (2008) discuss potential ways to distinguish between revealed and normative preferences. In concurrent work, Baicker, Mullainathan, and Schwartzstein (2015) studies medical care utilization with a welfare model that also implies a gap between the choices consumers make and the choices that maximize their welfare if fully informed.

well as consumer time and hassle costs. Overall, our descriptive analyses suggest that information frictions and hassle cost perceptions matter for choices and that, if we omit these factors from our choice model, we will overestimate risk preferences in our setting due to the structure of insurance plans and the frictions present.

We next study the importance of explicitly accounting for these additional friction measures by estimating a series of structural choice models. These include (i) a baseline model, based just on administrative data, with risk preferences and health risk; (ii) our primary model that adds information frictions and hassle costs measures derived from the linked survey; and (iii) a types model that aggregates measures of information frictions into a one-dimensional information index. Each model incorporates the output from a detailed ex ante cost model that predicts future health expenditure distributions at the time of plan choices. All models we estimate are static in the sense that they study consumer information sets at a given point in time and thus do not study consumer learning about plan features over time.[3] A key assumption maintained in all models that include friction measures is that those measures are orthogonal to classical risk preferences, conditional on detailed consumer demographic and health information. Comparison between the baseline model, which bears some similarity to those in the literature, and each model with additional frictions allows us to quantify both the importance of these frictions for consumer choices and how much risk preference estimates are biased by omitting these friction measures from the analysis.

Our estimates reveal the importance of the additional friction measures. The baseline model, based on the administrative data alone, predicts substantial risk aversion, with a mean constant absolute risk aversion (CARA) coefficient of $1.60 \cdot 10^{-3}$. Framed in terms of a simple hypothetical gamble of similar scale, a consumer with this level of risk aversion would only be indifferent between not taking any action and taking on a gamble in which he gains \$1,000 with a 50 percent chance and loses \$367 with a 50 percent chance. In other words, he would have to be paid a risk premium of roughly \$633 in expectation to take on this risky bet. Incorporating inertia into the model, consumers are estimated to be less risk averse; they would be indifferent between no gamble and the same gamble that loses \$812 with a 50 percent chance rather than \$367.[4] Our primary model—incorporating friction measures—leads to lower estimates of risk aversion relative to both baseline models: in the full model with all frictions the consumer would be indifferent if the gamble included a 50 percent loss of \$913, while in the types model this value is \$924.

The most influential frictions we measure are a lack of information about available medical providers/treatments and perceived time and hassle costs for the HDHP plan. For example, a consumer who incorrectly believes that the PPO option grants greater medical access than the HDHP is willing to pay \$2,267 more on average for the PPO relative to a correctly informed consumer. This is despite the

[3] Since consumer inertia could be an important factor in our choice setting, the baseline model we emphasize also includes estimates of inertia identified in the administrative data by comparing the choices made by new employees to those made by existing employees. Our conclusions on the impact of including additional frictions for risk preference estimates are robust to the model of inertia used.

[4] This suggests that, in our setting, if one has just administrative data, incorporating inertia into the model matters a lot for risk preference estimates. In the recent literature mentioned earlier, people usually either model inertia explicitly (e.g., Handel 2013) or study active choice settings (e.g., Einav et al. 2013).

fact that, once enrolled, that consumer would have access to exactly the same set of doctors. Aggregating across all frictions measures we include, the average consumer is willing to pay $1,694 more for the PPO relative to a fully informed consumer with zero perceived hassle costs. Without the linked survey data, these frictions would primarily be proxied for by risk preference estimates as in our baseline model, but, once we include them, the degree of estimated risk aversion is substantially reduced.

Whether consumer choices are driven by risk preferences or the frictions we measure has important implications for market regulation and consumer welfare. We illustrate this by studying the impact of a counterfactual that allocates all consumers in our sample to the HDHP, essentially removing the PPO option from the choice set. This analysis is directly relevant to our setting, as the firm we study actually implemented this policy and removed the PPO option from consumers' choice sets in 2013.[5] For this exercise, we (i) keep all HDHP plan characteristics as observed in our setting and (ii) assume that, even though the frictions we measure impact willingness to pay, conditional on being enrolled in a plan they do not impact welfare. The latter assumption implies that, for example, even if a consumer doesn't know that provider access is identical under both plans, once enrolled in the HDHP this ex ante lack of information doesn't matter for welfare.[6] Our analysis should be seen as examining the implications of increased consumer risk exposure when risk aversion is estimated with and without additional data on the frictions we measure. Even if the willingness to pay associated with our friction measures has some welfare-relevant component, as long as they do not capture classical risk preferences our analysis appropriately reflects the implications of increased consumer risk exposure.[7]

Relative to the baseline case of risk neutrality, we find that the full model estimates, with lower risk aversion, imply an average welfare loss of $62 per person from increased risk exposure in moving the entire population to the HDHP. The baseline model with (without) inertia implies a more than double $148 ($511) relative loss. We illustrate the implications of these results for a specific policy decision by viewing them in light of the fundamental trade-off between risk protection and moral hazard inherent to optimal insurance design (see, e.g., Zeckhauser 1970). Under the baseline model, with higher risk aversion, a price elasticity of demand for health care utilization of at least 0.280 would be necessary to justify the policy shift to the HDHP, while under the full model the elasticity would be 0.178.[8]

[5] It has become increasingly common for large employers to pursue this "full replacement" strategy whereby all existing plan options are replaced with a high deductible plan (see, e.g., Towers Watson 2014).

[6] This same logic extends naturally to other information frictions. On the other hand, time and hassle costs could have tangible welfare implications once enrolled. We examine a range of scenarios from the (baseline) case where hassle costs are not welfare relevant (e.g., due to ex ante misperceptions or counterfactual improvements in plan design) to the case where they are fully relevant upon forced enrollment.

[7] It is important to note that this counterfactual analysis studies a forced choice, or direct allocation of consumers to plans, rather than the case where consumers choose from a new menu of plans. In general, because our models estimate structural risk preference parameters but include our measures of information frictions in a reduced-form manner, our estimates can be directly applied to investigate consumer welfare losses from risk exposure for a given allocation of consumers to plans. However, we would require additional assumptions to study choice and welfare when consumers can choose between counterfactual plan menus. This implies that, e.g., our estimates do not have specific implications for questions like how many plans should be offered in a market, but do have implications for, e.g., what level of risk exposure regulators allow insurers to offer.

[8] These results assume zero marginal value of medical care forgone. If consumers value the care forgone at the high-deductible plan co-insurance rate, these elasticities are 0.407 and 0.258 respectively.

For all of our analysis, it is important to keep in mind the potential limitations of our survey data. Broadly, a downside to using survey data is that it relies on elicitations, rather than exogenous variation in administrative data, to identify the extent of the frictions we study. While an "ideal" investigation of these factors would use only administrative data with exogenous variation on many dimensions (such as, e.g., information provision), in practice this has not been done and seems quite difficult. In our specific context the survey data are subject to several potential concerns. First, consumer answers may reflect information about the specific plan dimension studied as well as other correlated factors, implying the answers given are signals about information frictions rather than direct measurements of them. Second, there may be selection into answering the survey on unobservable dimensions that are correlated with information about health plan choices. Third, the survey was conducted after consumers made their plan choices, potentially leading to (i) confirmation bias or (ii) consumer forgetting and learning between open enrollment and the survey administration. Each of these issues could impact the extent to which survey answers reflect consumer information at the time of choice, and, thus, the conclusions drawn from our analysis. We discuss these issues and present some relevant evidence in the context of our descriptive analysis.

We also note that all results presented here are specific to the large employer context that we study. From a theoretical perspective, incorporating information friction and hassle costs measures into typical insurance choice models could either increase or decrease the extent of estimated risk aversion. The direction of this effect will depend directly on the plans consumers can choose between and the relative information they have about each option. We illustrate here that the additional choice factors we study can matter for choice analysis, welfare analysis, and policy analysis, but the exact implications will depend on the specific context.

The paper proceeds as follows. Section I develops a conceptual theory of insurance choice. Section II describes the data, empirical setting, and presents some descriptive analyses. Section III develops our empirical model of insurance choice. Section IV presents results. Section V presents our welfare analysis of the counterfactual insurance allocation we consider while VI concludes.

I. Foundations of Choice in the Health Insurance Market

A. *Standard Model*

The canonical model of preferences for health insurance is based on a risk averse consumer who would prefer to pay a fixed premium to avoid losses in the bad state of the world in which he becomes sick (see, e.g., Arrow 1963 or Rothschild and Stiglitz 1976). In this simple case, the insurance plan decision depends on the consumer's out-of-pocket payment under different scenarios and his degree of risk aversion; health insurance is a tool for financial risk protection. We model this as an individual (or family), indexed by k, choosing health insurance plan j from a set of options $\mathcal{J}$. The consumer's utility for plan j is

$$u_{kj} = \int_0^{\infty} f_{kj}(s \mid \psi_j, \mu_k) u(W_k - P_{kj} - s, \gamma_k)\, ds. \tag{1}$$

Here, W_k is wealth, P_{kj} is the premium facing individual k in plan j, and $f_{kj}(s \mid \psi_j, \mu_k)$ is the probability density of out-of-pocket expenditures in plan j for individual k. Out-of-pocket spending is determined in each plan by two features: the plan design, indexed by ψ_j, and the consumer type, indexed by μ_k, that captures ex ante health status.[9] Together, the terms of the plan and total spending distribution define the joint density of out-of-pocket spending. The term γ_k is a coefficient of risk aversion for individual k.

This simple framework captures the standard model of preferences for insurance. Individuals are willing to pay a higher premium for a plan if it reduces the mean or variance of expected out-of-pocket spending and their willingness to pay for the latter is increasing in risk aversion. The individual making a choice has uncertainty over health care expenditures in different states of the world. However, he does know with certainty the density of expenditures—implicitly he is able to place a probability weight on each of the different illnesses that might befall him, know how much the appropriate treatment would cost, and understand the terms of the different plan options that result in different rates of cost sharing depending on expenditures/illness states. This workhorse model has a number of important advantages. It is a tractable representation of preferences with a clear empirical analog. Further, the model elements can be observed in widely available administrative datasets (e.g., expected expenditures for an individual and the plan options).[10]

B. *Nonfinancial Attributes in Plan Choice*

To better reflect actual choices, we must account for the fact that modern health insurance is not a purely financial product. With the rise of managed care and alternate benefit designs, the insurance one holds can determine the type of care available, the total price paid, and the hospitals and doctors one can access. The introductions of health savings accounts (HSA) and flexible spending accounts (FSA) have introduced additional plan attributes not directly related to consumer risk protection. Plans can also have varying degrees of time and hassle costs linked to plan administration and logistics (e.g., dealing with medical bills). More generally, health insurance plans are differentiated products across a variety of dimensions beyond simple financial risk protection.

We extend the model to account for additional components of the choice problem that are not directly related to financial risk.[11] Plans differ by the network of physicians and hospitals available, the time and hassle costs associated with dealing with claims, and the tax benefits of linked financial accounts. Here, for exposition, we subsume these nonfinancial attributes with a plan-specific shifter $\pi_j(\psi_j, \mu_k, (1 - t_k))$ that depends on plan design (ψ_j) and consumer type (μ_k) to reflect the fact that utility

[9] For the case of a family buying insurance, μ_k is a vector of health status types for all family members.

[10] We note that this model can easily be extended to allow for a trade-off between the value of health care consumed and the price of health care, as in the moral hazard literature. In the model we abstract away from this trade-off, since it is not central to our choice analysis, though we do discuss moral hazard in the context of (i) our identification strategy and (ii) our counterfactual plan allocation analysis.

[11] The inclusion of these features in models of insurance choice is not new (see, e.g., Ho 2009; Cutler, McClellan, and Newhouse 2000). However, measurement of these plan attributes, and preferences for them, has been difficult for researchers.

for these factors can depend on consumption of care and illness.[12] π_j also depends on an individual's marginal tax rate, to reflect the value of FSA and HSA contributions. Incorporating these features into the model utility from plan j for individual k yields

$$(2) \qquad u_{kj} = \int_0^\infty f_{kj}(s \mid \psi_j, \mu_k) u(W_k - P_{kj} + \pi_j(\psi_j, \mu_k, (1 - t_k)) - s, \gamma_k)\, ds.$$

In this model, consumers still value plans as tools for risk protection, but, in addition, may be willing to pay more for a plan with valuable nonfinancial attributes.

C. *Information Frictions in Plan Choice*

In the model above, the choice of insurance plan relies entirely on individuals' risk preferences, their expenditure projections, and their values for plan attributes. Importantly, this model assumes that when individuals make insurance choices they can access and process the information necessary to make correct decisions under uncertainty. Accordingly, individual choices reflect real preferences for trading off premiums in exchange for shifts in either the distribution of out-of-pocket spending or nonfinancial attributes across different plans. This assumption is critical and underlies positive analysis of choice patterns throughout the literature on health insurance markets. Without this assumption, assessing welfare using revealed preference becomes more challenging (see, e.g., Spinnewijn 2012 and Bernheim and Rangel 2009).

There are many ways that choices could differ from the model described in equation (2). The feature that is perhaps most critical and potentially unlikely to hold in practice is that consumers are fully informed about health plan attributes. Without the assumption of full information, in the standard model where preferences are merely over financial risk the consumer might not know or understand the financial attributes that differentiate each plan, implying an inability to accurately forecast spending in each option. Similarly, individuals may not have perfect information on the nonfinancial attributes of plan options (e.g., provider networks and hassle costs), particularly in the absence of having experience with a plan. To model information frictions we allow the true value of the key parameters of the choice model to be observed with error:

$$\widehat{\mu_k} = \mu_k + \delta_k^{\mu} + \epsilon_k$$

$$\widehat{\psi_j} = \psi_j + \delta_j^{\psi} + \epsilon_j$$

$$\widehat{t_k} = t_k + \delta_k^{t} + \epsilon_k$$

$$\widehat{\pi_j} = \pi_j + \delta_k^{\pi} + \epsilon_j.$$

[12] In our empirical model, we model each of these nonfinancial attributes as a distinct factor. Here, π_j can be thought of as a utility model for each of these factors.

We assume that individuals observe each type of plan attribute with two types of error. The first is standard, mean zero, measurement error captured by ϵ. The second is an attribute specific shifter, δ, that captures information frictions in the model. Consumer choices no longer necessarily reflect the exact attributes of the plans (and preferences over those attributes) but, instead, beliefs about those attributes that could be incorrect. Incorporating these features into the choice model, consumers plan utility is based on their beliefs about plan attributes and cost as follows:

$$(3)\quad \widehat{u_{kj}} = \int_0^{\infty} f_{kj}\left(s \,|\, \widehat{\psi_j}, \widehat{\mu_k}\right) u\Big(W_k - P_{kj} + \widehat{\pi_j}\left(\widehat{\psi_j}, \widehat{\mu_k}, \left(1 - \widehat{t_k}\right)\right) - s, \gamma_k\Big)\, ds.$$

From (3) we see how information frictions can impact the choice behavior of consumers in potentially important ways. Since both $\widehat{\psi_j}$ and $\widehat{\mu_k}$ enter the choice problem and impact the perceptions of (and subsequent responses to) out-of-pocket expenditure risk, even if we observe the choices of individuals who optimize given their beliefs, we cannot necessarily recover key features of the model, such as risk preferences, with typical administrative data. Similarly, if individuals are imperfectly informed about the nonfinancial attributes of the plan this will lead to choices that differ from what would have occurred with full information on the plan's network of physicians, true time and hassle costs, or a correct understanding of the tax benefits of plan features such as an HSA.

While choices may be affected by information frictions, these frictions may not impact true, welfare-relevant, utility conditional on enrolling in a given plan option (captured in equation (2)). For example, if a consumer believes that the providers available in-network in two plans differ, when they are in fact the same, this will impact choices but should not impact actual ex post consumer utility and welfare for one option relative to another. Thus, when information frictions impact choices, the standard model may (i) omit key choice foundations; (ii) have biased estimates of the choice foundations, such as risk preferences; and (iii) lead to biased assessments of the welfare impact of different market environments or policy scenarios.

Whether information frictions exist in practice and, if so, how important they are, is an open question. Addressing this empirically has been a challenge because the data requirements are substantial. To compare the model in equation (2) to equation (3) requires both data on actual choices and plan attributes as well as measures of information and beliefs about plan attributes (or, alternatively, exogenous variation in the choice environment). Our empirical setting provides exactly that, by combining administrative data on claims and choices of insurance with a detailed survey on consumer information about plan attributes and key risk characteristics. The remainder of the paper focuses on developing an empirical model, related to equation (3), to assess the positive impact of information frictions on choice as well as the impact of including information frictions on welfare predictions for different counterfactual scenarios.

II. Data and Descriptive Analysis

We study health plan choice and utilization for the employees (and dependents) of a large self-insured employer with approximately 55,000 US employees (in

2012) covering approximately 160,000 lives. We observe detailed administrative data with several primary components over the time period 2009–2012. First, we observe the health insurance choices that employees have in each year, as well as the choices that they ultimately make. Second, we observe the universe of line-by-line health care claims for all employees and their dependents in all plans. This includes payment information, such as the total payment for a given service and the employee out-of-pocket payment, as well as diagnostic medical information that can be used to model health status. Finally, we observe demographic and linked choice information for each employee. For demographics, this includes, e.g., information on job characteristics, income, age, and gender. For other choices, we observe, e.g., HSA participation and contributions, FSA participation and elections, and 401(k) contributions. These administrative data are similar to those recently used in the literature studying insurance provision at large self-insured firms (see, e.g., Einav et al. 2013; Carlin and Town 2010; or Handel 2013). These data, combined with individually-linked survey data, allow us to move beyond this work and study multiple additional micro-foundations that could impact both plan enrollment and consumer welfare.

The first column of Table 1 presents summary statistics for all employees present in all four years in the data from 2009–2012. There are 41,361 employees present in all four years, covering a total of 115,136 lives.[13] The employee population is heavily male (76.4 percent), young (49.7 percent less than 40 years old), and high income (50.7 percent less than $125,000 annually) relative to the general population. Twenty-three percent of employees are single, covering only themselves, with 19 percent covering a spouse only, and 58 percent covering at least a spouse plus a dependent. Mean total medical expenditures for a family was $10,191 in 2011. While the population we study is specific to our firm, implying the final numbers have limited external validity, we are particularly interested in the results insofar as this population seems more likely to have the education, resources, and cognitive skills to overcome information frictions.

A. *Health Insurance Choices*

Over the entire period 2009–2012, employees at the firm choose between two primary health insurance options, a PPO option with generous first dollar coverage and a HDHP with a linked HSA. We focus our analysis on the years 2011–2012 to match the time frame of our linked survey data.[14] The PPO option had the largest share of employees over time, and had been the primary health insurance plan for many years prior to the introduction of the HDHP option in 2009. Since the HDHP introduction, the firm has promoted the financial benefits of that plan to employees in order to incentivize employees to economize on potentially wasteful medical expenditures (while returning some of those savings in the process). For 2013, just

[13] This sample is about 80 percent of the size of the mean number of employees present in *each* year from 2009–2012. We present descriptives for this "full sample" as a baseline since this is the sample we use to estimate models with all employees, as described below. This sample also omits people who select the sparsely chosen HMO option that we exclude from the analysis.

[14] Depending on the location of the office within the United States, a subset of employees could also choose a health maintenance organization (HMO) option. Since approximately 5 percent of employees in the relevant locations choose this option (remaining steady over time) we exclude those who choose the HMO from our analysis and do not include the HMO option in our choice estimation.

TABLE 1

Sample demographics	Full sample	Survey recip. (weighted)	Survey resp. (weighted)
Number of employees	41,361	4,500	1,661
N_d: emp. and dep.	115,136	11,690	4,584
2011 PPO%	88.8	89.6	88.7
2012 PPO%	82.7	83.0	81.6
2011 HDHP%	11.2	10.4	11.3
2012 HDHP%	17.3	17.0	18.4
Gender (percent male)	76.4	76.8	75.6
Age (percent)			
18–29	8.6	14.9	11.6
30–39	41.1	43.8	42.7
40–49	38.1	32.7	34.1
50–59	10.9	7.7	10.5
≥ 60	1.3	0.9	1.2
Income (percent)			
Tier 1 (< \$75K)	2.7	2.2	2.2
Tier 2 (\$75K–\$100K)	10.1	13.1	14.0
Tier 3 (\$100K–\$125K)	35.3	38.9	37.9
Tier 4 (\$125K–\$150K)	30.5	29.6	31.3
Tier 5 (\$150K–\$175K)	12.0	10.8	10.0
Tier 6 (\$175K–\$200K)	4.7	3.5	2.9
Tier 7 (\$200K–\$225K)	2.0	1.0	0.9
Tier 8 (\$225K–\$250K)	0.7	0.1	0.0
Tier 9 (> \$250K)	0.8	0.1	0.0
Family size (percent)			
1	23.0	29.0	20.9
2	19.0	19.4	21.9
3+	58.0	51.6	57.2
Family spending			
Mean	\$10,191	\$8,820	\$11,247
Median	\$4,275	\$3,363	\$4,305
25th	\$1,214	\$878	\$1,176
75th	\$10,948	\$9,388	\$11,555
95th	\$35,139	\$32,171	\$41,864
99th	\$87,709	\$80,370	\$87,022

Notes: This table presents summary demographic statistics for the samples we study. The first column represents all employees who were present in our data and have complete records for at least eight months in 2009, 2010, and 2011, and the first month of 2012. The second column represents all employees who received our survey, regardless of whether or not they responded. The third column represents all employees who responded to our survey. Statistics from gender onward represent only 2011, and use the re-weighted statistics for the second and third columns, as described in the text.

past the end of our study period, the firm transitioned away from the PPO option and moved all employees previously enrolled there to the HDHP. Our counterfactual analysis in Section V studies the welfare implications of this change.

Table E1 (presented in online Appendix E) compares the important characteristics of both plans. The PPO and HDHP have substantial differences in financial characteristics (e.g., premium, deductible, out-of-pocket maximum, HSA benefits) but, conditional on these financial elements, are identical on all other key features. Crucially, the HDHP offers access to the same set of in-network providers and the same medical treatments (at the same total cost) as the PPO, both key inputs into plan value. This allows us to model relative consumer welfare from plan enrollment as a function of financial characteristics and subsequent risk exposure, rather than medical care differentiation. On the financial dimension, the PPO option is the simpler and more comprehensive of the two options in terms of cost-sharing: it has no in-network deductible, no in-network co-insurance, and no in-network out-of-pocket maximum. Alternatively, the HDHP has a substantial deductible equal to \$1,500 for individuals, \$3,000 for a couple (or parent and one child), and \$3,750 for a family. In that plan, once an employee spends an amount in excess of the deductible, he must then pay co-insurance of 10 percent of allowed costs for in-network providers and 30 percent for out-of-network providers until his total spending exceeds the out-of-pocket maximum—\$2,500 for individuals, \$5,000 for a couple, and \$6,250 for a family—at which point all expenditures are paid by the insurer.

The PPO plan charges no upfront premium while the HDHP provides an upfront subsidy equal to \$1,500 for an individual, \$3,000 for a couple, and \$3,750 for a family. This subsidy should be interpreted as the primary premium for the PPO relative to the HDHP.[15] The HDHP subsidy is deposited into the HSA linked to that plan and, thus, can be used for medical expenditures on a pretax basis in both the short run and the long run. If employees want to use these funds for nonmedical expenditures at any point in their lives, they can do so on a post-tax basis.[16] The linked HSA can also provide additional value to employees, above and beyond the subsidy, as employees can contribute their own funds pretax to the HSA, up to a maximum of \$3,150 for individuals and \$6,250 for all others (gross of the subsidy). Finally, in addition to the pretax benefits for medical expenditures, all HSA funds can be invested in a pretax manner over time, providing similar benefits to those of a 401(k) investment.

Figure 1 integrates all of these plan characteristics and depicts the financial returns to selecting the HDHP option relative to the PPO option for an employee in the family tier.[17] The x-axis plots realized total health expenditures (insurer + insuree) and the y-axis plots the financial returns for the HDHP relative to the PPO as a function of those total expenditures. The figure demonstrates that there is a unique level of total expenditure above which the PPO plan is valuable ex post relative to the HDHP. Furthermore, the maximum financial loss from choosing the HDHP is \$2,500.[18] Thus, for a family, the range of potential ex post relative value for the HDHP spans [−\$2,500, +\$3,750]. The figure illustrates how this range shifts up if consumers make valuable incremental HSA contributions. Using the underlying plan design framework depicted in this figure, we compute the share of employees whose total medical expenditures were below the break-even point in 2011, determining those who would have been ex post better off in the HDHP. If we assume consumers make 50 percent of the maximum possible incremental HSA contributions (close to what

[15] Throughout our analysis, we presume that consumers treat the subsidy as a relative premium, or relative difference in money between the plans, regardless of whether it represents a gain or loss from their baseline. It is worth noting that the subsidy in our context may be interpreted differently by consumers than if it were a premium (see, e.g., Kőszegi and Rabin 2006 or Kahneman and Tversky 1979) for work that illustrates this point).

[16] If they use these funds before 65 for nonmedical expenditures, they pay an additional tax penalty of 10 percent.

[17] The same general structure holds for couples and individuals, with shifts in the levels of the key plan terms.

[18] In a series of focus groups we conducted at the firm, the true magnitude of the maximum loss was particularly surprising to employees: many thought that the maximum financial loss in the HDHP would be larger.

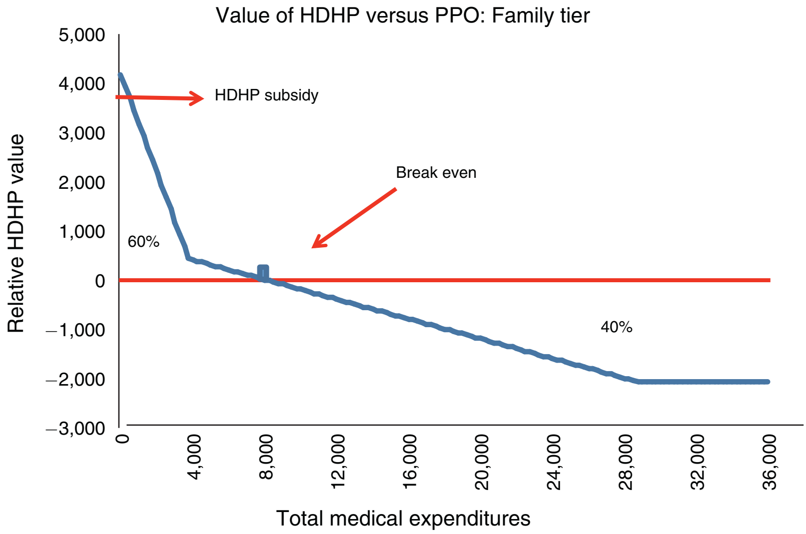

FIGURE 1

Notes: Description of HDHP financial value relative to the PPO in 2012, for the family tier, as a function of total medical expenditures. This chart assumes that employees contribute 50 percent of the maximum possible incremental amount to their HSA, near the median in the population. Sixty percent of all employees break even, given their respective coverage tiers.

is observed in the data) then 60 percent of employees would have been ex post better off in the HDHP.[19]

Despite the potential value that the HDHP provides for consumers, relatively few choose that plan. As Table 1 reveals, in 2011 11.2 percent of employees in the full sample chose the HDHP, while in 2012 17.3 percent did. The actual choice percentages are much lower than the ex post optimal percentages just described. This simple comparison suggests that consumers are choosing the PPO plan more than they "should" from either an ex post perspective or from a risk-neutral ex ante perspective. An obvious reason for this could be that consumers are risk-averse and value risk protection. Accordingly, the standard approach in the structural empirical literature would rationalize the observed choices by allowing for risk-averse consumers, with respect to financial risk.

Given the actual choices, a model where risk-aversion and health risk are the primary choice drivers yields very high estimates of risk aversion (see results in Section IV). This should not be surprising, given that consumers have limited financial downside risk in the HDHP while there are similar potential gains. Especially in light of the fact that about half of the employees in our sample earn over $125,000, high risk aversion with respect to purely financial risk seems to be an unsatisfactory explanation for the low proportion of employees choosing the HDHP. This low proportion could, however, also result from other factors that should matter for

[19] This analysis assumes a 35 percent marginal tax rate on income, near the average in the population. If we assume that all employees contribute the maximum amount to their HSA, 73 percent would have been better off in that plan ex post. Under the assumption that employees make no incremental HSA contributions, 35 percent would have been better off.

consumer choice in insurance markets, such as (i) a lack of information on plan features; (ii) a lack of information on the distribution of possible total medical expenditures; (iii) beliefs about nonfinancial attributes of the plan (i.e., time/hassle costs, physician networks, etc.); or (iv) actual differences in nonfinancial attributes of the plans (e.g., time/hassle costs). This paper focuses on understanding which of these potential alternative micro-foundations can help explain observed choice behavior, as well as their differential welfare implications relative to the traditional explanation of risk aversion.

B. *Survey Data and Design*

In order to develop measures of information frictions and beliefs about nonfinancial plan attributes (such as time and hassle costs), we developed a survey instrument. In this section we discuss the key features of the survey as it pertains to our main analysis. In addition, we discuss some of the limitations of using our survey to generate measures of information frictions and hassle costs. Online Appendix A contains a more detailed discussion of the survey questions and methodology.

Our survey instrument was designed in conjunction with both the Human Resources department and the Marketing and Communications department at the employer we study. The survey was administered by the firm's insurance administrator, a large private insurer, using a clear and simple to navigate online format (see online Appendix A for screen shots). The insurance administrator released the survey early in the calendar year of 2012, and it remained open for a period of two weeks, with reminders sent to the recipients just before the end of that period. The survey contained approximately 30 multiple choice questions. No incentive was given in the form of money or a prize to induce response. The survey was sent to 4,500 employees total, coming from three equal sized groups defined as (i) employees enrolled in the HDHP plan for both 2011 and 2012 ("incumbents"); (ii) new HDHP enrollees in 2012 (almost exclusively people who switched from the PPO); and (iii) those in the PPO plan in both 2011 and 2012.[20] Of the 1,500 initially contacted in each group, we received responses from 579 incumbent HDHP enrollees, 571 new HDHP enrollees, and 511 PPO enrollees, implying an average overall response rate of 38 percent.

The three survey cohorts were specifically designed to over-sample the HDHP population relative to the PPO population in order to assure enough sample size for the former and ensure sufficient statistical power. In our primary analysis, we re-weight both the survey recipients and survey respondents to reflect the actual plan choice composition in the market. This follows the econometric literature on re-weighting, which advocates re-weighting based on the dimension of explicit over-sampling (in our case plan choice). For a further discussion, see, e.g., Solon, Haider, and Wooldridge (2013) or Manski and Lerman (1977). Throughout our analysis, when we refer to our "primary sample," we mean this re-weighted sample of survey respondents (or recipients when relevant).

[20] Very few employees enroll in the HDHP in 2011 and switch to the PPO in 2012.

The last two columns of Table 1 present summary statistics for the randomly selected survey recipients as well as the total survey respondents (both re-weighted) and compares those samples to the full sample described in the first column. The different populations are, on the whole, quite similar on observable dimensions, mitigating sample selection concerns for the survey respondents sample. Comparing the survey respondents to both the recipients and to the full population reveals that the populations are very similar in terms of age, gender, income, and family size. The average spending is slightly higher among the respondents compared to the overall population, but, comparing spending at different points in the distribution, this appears to be a small effect that is driven by higher spending in the upper tail of the cost distribution for respondents, rather than systematically higher spending across this distribution.[21,22]

We designed the survey to contain only multiple choice questions in order to have a simple format where we could clearly interpret question answers.[23] Each multiple choice question was motivated by our desire to learn about a specific dimension of consumer information, experience, or decision-making as described in our model in Section I. Tables 2 and 3 summarize the primary questions used in our analysis and the responses from the survey population, broken down by cohort.

The questions focus on four major areas of the benefits choice. The first targeted area assesses knowledge of the financial features of benefit design in the HDHP. These questions target information frictions directly as they ask respondents to correctly answer questions about key features of the HDHP. Each respondent was asked to correctly identify the deductible, co-insurance rate, out-of-pocket maximum, HSA subsidy level, and tax benefits for HSA contributions from a set of options.[24] The second set of questions focused on a related source of information frictions: beliefs about plan attributes and medical expenditures. Respondents were asked whether the PPO or HDHP had any differences in the networks of providers available through each (recall they are identical). The survey also asked a set of questions to determine whether respondents were able to assess past medical expenditures and likely future medical expenditures. The third area of focus was on time and hassle costs associated with the HDHP. These included questions about the time and resources required to manage both the HSA and the HDHP (e.g., collecting and submitting receipts for care to be reimbursed from their HSA). In addition to directly eliciting beliefs about the time required, we asked questions about preferences for hassle in the HDHP. Finally, we asked a set of questions to ascertain the

[21] Of course, the respondents could differ on unobservable dimensions (such as knowledge or degree of interaction with health benefits). We discuss this issue in depth at the end of this section.

[22] We note that the survey recipients were selected at random from the entire population *after* removing a few thousand executive and top-level employees from the potential recipient pool. As a result, the recipient pool is slightly younger, slightly lower income, a little more likely to be single, and have slightly lower health care spending.

[23] We considered, e.g., including some belief elicitation or risk preference elicitation questions, but ultimately, together with the firm's Human Resources group, concluded we could best achieve our goals through transparent, information-based questions.

[24] Throughout the survey, much of our focus is on consumer information about and experience with the HDHP. An implicit assumption is that consumers have a similar amount of information about the simpler PPO option, and that, consequently, their answers to survey questions about the HDHP represent the relative difference in information about the HDHP and PPO. This could be thought of as assuming that everyone has close to full information about the PPO plan, which is likely reasonable since the plan design is extremely simple and the plan has been in place for many years. This assumption is supported by the questions we do ask consumers about the PPO.

Table 2—Responses to Plan Financial Characteristics Survey Questions (*Percent*)

Question	Correct	Incorrect	Not sure
1. What is the deductible under the HDHP?	27.08	22.40	50.53
HDHP: existing	52.68	11.23	36.10
HDHP: new	50.79	13.49	35.73
PPO	21.53	24.66	53.82
2. What is the co-insurance rate under the HDHP?	18.56	25.64	55.80
HDHP: existing	33.85	21.24	44.91
HDHP: new	29.07	21.37	49.56
PPO	15.66	26.61	57.73
3. What is the out-of-pocket maximum under the HDHP?	18.47	21.98	59.55
HDHP: existing	28.32	22.11	49.57
HDHP: new	31.87	18.91	49.21
PPO	15.85	22.31	61.84
4. How much is the employer HDHP subsidy?	31.42	19.94	48.64
HDHP: existing	73.40	11.05	15.54
HDHP: new	68.65	11.21	20.14
PPO	22.50	21.92	55.58
5. Do you get to keep HSA funds after the end of the year?	75.69	9.23	15.08
HDHP: existing	96.73	1.38	1.90
HDHP: new	94.22	1.75	4.03
PPO	71.23	10.96	17.81
6. How much is $1,000 worth in pretax dollars?	14.50	44.86	40.64
HDHP: existing	16.93	31.78	51.30
HDHP: new	15.76	42.73	41.51
PPO	14.09	46.58	39.33

Note: Exact wording of questions and answers in online Appendix A.

amount of effort that went into an employee's choice, the clarity of their beliefs about the plans, and their satisfaction with their choice.

C. *Frictions: Descriptive Evidence*

Before turning to our formal choice model, we present some descriptive results to demonstrate the potential importance of the frictions we study. There are clear patterns in the raw survey responses that are consistent with limited information, as well as time and hassle costs. Furthermore, answers to some survey questions have a strong gradient with respect to actual plan choices made, even after conditioning on measures of health risk.

Table 2 describes consumer responses to questions that target knowledge of health plan financial characteristics. A (slim) majority of employees who were enrolled in the HDHP were able to correctly identify their deductible in that plan. Only slightly more than 20 percent of employees who enrolled in the PPO could identify the deductible for the HDHP choice option. In fact, more PPO enrollees answered incorrectly than correctly, though the majority were "not sure." A similar pattern holds for the questions asking about the post-deductible co-insurance rate and the out-of-pocket maximum in the HDHP, though fewer respondents have information on these characteristics, relative to the deductible. Approximately 70 percent of HDHP enrollees know the premium difference between the two plans, linked to the

HSA subsidy, while only 20 percent of PPO enrollees do. Almost all HDHP enrollees know that HSA funds can be rolled over from year to year, while approximately 75 percent of PPO enrollees do. The answers to this question suggest that there is real information content in the survey question answers, as most PPO enrollees can answer this simple question regarding the HDHP correctly (rather than, e.g., "not sure"). Another pattern from Table 2 is that existing HDHP enrollees (enrolled in that plan for at least one year prior to 2012) have very similar answer proportions to new HDHP enrollees, who signed up for that plan just before the survey, suggesting that experiential learning may not be substantial.

Table 3 presents respondent answers to questions about nonfinancial plan characteristics. The first question asks how the doctors and medical services that can be accessed in-network compare across the two plans. Recall that the networks are in fact, identical on all dimensions for the two plans. If consumers believe that one plan provides access to higher quality doctors, or a greater range of medical services, this could have a significant impact on their plan choices, even though this should not impact their relative welfare between the two plan options conditional on actually enrolling in either plan. Forty-nine percent of incumbent HDHP enrollees, 41 percent of new HDHP enrollees, and 32 percent of PPO enrollees understand that one can access the same physicians in-network in both plans. Fifteen percent of PPO enrollees (who comprise most of the overall population) believe that the PPO provides greater access to physicians, compared to 3 percent and 4 percent in the HDHP populations. Similar shares of both groups believe the reverse or are "not sure." This level of incorrect and uncertain beliefs about a plan attribute that was both relatively straightforward to consider and emphasized in the information provided by the employer underscores the role of information frictions.

To better understand how important information about provider access is for explaining choices, Figure 2 studies plan choices as a function of respondent answers. The left panel presents the share of enrollees in the HDHP based on their answers to this question. It is clear that those who understood that medical access was the same were far more likely to select the HDHP: 23 percent chose that plan, compared to 6 percent among those reporting the PPO had a larger network and 17 percent among those answering "not sure." The right panel gives a sense of whether this relationship is caused by an underlying correlation between question answers and medical expenditures: it presents the optimal ex post choice based on actual 2011 expenditures. The figure indicates that a similar proportion of consumers should choose the HDHP across the survey question answer groups (between 30–40 percent with no incremental HSA contributions). This implies that the gap between the proportion of people who *should* choose the HDHP and those who *actually* do is much larger for those consumers who believe the PPO provides access to more physicians.

The second and third questions in Table 3 ask about consumers' expectations of and preferences for time and hassle costs stemming from plan administration and logistics (e.g., dealing with medical bills).[25] The hassle of dealing with paying for medical expenditures directly and being reimbursed is a potentially important

[25] The actual question asked to employees is presented in online Appendix A and is carefully worded so as to define what we refer to as time and hassle costs.

Table 3—Responses to Plan Nonfinancial Characteristics, Hassle Cost, and Medical Expenditure Survey Questions (*Percent*)

Question	Same	HDHP bigger	PPO bigger	Not sure			
7. How do the provider networks of the two plans compare?	34.52	6.04	12.46	46.98			
HDHP: existing	41.28	6.74	2.76	49.22			
HDHP: new	49.39	3.33	4.20	43.08			
PPO	32.09	6.26	14.48	47.16			
	None	< 1 hour	1–5 hours	6–10 hours	11–20 hours	> 20 hours	Not sure
8. How much time do you expect to spend in the HDHP?	1.76	5.99	21.73	17.40	12.88	24.92	15.34
HDHP: existing	5.18	19.17	46.11	17.62	5.53	6.39	—
HDHP: new	3.50	14.71	40.81	22.24	11.21	7.53	—
PPO	1.17	3.52	16.83	16.83	13.89	28.96	18.79
In the PPO?							
PPO	15.85	29.75	29.16	11.35	2.94	4.11	6.85
	Understand, not concerned	Accept, but concerned	Don't like, no matter what				
9. How do you feel about spending time managing your health plan?	14.82	42.52	42.65				
HDHP: existing	39.03	32.64	28.32				
HDHP: new	26.62	39.05	34.33				
PPO	10.76	44.04	45.21				
	Correct	Overestimate	Underestimate	Not sure			
10. How much was spent on you and your dependents in 2011?	36.66	29.81	23.31	10.22			
HDHP: existing	41.97	35.75	16.41	5.87			
HDHP: new	37.13	27.85	23.47	11.56			
PPO	36.01	29.35	24.07	10.57			
	Very confident	Somewhat confident	Not confident				
11. How confident are you in this estimate?	35.85	43.90	20.25				
HDHP: existing	38.34	49.22	12.44				
HDHP: new	30.11	46.13	23.77				
PPO	36.20	43.05	20.74				
	Yes	No	Not sure				
12. Do you think you will benefit/would have benefited from the HDHP in 2012?	16.49	58.35	25.16				
HDHP: existing	56.65	23.83	19.52				
HDHP: new	30.47	42.91	26.62				
PPO	10.37	63.99	25.64				

Note: Exact wording of questions and answers in online Appendix A.

nonfinancial attribute of the HDHP that might impact choice. The question on time and hassle cost expectations had seven multiple choice options, ranging from "none" to "> 20 hours" ("not sure" was also an option). The results point to a substantial difference in perception of the time required to deal with the HDHP among those enrolled in the HDHP compared to PPO enrollees. For example, 29 percent of PPO enrollees answer that they would expect to spend more than 20 hours on HDHP plan administration and logistics, while only 6 percent and 8 percent do in the two HDHP cohorts. This is despite the fact that only 4 percent of PPO enrollees believe

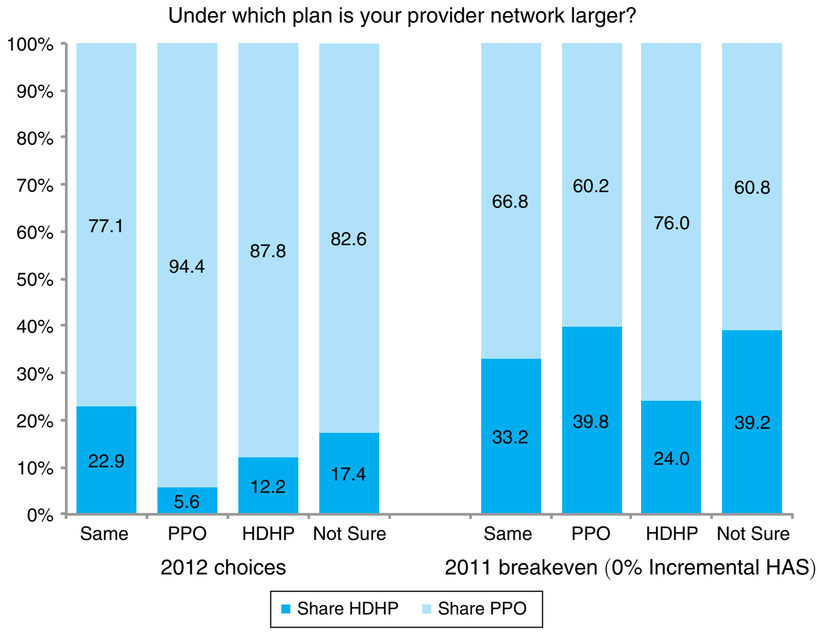

Figure 2. Actual versus Predicted Plan Choices by Knowledge of Plan Provider Networks

that the PPO plan leads to "> 20 hours" in time/hassle costs. It is interesting to note that new HDHP enrollees have quite similar beliefs about time and hassle costs as incumbent enrollees who had already experienced the plan, suggesting that the difference between HDHP and PPO enrollees is not due only to experience with the HDHP plan. The third panel in Table 3 demonstrates a strong relationship between plan choice and how accepting consumers are of the time required to deal with the plan hassle costs. Only 11 percent of PPO enrollees report not being concerned that they may need to spend time managing health care costs compared to 39 percent of existing HDHP enrollees.

Figure 3 studies plan choices as a function of time and hassle cost perceptions. There is a strong relationship between expected time/hassle costs and plan choices: as projected costs increase, consumers are much less likely to choose the HDHP. For example, 37.2 percent of consumers who expected to spend 1–5 hours on plan administration and logistics in the HDHP choose that plan, while only 5.1 percent of those who expect to spend > 20 hours on these activities choose that plan. We note that our measures of expected time and hassle costs could represent multiple micro-foundations. The right panel of Figure 3 reveals that the relationship between plan choices and projected time/hassle costs is due in part, but not fully, to correlation between expected time and hassle costs and medical utilization. The figure indicates that those who expect to have lower hassle costs also have lower expenditures and, thus, ignoring utility from those time/hassle costs, should choose the HDHP in higher proportions. However, the gap between these ex post optimal choices and actual choices becomes larger as expected time and hassle costs do, suggesting that differences in perceived time/hassle costs are only due in part to differences in medical utilization.

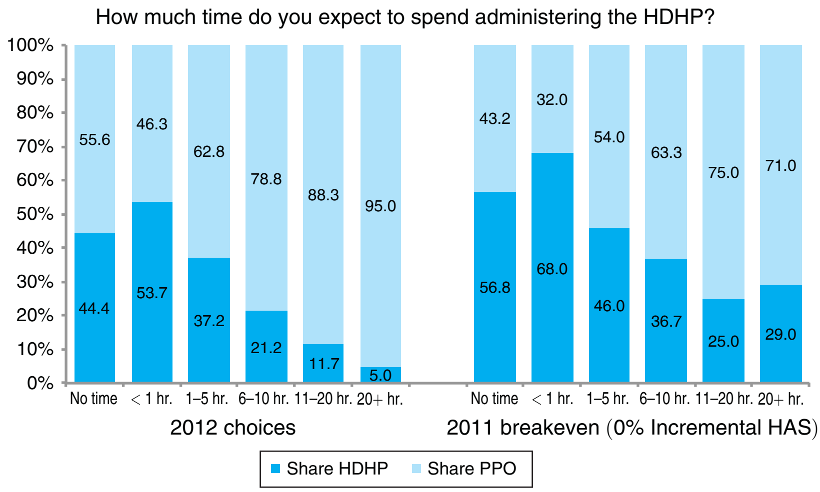

Figure 3. Actual versus Predicted Choices as a Function of Time and Hassle Cost Perceptions

Table 3 also presents the responses to questions asking about knowledge of total medical expenditures and knowledge of the tax benefits provided by an HSA. In order to understand out-of-pocket expenditure risk in the HDHP, it is necessary to understand total potential medical charges as well as plan characteristics such as deductible and co-insurance. We ask consumers to identify their amount of total medical spending for the calendar year 2011 (which had just ended at the time of the survey) and compare their answers to their actual total spending in that year. Consumers chose between the multiple choice options of \$0–500, \$501–2,500, \$2,501–5,000, \$5,000–10,000, and more than \$10,000. The table presents the results for whether consumers overestimate, underestimate, or correctly guess their expenditures for the past year. Overall, the proportions in each of these buckets does not change much by cohort. Across the three cohorts, 36–42 percent answer the question correctly, 29–36 percent overestimate their past expenditures, and 17–24 percent underestimate them. When we subsequently asked survey respondents to provide their confidence in their estimate of their past year total medical expenditures we find that the majority of respondents in each cohort reply that they are somewhat or very confident in their estimate. Thus, while it appears individuals are not well equipped to estimate their total expenditures in the past year, even to the level of expenditure buckets, people do not appear to recognize this lack of understanding.

It is also important to understand correlation patterns in the answers to these questions. If survey responses are highly correlated across a given subset of questions, this could suggest that there are certain "types" of consumers who have similar information content and choice frictions across these questions. Tables E2 and E3 in online Appendix E present the full correlation matrix for the responses to our primary questions of interest. Table E2 studies correlations between the responses to the questions on plan financial characteristics presented in Table 2. The correlation between these answers are fairly high. On the other hand, the degree of correlation is lower between responses to other questions, as shown in Table E3. This suggests that there is meaningful multi-dimensional heterogeneity across these frictions, and that modeling them in a disaggregated manner could be fruitful. In our upcoming empirical analysis, we examine several specifications, ranging from a disaggregated specification that includes most friction measures as distinct variables to a types specification that develops a one-dimensional information index for consumers.

D. *Survey Data: Limitations*

We believe that detailed survey data, linked to rich administrative data, can provide meaningful insights about information frictions and hassle costs, especially given that these factors are quite difficult to measure with administrative data alone. However, there are several important concerns to keep in mind when interpreting both our descriptive results just presented and the model-based results to come. These concerns reflect both specific aspects of our survey as well as more general issues typical of analysis with survey data.

A first concern is selection into answering the survey: the 38 percent of consumers who answered the survey may be systematically different than the 62 percent who did not. As noted earlier, Table 1 illustrates that those who answer the survey are similar on demographic and health dimensions to those who do not. While this is reassuring, selection on unobservable factors could still be an important concern. Consumers could select into the survey because they are more informed about health benefits, or because they perceive a lower degree of time and hassle costs in filling out a survey. If consumers who choose to answer are more well-informed than those who don't, our results should reflect lower bounds on the impact of information frictions. If the reverse were true, and answering the survey was correlated with lower information (say because those with low time costs of filling out the survey are less sophisticated) the survey data could overpredict the impact of frictions on choice. We cannot rule out this latter possibility: in general, it would be useful to get to offer a financial incentive for a random subset of consumers to answer the survey, to assess the degree of selection on unobservables.

A second concern is that consumers forget (or learn) information about a plan in between when they choose a plan during November 2011 and when our survey was administered at the beginning of the calendar year 2012. In the former case, if consumers forget information, they will seem less informed at the time of the survey than they were when they chose a plan (moreover, there could be selection into/out of the survey based on whether consumers remember plan features). This could be a general phenomenon or impact specific questions differentially; for example, it is unlikely that consumers would forget simple pieces of information (such as that there are identical provider networks) over a short time period but more likely they would forget more detailed contract characteristics such as a plan out-of-pocket maximum (though multiple choice answers facilitate recall). We cannot rule out this issue in any formal sense. One piece of relevant evidence is that there are strong positive correlations for answers to plan financial characteristic questions (shown in Table E2), suggesting that information on these more complex dimensions is more of an "all or nothing" proposition. Thus, consumers who answer the survey can be easily classified into informed or uninformed overall, and those classified as uninformed would had to have forgotten everything they know since open enrollment. Finally, we don't believe that the questions about time and hassle cost expectations should be markedly impacted by forgetting. We are less concerned about experiential learning though this could still be an issue. First, and most importantly, the survey was conducted near the beginning of 2012, indicating that experiential learning would have to occur mostly before new HDHP enrollees had much experience with that plan. Second, new HDHP enrollees exhibit similar information levels to existing enrollees, indicating that people with a full year of plan experience do not know much more than those who just signed up.[26]

A third potential issue is *confirmation bias* whereby consumers who enroll in a certain health plan are more likely to choose the answers that favor the attractiveness of that plan, validating their recent choices (see, e.g., Rabin 1998) for a richer discussion). Given that consumers had already made their plan choices at the time of the survey, confirmation bias in survey responses would lead to consumers who select the HDHP (PPO) choosing answers that confirm or validate their choices. For example, someone who chose the PPO might answer that they believe that plan has access to more physicians in-network due to confirmation bias. We note that confirmation bias *does not* have anything to do with search for information: if consumers who chose the HDHP were more likely to do research on the HDHP, and health plans in general, there is no issue since information set at the time of plan choice is exactly what we aim to capture. Though we cannot rule out the possibility of confirmation bias there is some evidence against it being a very strong factor in our analysis. For example, Table E3 in online Appendix E reveals limited pairwise correlations between an aggregated measure of plan financial characteristic knowledge, knowledge about provider networks, expected time and hassle costs, and knowledge of own past medical expenditures. This suggests that if confirmation bias were present, it would have to manifest on different dimensions for different consumers, which we believe is less likely than the case where it is present on similar dimensions across consumers. Since no evidence rules out confirmation bias in any formal sense, we discuss the remainder of this suggestive evidence in online Appendix E.

While we believe that the survey taken as a whole provides very useful signals about consumer information and hassle costs, these issues should be kept in mind throughout the analysis. We note that the "types" specification that aggregates consumer answers into a one-dimensional information index may be the more robust/preferred specification for readers concerned about these issues.

III. Empirical Framework

The analysis in the previous section provides evidence that information frictions are present for a variety of key choice dimensions and are correlated with consumers' health plan choices in a manner that implies more informed consumers are choosing plans that provide them more value. In this section, we develop a series of models that quantify the impact of information frictions, perceived hassle costs, and risk preferences on health plan choices.

[26] We note that experiential learning is not an issue for us if this learning occurred prior to or during the open enrollment period in 2011 since we use the survey measures as proxies for information and expectations at the time of plan choice: it can only be an issue if it occurs in between open enrollment and the survey administration.

In order to illustrate how the inclusion of information friction and hassle cost measures impact risk preference estimates, we start with a "baseline" model that includes just health risk, risk preferences, and health plan characteristics. We then add measures of information frictions and hassle costs derived from the linked survey using several different methodologies including (i) our "full" model, which includes disaggregated reduced form indicators of frictions and (ii) a "types" model that aggregates all information frictions into a one-dimensional index.[27] In addition to the specific estimates of risk preferences and frictions in the "full" and "types" models, which may be of intrinsic interest, the structural approach allows us to study how risk preference estimates are impacted by including additional factors that link to plan choices. The distinction between choices based on risk preferences and choices based on information frictions and perceived hassle costs is crucial to the welfare analysis discussed in Section V. While risk preferences impact both choices and welfare, a lack of information may be relevant for choices *given a menu of options* but may not impact actual welfare *conditional on enrollment in an option*.

A. *Baseline Choice Model*

The baseline model studies expected utility maximizing families who make active (non-inertial) choices and are fully informed about all health plan options. Consumer choices depend on (i) ex ante cost risk; (ii) risk preferences; and (iii) an idiosyncratic mean zero preference shock. We describe the baseline choice framework here *conditional* on our ex ante cost projections, which are estimated in a separate detailed medical cost model described later in this section and do not vary with the choice model specification. The model presented is the empirical analog to equation (1) in Section I.

Denote the family-plan specific distributions of out-of-pocket health expenditures output by the cost model as $F_{kj}(\cdot)$.[28] Here, $k \in K$ is a family unit, $j \in J$ is one of the two health plan options available at the firm in 2012. The baseline model assumes that families' beliefs about their out-of-pocket expenditures conform to $F_{kj}(\cdot)$. Each family has latent utility U_{kj} for each plan and chooses the plan j that maximizes U_{kj}. We assume that U_{kj} has the following von Neumann-Morgenstern (vNM) expected utility formulation:

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

Here, $u_k(\cdot)$ is the vNM utility index and s is a realization of out-of-pocket medical expenses from $F_{kj}(\cdot)$. W_k denotes family-specific wealth and x_{kj} represents consumption in a given state of the world (defined below). P_{kj} is the family-time specific premium for plan j. Formally, in our setting we define the premium $P_{k,HDHP}$ as

$$P_{k,HDHP} = -\left(HSA_k^S + \tau_k HSA_k^C\right).$$

[27] In addition, we estimate a more structural version of our full model that directly links information friction measures from the survey to structural beliefs in the consumer decision problem.

[28] Note that, as described in online Appendix B, the distribution F incorporates a family's distribution of total medical expenditures mapped through each nonlinear financial insurance contract.

HSA_k^S is the firm's subsidy to each employee's HSA when they enroll in the HDHP. HSA_k^C is the incremental contribution a family makes to the HSA, on top of HSA_k^S, when they sign up for the HDHP. The value of these contributions is equivalent to the value of pretax dollars relative to post-tax dollars, and thus depends on marginal tax rate τ_k.[29] Empirically, we model HSA_{kt}^C based on actual contributions made by those who sign up for the HDHP. This model yields a family-specific prediction of incremental HSA_k^C, denoted $\widehat{HSA_k^C}$, which is inserted into the model such that $P_{k,HDHP} = HSA_k^S + \tau_k \widehat{HSA_k^C}$. Online Appendix F discusses this model in detail.

Given this setup, we follow the literature and assume that families have constant absolute risk aversion (CARA) preferences implying that, for a given ex post consumption level x:[30]

$$u_k(x) = -\frac{1}{\gamma_k(\mathbf{X}_k^A)} e^{-\gamma_k(\mathbf{X}_k^A)x}.$$

Here, γ_k is a family-specific risk preference parameter that is known to the family but unobserved to the econometrician. We model this as a function of employee demographics $\mathbf{X}_k^A$. As γ increases, the curvature of u increases and the decision-maker is more risk averse. The CARA specification implies that the level of absolute risk aversion $\frac{-u''(\cdot)}{u'(\cdot)}$, which equals γ, is constant with respect to the level of x (and, thus, W_k).[31]

In our baseline empirical specification a family's overall level of consumption x conditional on a draw s from $F_{kj}(\cdot)$ is

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

Here, ϵ_{kj} is a family-plan specific idiosyncratic preference shock that is assumed to be mean zero in estimation. Subject to this model, families choose the plan j that maximizes U_{kj}.

There are several key assumptions in the baseline model. First, it assumes that families know the distributions of their future health expenditure risk F_{kj} and that this risk conforms to the output of the cost model described later in this section. This presumes that consumers (i) are fully informed about their own health risk, and (ii) fully understand the mapping between total health expenses and out-of-pocket expenses in each plan. The first assumption is violated if, e.g., families have private information about their health statuses that is not captured in prior claims data. Given our detailed individual-level claims data, we believe it is unlikely that there are many consumers with substantial private information in our data (we discuss this further below, in the context of the cost model). Conversely, given potential

[29] Incremental contributions to the HSA have value equal to $\tau_{kt} HSA_{kt}^C$ if at any point in the employee's life their family spends that money on health care. If they spend part or none of those incremental funds on health, then the value of these incremental contributions is lower. We do not incorporate the value of the HDHP as a tax-free investment vehicle explicitly.

[30] In addition to the reasons the literature assumes CARA risk preferences (such as simplicity) it is important for us to use CARA so that our analysis of adding information frictions is an "apples to apples" comparison to prior work.

[31] The measure for W_k would matter for an alternative model such as constant relative risk aversion (CRRA).

difficulties in projecting health risk and expenditures, families may have *less* information about these projections than the econometrician. This possibility, along with the possibility that consumers don't fully understand the health plan characteristics that determine out-of-pocket expenditures, is precisely the kind of issue that motivates the upcoming analysis of information frictions. Our full model, which incorporates our individually-linked survey data about plan and health risk knowledge, addresses a variety of ways in which consumers have limited information about potential out-of-pocket expenditures when choosing a plan.

Finally, the baseline model also assumes that plans are identical (up to mean zero idiosyncratic ϵ) on nonfinancial characteristics such as provider network and time/hassle costs. The former is factually correct, though the full model reveals that many lack this knowledge when choosing a plan. For time/hassle costs, we expect there to be differences between the two plans given their respective designs, something that the full model estimates bear out.

B. *Baseline Model With Inertia*

One important feature of the choice not captured in the baseline model is inertia. In our setting, if consumers take no action at the time of plan choice in 2012, they will be enrolled in the plan they chose previously as a default option. Prior work (e.g., Handel 2013 and Marzilli Ericson 2014) illustrates the inertia, defined as choice persistence not resulting from stable preferences, can have a substantial impact on the choices made and consumer welfare.

We incorporate inertia into the baseline model as an implied monetary cost of switching plans when a default option is present, similar in structural interpretation to a tangible switching cost. Inertia changes the baseline model by augmenting consumption x_{kj} as follows:

$$x_{kj} = W_k - P_{kj} - s + \eta(\mathbf{X}_k^B)\mathbf{1}_{j_t = j_{t-1}} + \epsilon_{kj}.$$

Here, η represents inertia and depends on observed demographic variables $\mathbf{X}_k^B$, which are described in more detail in the estimation section. $\mathbf{1}_{j_t = j_{t-1}}$ is an indicator for whether the plan you choose this year is the same as your incumbent plan. Apart from the inclusion of η the model with inertia is identical to the baseline model.

There are several assumptions in the model of inertia that warrant discussion. First, inertia is modeled as an incremental cost paid conditional on switching plans (following, e.g., Handel 2013; Shum 2004; or Dube et al. 2008). This implies that, on average, for a family to switch at t they must prefer an alternative option by \$$\eta$ more than their default. There are multiple potential underlying micro-foundations for inertia, each of which could correspond to an alternative model. In our setting, we identify the extent of inertia by comparing the relative value of health plan choices made by new employees, who make active plan choices with no default option, to similar existing employees who do have a default option. We return to identification in detail below.

Lastly, we note that information frictions could increase the extent of suboptimal plan enrollment through both lower quality active decisions and increased inertia. For our primary questions, we care about incorporating inertia into the model along with frictions to better identify risk preferences (as well as to compare our results to similar past work in the literature). Our counterfactual menu design analysis assumes a forced or active choice environment, so as long as non-inertial preferences are unbiased (e.g., risk preferences) our specific model for inertia does not matter for that analysis. Additionally, we are interested in understanding the link between inertia and information frictions. We analyze the extent to which information frictions proxy for inertia if inertia is excluded from the model below. In the model where both inertia and frictions are included, the friction estimates could be interpreted, with some caution, as the "active choice" impact of frictions above and beyond inertia.

C. *Full Model*

The baseline models, with or without inertia, resemble the models examined previously in the structural literature on health insurance markets. Our full model builds on this work by allowing for variation in both consumer information and perceived plan time and hassle costs. While the insight that these factors matter for consumer choice is not new, the ability to measure them and incorporate them into a model with risk preferences and health risk empirically is the central innovation of this paper. This is made possible in our setting because of the rich individually-linked survey, claims, and choice data.

There are a multitude of potential ways to incorporate measures of information frictions and hassle costs into our empirical choice model. These span the range from structural to reduced form. A fully structural approach would directly link friction measures derived from the survey to parameters from a model of decision-making under uncertainty subject to limited information. A reduced-form approach would include these measures as factors that impact plan valuations without linking them directly to the underlying decision model parameters. In our setting, there is an inherent tension between making additional structural assumptions and the extent to which we must rely on the data to represent specific theoretical parameters. For example, if a consumer incorrectly answers a multiple choice question about what the deductible in the HDHP plan is, we could use the information contained in the answer (e.g., how high or low they answer the deductible is) together with some fairly strong assumptions to estimate a parameter governing how this lack of information directly contributes to the uncertainty in out-of-pocket expenditures represented by $F_{kj}(\cdot)$. Alternatively, a reduced-form approach would estimate a shift in valuation for the HDHP plan, relative to the PPO plan, for those who are uninformed relative to those who are informed.

Our primary specification reduces the number of structural assumptions required and incorporates our survey data using a reduced-form approach (we also develop and estimate a more structural version, summarized at the end of this subsection and discussed in depth in online Appendix D). Using the data from our linked survey, we construct indicator variables for "informed," "uninformed," or "not sure" answers to each information-relevant survey question as well as variables derived from answers to questions about hassle costs and knowledge of own health expenditures. We include these variables as observable measures of consumer information and perceived hassle costs that imply shifts in value for the HDHP relative to the PPO.

For each friction, one category (corresponding to "no friction," i.e., "informed") is excluded so that the value shift for the HDHP plan is relative to a frictionless consumer for the measure in question. Specifically, each included friction variable, denoted Z_f from vector $\mathbf{Z}$, shifts the willingness to pay for each plan, x_j, by $\beta_f Z_f$, which is assumed constant across all potential health state realizations s from $F_j(\cdot)$:

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

Here, $\mathbf{I}_{HDHP}$ is an indicator variable taking on value of one if plan j is the HDHP plan. To illustrate this setup, if variable Z_1 is an indicator variable that equals 1 if a consumer is uninformed about his deductible, then β_1 measures the difference in willingness to pay for the HDHP plan, for an uninformed person, relative to an informed person. The coefficient β_1 is a reduced-form measure that represents the implications of an underlying model of choice under uncertainty with limited information, similar to that presented in Section I (and estimated in online Appendix D).

The full model includes 13 different variables derived from the survey in the vector $\mathbf{Z}$, not including the excluded "no friction" categories. These measures are:

- **Information about Plan Financial Characteristics** (**Questions 1–3 in Table 2**)**:** We construct a binary variable equal to 0 if a consumer knows the deductible, co-insurance rate, and out-of-pocket maximum for the HDHP and a value of 1 otherwise (implying they are at least partially uninformed). A second binary variable has value 1 when a consumer answers "not sure" to any of these financial characteristic questions, and 0 otherwise.[32,33]
- **Provider Network Knowledge** (**Question 7 in Table 3**)**:** The first (second) variable has value 1 if the consumer believes that one can access more providers/services in the PPO (HDHP). The third equals 1 if the consumer answers "not sure" to the question on relative provider access. The omitted case is correct knowledge that the plans provide equal access.
- **Information on Own Total Expenditures** (**Question 10 in Table 3**)**:** We use three indicator variables with values equal to 1 if consumers (i) overestimate; (ii) underestimate; or (iii) are not sure about their actual past expenditures. The omitted case is correct knowledge of past expenditures. We use this measure of past expenditure knowledge to proxy for over or underestimation of projected expenditures for the coming year (the relevant choice object).
- **Tax Benefits Knowledge** (**Question 6 in Table 2**)**:** We measure whether or not a consumer understands the tax benefits that a health savings account provides (its main advantage). The first variable equals 1 if the person answers this question incorrectly, while the second one equals 1 if the person answers "not sure." The omitted case is the one where the person understands the tax benefits of the HSA.

[32] We include the separate indicator for "not sure" versus "incorrect" because we believe these answers could be indicative of different types of misinformation.

[33] It is important to note that, in this specification, the true deductible, co-insurance, and out-of-pocket maximum enter into the calculation of a consumer's rational expectations health distribution F, and that the coefficient on these indicator variables is a reduced-form way to reflect a departure from that distribution. See the more structural model in online Appendix D for a model that integrates question answers directly into perceptions of F.

- **Time and Hassle Costs (Questions 8–9 in Table 3):** The first measure, Z_{HC}, equals the midpoint of the multiple choice option chosen for perceived time spent on HDHP logistics and administration. Thus, if family k answered that they expected to spend "6 to 10 hours" on these activities in the HDHP, $Z_{HCk} = 8$. The second variable equals $Z_{HC} \times \mathbf{I}_D$ while the third equals $Z_{HC} \times \mathbf{I}_C$. Here, $\mathbf{I}_D = 1$ if someone states that they "strongly dislike" spending time on plan logistics/administration while $\mathbf{I}_C = 1$ if they answer they are "concerned about but accept" some time spent on these activities. For preferences, the answer "don't care about" time spent on these activities is omitted, implying that the coefficient on just Z_{HC} represents the implied time and hassle costs for people with those stated preferences. See Section II for an extended discussion.

In addition to estimating the full model described here we estimate a series of models that each include only one of the above frictions, implying five such "incremental" models. The estimates from these models can be compared to those from the baseline models to see how risk preference estimates are impacted by the inclusion of one additional factor.

For a fully informed individual with no perceived hassle costs the full model with all friction measures reduces to the baseline model (with inertia). Identification and estimation of the full model requires a set of assumptions. First, we assume that risk preferences γ are independent of friction measures $\mathbf{Z}$. Intuitively, this could be violated in either direction. If consumers that are more risk averse give more effort to acquire information, γ will be positively correlated with better information. Conversely, if more sophisticated consumers are generally less risk averse, but acquire information more effectively, this correlation will be negative.[34] As described in the estimation section, we do estimate risk aversion as a function of demographics like age, gender, and income, but this only partially reduces the impact of this assumption. Under this assumption, the choices of fully informed consumers formally identify risk preferences separately from the impact of information frictions for the entire population. If this assumption is violated, then the choices of both informed and uninformed consumers matter for our risk preference estimates, which could be biased in either direction depending on the correlation between risk preferences and our friction measures.[35] If our friction measures capture higher (lower) risk aversion for uninformed consumers, our coefficients can be interpreted as upper (lower) bounds on the true coefficients.

The full model also assumes that frictions shift utility by the same amount for all potential realizations of health expenditures from F. This could be violated if, for example, someone who believes the PPO plan grants access to more providers

[34] Note here that if consumers have concave utility with respect to uncertainty about plan features (e.g., deductible) this is a different type of risk aversion than that measured by γ. We are concerned with estimating γ, which is risk aversion with respect to out-of-pocket medical expenditures, which insurance is inherently intended to address. We are happy to include the impact of risk aversion with respect to plan characteristics in the coefficients β, since, if forced to enroll in a given plan, we believe this should not be a welfare relevant component of utility, since it does not actually impact marginal utility in good and bad states of the world.

[35] We note that a model that conditions risk preferences on $\mathbf{Z}$ would be identified but would substantially increase the number of parameters and, thus, the complexity of the model. Including these correlations would best be done in the "types" model described shortly, where risk preferences could depend on the one-dimensional information index.

believes that lack of access in the HDHP will decrease utility specifically in states where he has a bad health shock. To the extent that this decreases utility for the HDHP *conditional* on risk preferences, we believe that this is appropriately captured in the friction effects β. Since the distribution of risk F is input directly from the rational expectations cost model, both perceived state-contingent risk from frictions and risk aversion with respect to that risk will be captured together in β, as long as risk preferences and our friction measures are independent. This is true because, in that case, risk preferences are the same for those with and without frictions and β captures the total willingness to pay difference between these groups. If that independence assumption is violated, the presence of state-contingent friction effects would impact risk preference estimates.[36]

We do not explicitly model correlations between frictions $\mathbf{Z}$ and inertia η. Depending on the underlying model for inertia, the causal link between inertia and frictions could run in either direction: either inertia leads to a lack of search, and, thus, a lack of information, or, conversely, a lack of clear information provision creates an environment of uncertainty that perpetuates the status quo. In our setting, rather than condition η on $\mathbf{Z}$ and substantially increase the number of parameters, we examine the link between frictions and inertia by estimating the full model with and without inertia. In the model where both inertia and frictions are included, the friction estimates could be interpreted, with some caution, as the "active choice" impact of frictions above and beyond inertia. In the model without inertia but with frictions, friction estimates also generally capture the extent to which frictions can proxy for inertia.[37]

In addition to the full model described in this subsection, we also develop and estimate a specification that structurally integrates consumer answers to questions about plan financial characteristics as precise objects in the consumer decision problem. As discussed earlier, there is an inherent tension between posing survey questions that are simple for consumers to understand and questions that link clearly to subtle choice foundations in an economic model. Though this more structural version of the full model requires making stronger assumptions about how to interpret survey answers, we believe that it provides a useful robustness check on our primary estimates and illustrates how one could integrate survey data in a more structural manner. Section IV presents the main findings of this specification while online Appendix D presents and discusses this model, and its results, in detail.

[36] In addition, the model does not capture correlations between health risk and risk preferences. While prior work (e.g., Cohen and Einav 2007 and Einav et al. 2013) has illustrated this can be important, especially when thinking about questions related to adverse selection, our primary objective is to estimate shifts in the level of risk preferences when additional frictions are incorporated. Therefore, we are only concerned about this assumption to the extent that it impacts estimates of this level (though there could be some welfare implications if there is such a correlation).

[37] This approach works because, in 2011, approximately 85 percent of consumers enroll in the PPO plan so the β coefficients can also be thought of as generally indexing the non-default plan when inertia is explicitly excluded. When we present our results in Section IV, we show both that information frictions are strong proxies for inertia and that the explicit model of inertia does not have a major impact on the implications for risk preferences estimates in the presence of information frictions.

D. *Types Model*

The full model examines the impact of each specific friction measure on choices and on risk preference estimates. Given that we use survey data, rather than administrative data, to measure these frictions, there may be some concerns about how to interpret each survey question or how consumers answering the survey interpret each question. To address this, we also estimate a "types" model that maps the set of disaggregated information frictions described in the last section into a one dimensional index that captures the overall level of information in our environment for a given consumer. This analysis should be more robust; even if there is concern about the interpretation of one or two friction measures, the one dimensional index that aggregates these measures should reflect a measure of each consumer's level of information. We expect that the change in risk preference estimates when information types are included, relative to the baseline model, will be similar to those in the full model. The types model is also intrinsically interesting both to understand the distribution of types in the population and to see if there is a strong positive relationship between the overall level of consumer information and choice quality. See, e.g., Chetty et al. (2012) for an example of this kind of types analysis in the context of retirement decisions.

We construct our primary type measure as an index that simply adds up the number of information related questions about plan choices that a given consumer gets correct. We use all of the disaggregated frictions in $\mathbf{Z}$ described in the prior section, excluding hassle costs measures, which we still include in the model as a separate friction from the type index.[38] We include each of the financial plan characteristic measures (deductible, co-insurance, out-of-pocket maximum) as separate components, and add two additional measures related to (i) consumer information about the HDHP subsidy and (ii) knowledge about how the HSA compares to the FSA (these measures come from questions 4 and 6 in Table 2).

Denote the set of information friction measures going into the type index as $\mathbf{Z}'$. Then the information index q_k is defined

$$q_k = \Sigma_{Z_f \in \mathbf{Z}'}(1 - Z_f).$$

Here, to be consistent with the notation in the full model, when $Z_f = 1$ this implies a lack of information for a given friction. So, $q_k = 0$ for a completely uninformed consumer and $q_k = 8$ for a completely informed consumer, since we include eight information related friction measures. Figure 4 plots the distribution of q for the sample of survey respondents. The figure reveals that the distribution of types is skewed toward uninformed, but with substantial heterogeneity and a non-negligible mass of highly informed consumers. In online Appendix E we also investigate an alternative information type index q_k' that weights correct answers by the proportion of other consumers who are uninformed (rewarding consumers for degree of difficulty).

[38] Time and hassle costs are an important friction to include in all models, but do not have a natural fit into a one dimensional type index with information frictions since they are a distinct type of friction.

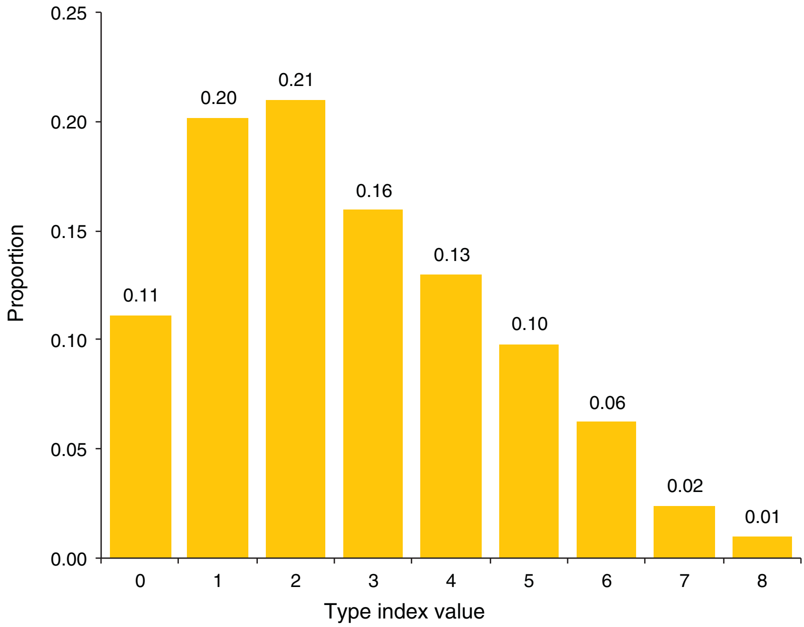

Figure 4. Histogram of Information Type Index q for the Sample of Survey Respondents

The empirical choice model with types is similar to the full model, with the type index replacing the disaggregated frictions. For simplicity, we divide the types q into quartiles ranging from least to most informed.[39] Denote the set of indicator variables, excluding the most informed quartile, as $\mathbf{Q}$. Then, the model for money metric utility in each health state s is

$$x_{kj} = W_k - P_{kj} - s + \eta(\mathbf{X}_k^B)1_{j_t = j_{t-1}} + \mathbf{Q}_k' \beta_Q \mathbf{I}_{HDHP} + \mathbf{Z}_{k,THC}' \beta_{THC} \mathbf{I}_{HDHP} + \epsilon_{kj}.$$

Here, the relative utility for the HDHP plan is shifted across all potential health state realizations s by $\mathbf{Q}'\beta_Q$. The set of time and hassle costs measures used in the full model is denoted here as $\mathbf{Z}_{THC}$ and enters the model exactly as before. We note that extensions to the full model, such as correlations between risk preferences and frictions, are more easily captured in the types model, where friction heterogeneity is described in a more parsimonious manner.[40]

E. *Cost Model*

The empirical choice framework, for all the specifications presented, takes the distribution of future out-of-pocket expenditures for each family, $F_{kj}(\cdot)$, as given. This section summarizes the empirical model we use to estimate $F_{kj}(\cdot)$, which closely follows the approach used in Handel (2013). Online Appendix B presents a

[39] Given that q_k is discrete, the division into quartiles is not exact but approximates true quartiles.

[40] In online Appendix E we consider robustness with respect to different representations of the index q, such as sextiles or including the index as constructed without dividing consumers into quartiles.

more detailed description of the model, its estimation algorithm, and its results. The cost model here is intended to estimate the full information, ex ante distribution of out-of-pocket expenditures for each family. Our empirical models account for limited information on F by incorporating survey responses.

Our approach models health risk and out-of-pocket expenditures at the individual level, and aggregates to the family level since this is the relevant metric for plan choice. For each individual and choice period, we model the distribution of future health risk at the time of plan choice using past diagnostic, demographic, and cost information. This ex ante approach to the cost model fits naturally with the insurance choice model where families make plan choices under uncertainty. The model has the following primary components:

(i) For each individual and open enrollment period, we use the past year of diagnoses (ICD-9), drugs (NDC), and expenses, along with age and gender, to predict mean total medical expenditures for the upcoming year. This prediction leverages the Johns Hopkins ACG software package and incorporates medically relevant metrics such as type and duration of specific conditions, as well as co-morbidities.[41] We do this for four distinct types of expenditures: (i) hospital/inpatient; (ii) physician office visits; (iii) mental health; and (iv) pharmacy.

(ii) We group individuals into cells based on mean predicted future utilization. For each expenditure type and risk cell, we estimate a spending distribution for the upcoming year based on ex post observed cost realizations. We combine the marginal distributions across expenditure categories into joint distributions using empirical correlations and copula methods.

(iii) We reconstruct the detailed plan-specific mappings from total medical expenditures to plan out-of-pocket costs. We combine individual total expense projections into the family out-of-pocket expense projections used in the choice model, F_{kj}, taking into account family-level plan characteristics.

The cost model assumes that there is no private information and no moral hazard (total expenditures do not vary with j). While both of these phenomena have the potential to be important in health care markets, and are studied extensively in other research, we believe that these assumptions do not materially impact our results. Both effects are likely to be quite small relative to consumers' total relative valuations of the two plans. Because our cost model combines detailed individual-level medical utilization data with sophisticated medical diagnostic software there is less room for private information than in prior work: additional selection based on private information is more unlikely than it would be with only coarse demographics or aggregate health information to measure health risk.[42] To address the question

[41] For example, a 35-year-old male who spent \$10,000 on a chronic condition like diabetes in the past year would have higher predicted future health expenses than a 35-year-old male who spent \$10,000 to fix a time-limited acute condition, such as a broken arm.

[42] Pregnancies, genetic predispositions, and non-coded disease severity are possible examples of private information that could still exist. Cardon and Hendel (2001) find no evidence of selection based on private information

of moral hazard, we perform a robustness analysis that incorporates elasticity estimates from the literature (see, e.g., Chandra, Gruber, and McKnight 2010) into our cost model. The results show the moral hazard impact is small relative to the overall difference in consumers' plan valuations and thus does not markedly impact our parameter estimates.

F. *Identification*

Identification of the empirical parameters in each model is relatively straightforward given the individual-level linked claims data, choice data, and survey data combined with the maintained assumptions. For the baseline model, inertia, information frictions, and time and hassle costs are assumed away and it is assumed that consumer beliefs about future expenditures correspond to the output of the cost model F_{kj}. Subject to F_{kj}, a family's choice in each year identifies a range of feasible risk preferences. In our estimation, described in the next section, we assume a parametric form for the population distribution of risk preferences (conditional on demographics), which leads to point identification of this distribution. The distribution of risk preferences is identified separately from the distribution of ϵ because risk preferences imply a specific relationship between the mean and variance of F and choices, while ϵ is orthogonal to F. This is similar to how risk preferences are identified throughout the literature (see, e.g., Cohen and Einav 2007; Einav et al. 2013; Handel 2013; or Einav, Finkelstein, and Levin 2010 for a survey).

For the baseline model (and full model) with inertia, we separately identify inertia from risk preferences by comparing new employees, who must always make "active" plan choices when they arrive, and existing employees who have a default option of their previously chosen plan if they take no action. Since this model assumes no additional frictions, it assumes that the two groups are identical on those dimensions. Together with the assumption that the distribution of risk preferences in the population is identical for both groups, conditional on observable heterogeneity, the distinction between new and existing employees identifies inertia separately from risk preferences. Intuitively, choices from active employees identify risk preferences conditional on demographics, and the differences between their choices and those of similar looking existing consumers identify inertia. Table E4 in online Appendix E describes the sample of 2,339 new employees for 2011 and repeats statistics for the full population from column 1 of Table 1 for comparison. New employees are slightly more likely to choose the HDHP, likely to be younger, likely to have lower income, and more likely to be single. Importantly, new employees span the ranges of age, gender, and income seen in the full population with non-negligible mass, such that estimates of preferences based on observable heterogeneity can credibly be extrapolated from one group to the other.

with coarser data while Carlin and Town (2010) use similarly detailed claims data and also argue that significant residual selection is unlikely. With similarly detailed data, Handel, Hendel, and Whinston (2013) implement a test that identifies the combined presence of selection on private information and moral hazard in the spirit of the correlation test proposed in Chiappori and Salanié (2000). They find that plan choice is not predictive of future health expenses, conditional on rich observable data. Importantly, it is also possible that individuals know *less* about their risk profile than we do, which we address to some extent with survey data in our full model.

Identification of the full model directly follows the fact that our friction measures are observable variables combined with the assumptions that our friction measures are independent of (i) risk preferences and (ii) inertia, conditional on demographics. See the description of the full model earlier in this section for an extended discussion of these assumptions. Under these assumptions, the decisions of frictionless consumers identify risk preferences, under the baseline model assumptions on beliefs about the distribution of out-of-pocket expenditures. Then, the β coefficients on friction measures are identified by comparing the decisions and relative full information plan valuations for consumers with a given friction relative to otherwise identical consumers without that friction (a similar logic holds in the types model). As discussed earlier, if the assumption that risk preferences and frictions are independent is violated, but we maintain that assumption for estimation, then risk aversion could be over or under estimated depending on the true correlation between risk preferences and frictions. Identification between the factors contained in the baseline model (risk preferences and ϵ) is the same here as discussed earlier in the context of that model.

We also note that, if the impact of frictions is correlated with expected medical spending (or other moments of F), then this could also impact risk preference estimates in the full model. In that case, risk preference estimates in the full model could reflect these unmodeled interactions, and, in turn, how those interactions manifest in less informed consumers, relative to more informed consumers (whose choices identify risk preferences). To assess whether this is an issue, we estimate a version of our baseline model with inertia only for the most informed consumers, with information type $q \geq 4$. The results of this exercise are presented in Table E6 in online Appendix E and validate the assumption that risk preferences in the full model can be identified based on the choices of the most informed consumers: the distribution of risk preferences in the baseline model with inertia for informed consumers is similar to that in the full model, and different than that in the baseline model with all consumers.

G. *Estimation*

In the primary implementation for each model we assume that the random coefficient γ_k for risk preferences is normally distributed with a mean that is linearly related to observable characteristics $\mathbf{X}_k^A$:[43]

$$\gamma_k\left(\mathbf{X}_k^A\right) \rightarrow N\left(\mu_\gamma\left(\mathbf{X}_k^A\right), \sigma_\gamma^2\right)$$

$$\mu_\gamma\left(\mathbf{X}_k^A\right) = \mu + \delta \mathbf{X}_k^A.$$

In the primary specifications $\mathbf{X}_k^A$ contains employee age, gender, and income. We assume that the family-plan specific error terms ϵ_{kj} are i.i.d. normal for each j with zero mean and variance σ_{ϵ_j}. We normalize the value of ϵ_{PPO}, the preference shock

[43] We assume that γ is truncated just above zero, at 10^{-15}, though this is generally nonbinding.

for the PPO plan, to zero and estimate the preference shock variance of the HDHP relative to that of the PPO.

We assume that the inertia term, $\eta(\mathbf{X}_k^B)$ is related linearly to demographics $\mathbf{X}_k^B$,

$$\eta(\mathbf{X}_k^B) = \eta_0 + \eta_1 \mathbf{X}_k^B.$$

$\mathbf{X}_k^B$ includes income, age, gender, and family insurance coverage tier dummies (corresponding to single, plus one dependent, or two or more dependents).

Our primary estimation sample is the re-weighted survey respondent population described in Section II and in column 3 of Table 1. Due to the limited sample of new employees in the survey respondent sample (approximately 100 consumers), we estimate inertia in a first-stage model with the full population of employees and then use these estimates of $\eta(\mathbf{X}_k^B)$ as our inertia parameters in the full models.[44] Denote the estimates of inertia from this first-stage model as $\eta\left(\widehat{\mathbf{X}_k^B}\right)$. We estimate the friction models incorporating $\eta\left(\widehat{\mathbf{X}_k^B}\right)$ into consumer utility as follows:

$$x_{kj} = W_k - P_{kj} - s + \eta\left(\widehat{\mathbf{X}_k^B}\right)\mathbf{1}_{j_t = j_{t-1}} + \mathbf{Z}_k' \beta \mathbf{I}_{HDHP} + \epsilon_{kj}.$$

It is important to note that the results on how risk preferences estimates (and subsequent welfare implications) change with information frictions are robust to how inertia is incorporated: we show this by comparing the full model results with and without inertia, described in Section IV.

All specifications are estimated with a random coefficients simulated maximum likelihood approach similar to that summarized in Train (2009). This approach simulates many values for the random coefficients γ and ϵ, given proposed parameters for those distributions, and searches for the parameters that optimize the fit between the choices predicted by the models and the actual choices made. No simulation is necessary for coefficients related to inertia, which are estimated based on observable heterogeneity, nor the coefficients for information frictions and hassle costs, which are linked directly to the observable survey data. Since the estimation algorithm is similar to a standard approach, we describe the remainder of the details in online Appendix C.

IV. Results

Table 4 presents the parameter estimates for our primary models of interest, for the re-weighted sample of survey respondents, our primary sample of interest. For risk preferences, in addition to providing the estimated CARA parameters, the table also provides a simpler interpretation for expositional purposes. The row labeled "Gamble Interpretation of Average μ_γ" presents the value X that makes a consumer indifferent between the status quo (accepting no gamble) and accepting a gamble where he wins \$1,000 with 50 percent chance and loses \$$X$ with 50 percent chance. Thus, if $X = 1{,}000$, the average consumer is risk neutral, whereas if $X = 0$, the

[44] As in the baseline model with inertia, this approach in the full model requires the assumption that new employees have the same distribution of information frictions and hassle costs as existing employees.

Table 4

Primary model estimates Model	Base (1)	Base + inertia (2)	Full model (3)	Structural information (4)
Average μ_γ	$1.6 \cdot 10^{-3\dagger}$	$2.3 \cdot 10^{-4}$	$8.6 \cdot 10^{-5\dagger}$	$4.9 \cdot 10^{-5\dagger}$
SD μ_γ	$3.1 \cdot 10^{-4\dagger}$	$3.6 \cdot 10^{-5}$	$1.4 \cdot 10^{-5\dagger}$	$6.16 \cdot 10^{-6\dagger}$
Gamble interp. of average μ_γ	366.74†	812.61	920.47†	952.89†
σ_γ	$1.8 \cdot 10^{-3\dagger}$	$1.6 \cdot 10^{-4}$	$2.2 \cdot 10^{-9\dagger}$	$5.8 \cdot 10^{-6\dagger}$
Total SD γ	$2.0 \cdot 10^{-3\dagger}$	$1.7 \cdot 10^{-4}$	$1.4 \cdot 10^{-5\dagger}$	$8.5 \cdot 10^{-6\dagger}$
σ_ε, HDHP	149.23	5.01	0.11	0.13
Benefits knowledge:				
Any incorrect		—	98.04	—
Any “not sure”		—	−467.48	—
Time cost hrs. X prefs:				
Time cost hrs:		—	−9.72	−12.31
X accept, concerned		—	−118.15**	−195.11**
X dislike		—	−128.98**	−220.38**
Provider networks:				
HDHP network bigger		—	−594.38	−1,424.55
PPO network bigger		—	−2,362.85**	−4,513.65**
Not sure		—	−201.81	−567.00
TME guess:				
Overestimate		—	62.98	1,178.21**
Underestimate		—	−208.30	−1,175.57
Not sure		—	−688.91	−1,552.80**
Average survey effect	—	—	−1,787.40**	−3,022.12**
σ survey effect	—	—	1,303.64	2,617.07
Likelihood ratio Test stat versus (2)	—	—	379.54	—

Notes: This table presents the estimates for our primary models of interest described in the text, plus a more structural version of the full model, described in more depth in online Appendix D. Column 1 presents the baseline model results (health risk, risk preferences) while column 2 presents the results for the baseline model with inertia. Column 3 presents the results of our full model, which includes all information frictions and hassle costs, as described in Section III. Column 4 presents the results of the full model that treats responses to information-related questions structurally. Standard errors for all parameters presented in online Appendix E.

†Point estimate outside of 95 percent CI for same parameter in model (2).

**95 percent CI for parameter does not include 0.

average consumer is infinitely risk averse. In what follows when we refer to “gamble interpretation” we are referring to this value of X. Bootstrapped standard errors for all parameters are provided in Tables E11–E15 in online Appendix E. The methodology for computing these standard errors is presented in detail in online Appendix C.

Column 1 presents the results from the baseline model that estimates risk preferences and health risk alone. The results reveal that the average consumer has what seems like a high degree of risk aversion with $X = \$366.74$ being the amount this consumer would be willing to lose to be just indifferent about accepting the hypothetical gamble.[45] Risk aversion is slightly increasing in age and income, and is

[45] In describing the results, when we refer to “high” or “low” risk aversion this is both relative to the other estimates in this paper and relative to other estimates in the literature. It is well known that interpreting specific

slightly higher for female employees than for male employees: only the age effect is distinct from zero given the 95 percent confidence bounds.[46] We estimate substantial unobserved heterogeneity in the risk preferences with σ_γ approximately equal to the average μ_γ.[47] This unobserved heterogeneity becomes much smaller as we move to the full models with information frictions, time/hassle costs, and inertia, suggesting that unobserved heterogeneity in γ may be capturing information that we measure directly in our survey data. The standard deviation of ϵ is rather small at 149.23, suggesting that unobserved heterogeneity is captured primarily in the risk preference estimates.

Column 2 in Table 4 presents the results for the baseline model with inertia.[48] The estimates illustrate the substantial impact of incorporating inertia on risk preference estimates: the "gamble interpretation" for the average consumer is $X = 812.61$ (with 95 percent CI [733.63, 864.68]) suggesting that, once inertia is accounted for, the implied level of consumer risk aversion is much lower than that from the baseline model. As in the baseline model, employee age is negatively related to risk aversion, significant at the 95 percent level, while female and income are also negatively related but with effects small in magnitude and statistically indistinguishable from zero. Notably, σ_γ is now much lower in the model with inertia relative to the baseline model as it is approximately 60 percent of the much lower average μ_γ. Thus, incorporating inertia (with observable heterogeneity) also explains much of the heterogeneity in risk aversion estimated in the baseline model, foreshadowing the effect of including additional friction measures on risk preference heterogeneity.

Column 3 in Table 4 presents the results for our primary specification, the full model that includes all friction measures.[49] The coefficient estimates on each friction can be interpreted as the average impact of each for choice-relevant valuations. Consumers who believe that the PPO plan has a larger network of medical providers value the HDHP by \$2,326 less than someone who correctly knows that these plans grants the same access (significantly different from 0, 95 percent CI upper bound of $-$\$1,286). Those who underestimate their own total medical expenditures for the past year value the HDHP by \$208.30 less than those with correct information while those who overestimate their expenditures prefer the HDHP by \$62.98 relative to the fully informed (counter-intuitively). Though the point estimates are wrong signed they are not statistically different from zero. Interestingly, those who answer "not sure" to this question value the HDHP by \$688.91 less on average: this may reflect

risk aversion parameters as "high" or "low" can be tricky because the economic and welfare implications of those estimates change with the nature of the specific gamble in question. The welfare results in Section V are the true indicators of the economic consequences of our estimates.

[46] Parameter estimates for observable heterogeneity in risk aversion are presented in Table E5 in online Appendix E.

[47] This implies that there is approximately a 30 percent mass of risk neutral consumers in the model, given that the normal distribution for γ heterogeneity is truncated at 0.

[48] Table E5 in online Appendix E presents the results for the baseline model with inertia for the full population. The estimates reveal that the average amount of money foregone in plan choice due to inertia is \$2,396 with a population standard deviation of \$503 based on observable heterogeneity. Figure E1 in online Appendix E presents a histogram showing the distribution of estimated inertia in the population as a function of observable heterogeneity. We incorporate these inertia estimates into the models for our primary sample of interest, as discussed in Section III.

[49] Table E7 in online Appendix E presents results from the incremental friction models where we add friction measures one at a time.

the fact that those who answer "not sure" have a deep lack of information that causes them to choose the PPO, though there are other potential micro-foundations for this.

Those who answer any of the three main questions on HDHP financial characteristics incorrectly actually prefer the HDHP by \$98.04 relative to those who get all of these questions correct, while those who answer "not sure" to any of these questions have $-$\$467.48 lower relative average valuations. These effects also have fairly wide 95 percent CIs that include zero. It is important to note here that while frictions with respect to total medical expenditure knowledge and plan financial characteristic knowledge both have imprecisely estimated coefficients near zero in the full model, in the incremental models the coefficients for these frictions are negative and large in magnitude, implying a distaste for the HDHP as expected. This suggests that these frictions do imply lower utility for the HDHP plan on their own, but, are overpowered by the other friction measures present in the full model.

Finally, stated time and hassle cost quantities and preferences have a substantial impact on choices. For *each* additional stated hour of time spent on plan billing, administration, and logistics, a consumer with a strong dislike for hassle costs values the HDHP by \$138.70 less. If a consumer "accepts but is concerned about" time and hassle costs, they value the HDHP by \$127.87 less per stated hour. These are relatively precise estimates: the upper bounds on the 95 percent CIs for these coefficients are $-$\$79.74 and $-$\$65.51, respectively. For the median individual in the sample, who expects to incur between six and ten hours of time and hassle costs, this implies (taking the midpoint of eight hours) a \$138.70 $\times$ 8 $=$ \$1,109.60 drop in utility for the HDHP plan if they state they have a strong dislike for hassle costs. Reassuringly, those who state that they are "not particularly concerned about" time and hassle costs have a coefficient estimate of \$9.72 less per stated hour which is statistically indistinguishable from zero.

For risk preferences, in the full model we estimate a mean gamble interpretation of $X = 920.47$, lying well above 864.68, the upper bound of the 95 percent confidence interval for the baseline model with inertia. Moreover, the estimate of σ_γ (and the total standard deviation in γ, reflecting observed and unobserved heterogeneity) is substantially reduced relative to the baseline inertial model, suggesting that the heterogeneity estimated in the baseline model proxies for these unobservable frictions. These results demonstrate that, at least in our setting, having the linked survey data to proxy for information frictions and hassle costs has a economically meaningful and statistically significant impact on estimated risk preferences. Specifically, this lower degree of estimated mean risk aversion μ_γ in the full model, together with the lower estimated unconditional variance of γ (presented in Table 4) imply a higher welfare impact of the forced switch of all consumers to the HDHP studied in the next section, relative to the case where the baseline model estimates are used.[50]

[50] For the incremental models presented in Table E7 in online Appendix E, which add one friction measure at a time, the mean "gamble interpretations" are $X = 895.35$ for the model with plan financial characteristic frictions, 852.14 with total medical expenditure frictions, 890.42 with provider network/medical access frictions, and 891.16 with time and hassle cost measures included. Except for the model that incorporates total medical expenditure frictions, all incremental models have gamble interpretations for the average consumer that lie outside the 95 percent confidence interval for that estimated in the baseline model with inertia. These models, discussed in more detail in online Appendix E, illustrate how survey data on even one or two questions can be valuable additions to typical administrative datasets.

The bottom rows of the table provide the average and standard deviation of the total effect of frictions on HDHP valuation for consumers in the data, relative to a perfectly informed consumer. Aggregating over all friction measures and estimated coefficients, in the full model the average impact of these frictions on HDHP willingness to pay is $-\$1,787$ with a standard deviation of 1,303.64. Thus, on average, frictions shift people toward choosing the simpler PPO option.[51]

Column 4 presents the results for the full model specification that links question answers about plan financial characteristics to structural beliefs about plan-specific premiums and out-of-pocket expenditures (this model is summarized in Section III and described in detail in online Appendix D). While this model requires stronger assumptions than our primary specification in terms of how it interprets the survey answers, it provides a useful robustness check on our primary estimates and illustrates how one could integrate survey data in a more structural manner. Estimated mean risk aversion in this model yields a mean gamble interpretation of $X = 952.89$, lying well above the upper bound of the 95 percent confidence interval for the baseline model with inertia (and just above that upper bound for our primary full model estimates). The unconditional variance of γ is also smaller in this structural specification relative to the full model estimates (about 60 percent as big). Overall, these results imply a slightly larger impact of including our additional friction measures on risk preference estimates, and, in turn, the welfare loss from additional risk exposure studied in Section V. This model continues to include questions about provider network information and time and hassle costs in a nonstructural manner: the coefficients are similar in spirit to those in our main specification, and larger in magnitude (potentially reflecting the fact that consumers perceive the money at stake in the plan decision to be larger than it actually is). See online Appendix D for an extended discussion of these results.

Table 5 presents the results of the types models (standard errors are presented in Table E13). The first two columns repeat the baseline model with inertia and the full model for comparison. Reassuringly, the primary types specification estimates, shown in the third column, imply similar implications for frictions as the full model. The average consumer "gamble interpretation" in the main types model is $X = 930.64$, which is similar to $X = 920.47$ for the full model and, crucially, falls well outside the upper bound of the 95 percent CI for the baseline model with inertia. The coefficients on time and hassle costs (which are separated from information frictions in the types model) are also similar in both the full model and the types model. The second most informed quartile has an average \$1,158 disutility for the HDHP compared with the most informed consumers (top quartile), with values of \$3,547 and \$6,803 for the third and fourth most informed quartiles respectively (for the least informed quartile, very few consumers choose the HDHP). The 95 percent CIs for each quartile do not overlap with each other. The average effect of frictions on HDHP utility is $-\$3,056$ with standard deviation 2,299 both somewhat larger that these figures for the full model (resulting from the high negative coefficient on

[51] The incremental models presented in online Appendix E illustrate the impact that including one friction measure has on this average willingness to pay. Moving through the incremental models to the full model, the link between the average survey effect and average risk aversion level is apparent: the stronger the mean impact of the frictions the lower the estimated risk aversion.

Table 5

Aggregated information types and hassle costs Model	Base + inertia (2)	Full model (3)	Types unweighted (5)	Types weighted (6)
Average μ_γ	$2.3 \cdot 10^{-4}$	$8.6 \cdot 10^{-5\dagger}$	$7.4 \cdot 10^{-5\dagger}$	$8.9 \cdot 10^{-5\dagger}$
SD μ_γ	$3.6 \cdot 10^{-5}$	$1.4 \cdot 10^{-5\dagger}$	$1.6 \cdot 10^{-5\dagger}$	$1.1 \cdot 10^{-5\dagger}$
Gamble interpretation	812.61	$920.47^\dagger$	$930.64^\dagger$	$917.83^\dagger$
σ_γ	$1.6 \cdot 10^{-4}$	$2.2 \cdot 10^{-9\dagger}$	$4.9 \cdot 10^{-6\dagger}$	$2.1 \cdot 10^{-8\dagger}$
Total SD γ	$1.7 \cdot 10^{-4}$	$1.4 \cdot 10^{-5\dagger}$	$1.7 \cdot 10^{-5\dagger}$	$1.1 \cdot 10^{-5\dagger}$
σ_ε, HDHP	5.01	17.70	0.07	1,929.25
Unweighted information index[a]				
Lowest quartile	—	—	−6,803.50**	—
Second quartile	—	—	−3,547.10**	—
Third quartile	—	—	−1,158.95**	—
Weighted information index[a]				
Lowest quartile	—	—	—	−3,655.12**
Second quartile	—	—	—	−1,928.53**
Third quartile	—	—	—	−49.46
Time cost hrs. X prefs:				
Time cost hrs:	—	−9.72	−3.09	−33.55
X accept, concerned	—	−118.15**	−119.99**	−101.22**
X dislike	—	−128.98**	−140.73**	−107.20**
Average survey effect	—	−1,787.40**	−3,056.91**	−2,597.91**
SD survey effect	—	1,303.64	2,299.06	1,785.42
Likelihood ratio	—	379.54	596.38	707.63

Notes: This table presents the results from the "type" models that aggregate our measures of information frictions into one-dimensional indices that describe the level of information an individual has. Section III in the text describes our two type measures "unweighted" and "weighted" in more detail. The last two columns in the table present the type models, while the first two columns, for comparison purposes, restate the results from Table 4—of (i) the primary model with inertia but no frictions and (ii) the full model. The overall implications for how risk preference estimates change are similar with the types models and the full models, suggesting the type measures are a good representation of underlying heterogeneity in information frictions. Moreover, as expected, the more informed types make "better" choices on average and are more likely to value the high-deductible plan appropriately. Standard errors for all parameters presented in online Appendix E.

[a] Omitted category is the fourth quartile, i.e., the most informed consumers.

† Point estimate outside of 95 percent CI for same parameter in model (2).

** 95 percent CI for parameter does not include 0.

the least informed types). The last column in the table provides a robustness check with a different type index that gives more credit for questions that are difficult to answer for others (described in more detail in online Appendix E). The results from this model for risk preferences are similar to those from the primary types model. Both types models have very high *LR* test statistics relative to the baseline model with inertia (as do our full model specifications).

The results for the full models just discussed incorporate inertia estimates from the first-stage model. Table E8 in online Appendix E examines a model that includes friction measures without the first-stage inertia estimates to (i) examine robustness of the risk preference results with respect to the inertia estimates, and (ii) better understand the links between friction measures and inertia. The results, presented in the third column of Table E8, imply similar mean risk aversion to our primary specification, with a "gamble interpretation" of $X = 914.40$ for population mean risk aversion. This illustrates the robustness of our results on risk preferences to the underlying model of inertia; whether we include first-stage estimates or allow frictions to proxy for inertia, the implications for risk preferences, and our counterfactual welfare analysis, are similar. The average impact of all survey effects in this model is −\$3,356 (SD \$1,707), approximately \$1,600 less than that from the model with first-stage inertia estimates. This suggests the our friction measures are good proxies for inertia in our environment. The impact on specific frictions is quite interesting: excluding the first-stage inertia estimates substantially increases the impact of both plan financial knowledge measures and total medical expenditure knowledge measures, while moderately impacting other estimates. This suggests that these two frictions are the most tightly linked to inertia.

Online Appendix E provides some additional robustness analyses, including an investigation of placebo variables derived from the survey and from our administrative data. These analyses verify that risk preference estimates are generally unchanged when including measures that we think should not be predictive of plan choice or utility.

Taken together, the results across the estimated models reveal our friction measures both enhance choice predictions and impact risk preference estimates. Additionally, the estimates shed light on which frictions may be most important to consumers choosing health insurance. The change in risk preference estimates as a result of including frictions directly impacts welfare analysis and the investigation of counterfactual insurance allocation policies, which we now turn to.

V. Policy Analysis: Welfare Impact of Forced HDHP Switch

Whether consumer choices are driven by risk preferences or the frictions we measure has important implications for market regulation and consumer welfare. We illustrate this by studying the impact of a counterfactual that allocates all consumers in our sample to the HDHP, essentially removing the PPO option from the choice set. Broadly speaking, the purpose of this analysis is to examine the implications of exposing consumers to additional risk, via insurance regulation, when risk aversion is estimated with and without the additional data on frictions that we measure. If risk preference estimates change a lot once additional signals of consumer information and time and hassle costs are included in the data, then the welfare implications of exposing consumers to additional risk will also change a lot. From a public policy perspective, regulation that impacts consumer risk exposure is ubiquitous, with a leading example being the Affordable Care Act (ACA) which legislates the actuarial equivalence values (degrees of cost sharing) that private insurance companies can offer to consumers (Kaiser Family Foundation 2011). In addition to investigating the welfare consequences of additional risk exposure from these differing risk preferences estimates, we also study how these differing estimates can impact an insurance regulation decision that trades off risk protection and moral hazard, as in e.g., Zeckhauser (1970).[52]

[52] It is important to note that this counterfactual analysis studies a forced choice, or direct allocation of consumers to plans, rather than the case where consumers choose from a new menu of plans (such as in, e.g., Grubb and Osborne 2015). In general, because our models estimate structural risk preference parameters but include our

More specifically, this analysis is directly relevant to our setting, as the firm we study actually implemented this policy and removed the PPO option from consumers' choice sets in 2013. This analysis thus highlights the welfare implications of our estimates for the firm's decision to switch more than 40,000 employees into the HDHP. Further, this kind of decision is now common in employer-provided insurance: Towers Watson (2014) discusses how large employers have increasingly pursued this "full replacement" strategy over time, whereby all existing plan options are replaced with a high deductible plan. This study shows, for example, that from 2010 to 2014 enrollment in HDHPs increased from 15 percent to 33 percent. The percentage of firms *only* offering HDHPs is projected to increase to 30 percent in 2015, up from 16 percent in 2014.

We investigate the welfare impact of allocating all consumers to the HDHP plan using the estimates from (i) the baseline model; (ii) the baseline model with inertia; and (iii) the primary specification of our full model that includes all frictions measures (column 3 in Table 4). For robustness we also examine the full model with no inertia (in online Appendix Table E8).[53] Across these models, the primary drivers of welfare, conditional on enrollment, are risk preferences and ex ante distributions of health risk.[54] A key distinction for the full model relative to the baseline models is that the inclusion of information friction measures causes a meaningful change to risk preference estimates *without themselves impacting welfare conditional on enrollment*. Information frictions thus generate a wedge between the demand curve and the welfare-relevant valuation curve which our full model is able to measure (see, e.g., Spinnewijn 2012 or Bernheim and Rangel 2009) for an extended discussion of such welfare distinctions). We now turn to a detailed discussion of our welfare model and the assumptions necessary to conduct welfare analysis in our context.

A. *Welfare*

We analyze welfare using a certainty equivalent approach that equates the *welfare-relevant* expected utility for each potential health plan option, U_{kj}, with a certain monetary payment Q_{kj}. For the baseline models Q_{kj} solves

$$\widehat{U_{kj}}(\gamma_k, \epsilon_{kj}, F_{kj}(\cdot)) = u(Q_{kj}) = -\frac{1}{\gamma_k(\mathbf{X}_k^A)} e^{-\gamma_k(\mathbf{X}_k^A)(W-Q_{kj})}.$$

The certainty equivalent loss Q_{kj} makes a consumer indifferent between losing Q_{kj} for sure and obtaining the risky payoff from enrolling in j. This welfare measure translates the expected utilities, which are subject to cardinal transformations, into

measures of information frictions in a reduced-form manner, our estimates can be directly applied to investigate consumer welfare losses from risk exposure for a given allocation of consumers to plans but require additional assumptions to study choice and welfare when consumers can choose between counterfactual plan menus. This implies that, e.g., our estimates do not have specific implications for questions like how many plans should be offered in a market, but do have implications for, e.g., what the level of risk exposure regulators allow insurers to offer.

[53] Since the analysis studies movement from a menu offering to a forced choice, inertia is only relevant insofar as it impacts estimates of risk preferences and other welfare-relevant factors when included in the choice model.

[54] Note, in a more general context where provider networks are not the same across plans, differences in provider/treatment coverage would also matter.

values that can be interpreted in monetary terms. In our setting, since Q_{kj} is a certainty equivalent loss, lower values of Q_{kj} are better from the consumer perspective. For example, $Q = 0$ implies full insurance with no premium while $Q > 0$ implies some cost sharing or premium. For the baseline models, when consumers are forced to join the HDHP, the change in Q coming from the PPO reflects the interaction between risk preferences and the changes in out-of-pocket expenditure risk and plan premium. All choice utility is welfare-relevant in this setup. The mean consumer welfare impact of a policy that forces all consumers into the HDHP is

$$\Delta CS = \frac{\Sigma_K [Q_{k\hat{j}} - Q_{k,HDHP}]}{K}.$$

Here, $Q_{k\hat{j}}$ is the certainty equivalent loss for the plan consumer k chooses to enroll in the true environment, while $Q_{k,HDHP}$ reflects the certainty equivalent loss when enrolled in the HDHP.

The full model with information frictions and time/hassle costs necessitates a more subtle framework. We define $\mathbf{Z}_W$ as subset of frictions that have tangible welfare implications conditional on enrolling in the HDHP and $\mathbf{Z}_{\overline{W}}$ as the complementary subset that do not. For the full model, we construct the welfare-relevant valuations for the different plans by setting the coefficients on $\mathbf{Z}_{\overline{W}}$, $\beta_{\overline{W}}$, equal to 0. These factors thus impact choice utility through $\beta_{\overline{W}}$ but not welfare, driving a wedge between these two quantities. The full model certainty equivalent of enrolling in plan j is

$$U_{kj}(\gamma_k, \epsilon_{kj}, F_{kj}(\cdot), \mathbf{Z}_W) = u(Q_{kj}) = -\frac{1}{\gamma_k(\mathbf{X}_k^A)} e^{-\gamma_k(\mathbf{X}_k^A)(W - Q_{kj})}.$$

Here, U_{kj} represents the welfare-relevant valuation for consumer k in plan j computed exactly as U_{kj} in Section III but setting non-welfare-relevant coefficients to zero.

While theoretically straightforward, a crucial issue is to determine which frictions are included as welfare-relevant conditional on HDHP enrollment. We believe that, for most of the micro-foundations, there are fairly clear arguments going in one direction or the other. The primary factors in the baseline models, risk preferences and health risk, are clearly welfare-relevant.[55] For our friction measures, we assume that all information frictions are non-welfare-relevant conditional on enrollment. For example, a lack of knowledge about relative provider access, plan financial characteristics, or own total medical expenditures impacts choices ex ante, but, conditional on enrollment in the HDHP, this lack of knowledge does not impact the *actual* ex post financial risk faced by consumers in a classical expected utility sense. In essence, we assume that the welfare-relevant utility (or utility conditional on enrollment) is that of a perfectly informed consumer that faces traditional uncertainty with respect to medical expenditures. These assumptions could be violated

[55] We also follow convention and assume that idiosyncratic preferences ϵ are welfare-relevant, though these estimates are small in magnitude so this assumption doesn't impact the analysis in any substantial way.

if, e.g., a lack of information about the deductible or the provider network impacts ex post health care consumption.[56,57]

The most challenging friction to do welfare analysis with is perceived time and hassle costs. If stated time and hassle costs in the HDHP relative to those in the PPO represent true time and hassle costs, then these should be welfare-relevant. Conversely, if the stated measures represent a lack of information about time and hassle costs in the HDHP, and the true values are similar to those in the PPO, the stated measures should not be welfare-relevant: once enrolled in the HDHP a consumer would not actually experience these costs. The analysis in Section II suggests that at least part of the high stated HDHP hassle costs are from perceptions rather than true differences. To deal with this issue in the counterfactual analysis, we compute the welfare impact of the forced switch for two scenarios: (i) stated time and hassle costs are full welfare-relevant and (ii) stated time and hassle costs are non-welfare relevant.[58]

B. *Results*

For our analysis of the counterfactual policy forcing all consumers to switch to the HDHP, we keep all characteristics of the HDHP constant such that the plan is exactly as in our observed environment. In addition to cost-sharing financial characteristics, this means that we hold the premium constant and don't examine endogenous re-pricing due to a different profile of population health risk. There are two motivations for this. First, we want to highlight the welfare implications for risk protection of incorporating rich data on information frictions and time/hassle costs, without adding a second dimension of endogenous re-pricing. Second, when the firm actually switched all consumers to the HDHP in 2013, the plan premium and financial characteristics remained constant (we could in principle examine counterfactuals where consumers are allocated to plans with other financial characteristics). Our counterfactual analysis focuses on our primary sample (re-weighted survey respondents) and presents the results of the policy change only for the 83 percent of the population that actually chose the PPO, since the welfare change is zero by construction for those who originally chose the HDHP.

The top half of Table 6 presents the welfare results for the policy that removes the PPO option from the choice set and forces all consumers to enroll in the HDHP (standard errors are presented in Table E16 in online Appendix E).[59] It presents the mean and distributional implications for this welfare impact for the baseline models (with and without inertia) and the full model (with and without inertia). In addition,

[56] Given generally low estimates in the literature of the price elasticity of medical expenditures, it is likely such ex post responses would not have a major impact on total ex post utility, implying that lack of knowledge on financial dimensions is not likely to markedly impact ex post behavior.

[57] When included in the model, we also assume that knowledge about HSA tax benefits are also non-welfare relevant, though this is a case where it is plausible that this friction could also impact ex post behavior, by causing the consumer to place less money into the HSA. Given the small magnitude of this coefficient, this assumption does not have a major impact on our results.

[58] The case where time and hassle costs are not welfare-relevant could also represent a counterfactual scenario where relative plan hassle costs are reduced to zero.

[59] The welfare estimates presented here for the full models are those that do not include stated time and hassle costs as welfare relevant. See the discussion earlier in this section, the results when these costs are considered welfare relevant in online Appendix E, and the descriptive analysis in Section II for an extended treatment of this issue.

Table 6

Forced HDHP enrollment welfare analysis Model	Mean	SD	25th	Median	75th	95th
Baseline model, no inertia	−1,237.61	851.31	−1,833.91	−1,422.06	−694.33	288.57
Baseline model	−874.46	975.27	−1,691.54	−953.03	−238.38	793.72
Full model, no inertia	−788.33	1,021.62	−1,651.19	−866.79	−109.89	971.53
Full model	−788.94	1,021.47	−1,653.4	−867.61	−114.01	968.42
Structural frictions	−741.75	1,060.47	−1,596.03	−804.55	−2.51	1,115.76
Risk neutral	−726.09	1,056.82	−1,622.6	−791.78	−24.150	1,120.93

Moral hazard necessary to justify switch	Elasticity lower bound	Elasticity upper bound
Baseline model, no inertia	0.280	0.407
Baseline model	0.197	0.286
Full model	0.178	0.258
Risk neutral	0.164	0.237

Notes: The top half of this table presents the welfare impact of a menu redesign that removes the PPO option and forces all consumers into the HDHP. The welfare results are presented for each of five different models to illustrate the impact of incorporating inertia, information frictions, and hassle costs on top of a basic model with health risk and risk preferences. The bottom half of the table illustrates, for each potential underlying model, the minimum consumer price elasticity of demand for medical expenditures that can generate enough cost savings to justify the forced switch to the HDHP.

we present the welfare implications of the reallocation under the assumption that all consumers are risk neutral. This is a useful benchmark that represents the best case welfare scenario in terms of risk protection for consumers moving into the HDHP from the PPO, given the specific plan designs and that consumers are not risk seeking.

The baseline model, where consumers are estimated to be more risk averse, predicts a mean welfare loss of $1,237 from the forced switch, with a population standard deviation of $851. The baseline model with inertia predicts a mean loss of $874 with standard deviation $975. The difference demonstrates that controlling for inertia, even without additional frictions measures, is an important component of preference estimation in our setting. The full model with inertia predicts a mean consumer surplus loss of $788 with standard deviation $1,021, while these values are $741 and $1,060 respectively for the model with structural frictions. Finally, if consumers are all risk neutral the mean loss is $726. Since the different consumer surplus estimates across the models come primarily from differences in risk preference estimates, it is interesting to consider the welfare losses under each model relative to the risk neutral case. The full model predicts $62 lower consumer surplus than the risk neutral case, while the baseline model with inertia predicts a $148 relative loss, almost two-and-a-half times as large as that from the full model (the baseline model without inertia difference is $511).[60]

Figure 5 provides a graphical representation of the distributional welfare results contained in Table 6. It presents the welfare results for the 5th, 10th, 25th, 50th, 75th, 90th, and 95th quantiles in the population, for each model. The baseline model curve represents demand in an inertial setting, the baseline model with inertia curve

[60] The median losses from the forced switch are $1,422 and $953 in the baseline model and baseline model with inertia respectively. This loss is $868 for the full model with inertia, $867 for the full model without inertia, and $791 with risk neutral consumers. The ranking of the welfare loss remains the same for all four models across all of the quantiles examined.

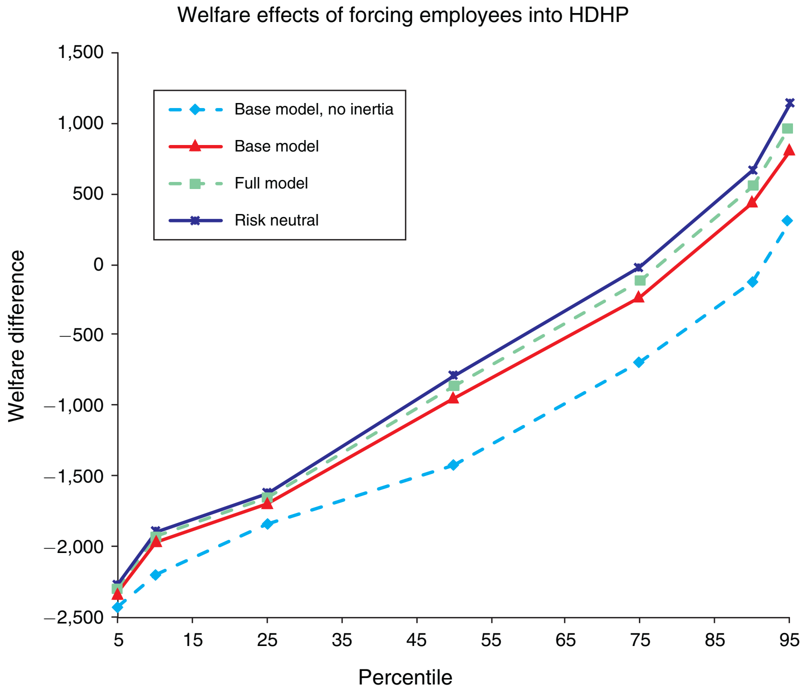

Figure 5

Notes: This figure plots quantiles of the welfare impact of the forced HDHP switch for each of the four models presented in Table 6. The results for both the types model and the full model with no inertia are not included because they heavily overlap with those from the full model presented here: the full model line is a very close representation of the results for each of those models.

represents demand in an active choice setting, and the full model curve represents welfare-relevant valuation conditional on enrollment. The figure reveals both that there are substantial distributional implications of the forced switch (not surprising given underlying heterogeneity in health risk) and that incorporating our additional friction measures drives a clear empirical wedge between demand and the welfare-relevant valuation of the HDHP relative to the PPO. Additionally, the similarity between the full model results with and without inertia suggests that (i) our friction measures do an excellent job of proxying for inertia when it is excluded and (ii) that our welfare conclusions in the full model are robust to the inclusion of inertia estimates from the administrative data.

C. *Risk Protection and Moral Hazard*

One motivation for the firm to switch to the HDHP is to incentivize consumers to reduce wasteful medical expenditures. More generally, this is an underlying reason that many large firms cite when moving employees into high-deductible health plans (see, e.g., Towers Watson 2014).[61] In order to illustrate the implications of

[61] An additional, off-cited, reason is the desire of large firms to avoid the "Cadillac Tax" included in the Affordable Care Act (ACA) that taxes plans with high average costs.

our results from the perspective of a policymaker, or a firm's HR head, we analyze the minimum necessary amount of moral hazard to justify the forced shift to the HDHP. In this calculation, the benefit of reduced wasteful medical expenditures is weighed against the cost of forcing consumers to bear more risk exposure (see, e.g., Zeckhauser 1970).

We implement this analysis by calculating the implied savings from reduced wasteful medical expenditures across a range of potential consumer price elasticities of medical expenditures. The analysis does not take a stance on what this elasticity is but instead is intended to find the *minimum elasticity* such that, for any elasticity above that minimum, switching everyone into the HDHP is socially optimal.[62] Since the different models we estimate predict different consumer welfare losses, due to different risk preference estimates, they also require different minimum elasticities to justify the full switch to the HDHP. As the consumer welfare loss from the forced HDHP switch predicted by a given model becomes larger, a larger price elasticity is necessary to justify that policy.

We calculate the cost savings from reduced medical expenditures in the HDHP due to consumer price responsiveness as follows:

$$\Delta TC = \frac{\Sigma_K \mu_{F_{k,HDHP}}}{\Sigma_K \mu_{TME_{k,HDHP}}} \times \frac{\Sigma_K \mu_{TME_{k,HDHP}}}{||K||} \times \xi.$$

Here, ΔTC represents the average reduction in total medical expenditures from forcing those enrolled in the PPO to switch into the HDHP. The first fraction measures the mean consumer out-of-pocket price of medical expenditures in the HDHP: this equals 34.9 percent in our setting and is computed as the average proportion of expenditures paid in the HDHP if consumers had the same total expenditures as in the PPO. μ_{TME_k} denotes mean predicted total medical expenditures for family k for 2012 while $\mu_{F_{k,HDHP}}$ denotes mean predicted out-of-pocket expenditures for that family in the HDHP that year. The second fraction determines mean total predicted medical expenditures across all families in 2012. We define ξ as the assumed candidate price elasticity for medical expenditures. To simplify our analysis, we assume a homogeneous elasticity in the population. Intuitively, the total cost savings from shifting PPO consumers to the HDHP equals the marginal price difference between those two plans, multiplied by the elasticity ξ to get the proportional reduction in expenditures, which is then multiplied by total medical expenditures to get actual cost savings.

When using these total cost savings in the context of a welfare comparison, it is also crucial to consider whether services foregone are purely wasteful or whether they have some value to consumers. If we directly compare ΔTC to the consumer welfare implications from the choice model, we are implicitly assuming that reduced medical expenditures come from reductions in purely wasteful services. In reality, if consumers utilize medical services rationally then they value them by

[62] Throughout our analysis we have assumed that consumers have a 0 price elasticity for medical utilization. For this exercise, our analysis measures *total cost savings* from a positive elasticity for both the employee and the firm and thus appropriately counts the benefit to the consumer as well as to the firm. As discussed in Section III it is unlikely that including a positive utilization elasticity in the choice model would markedly impact the key estimates.

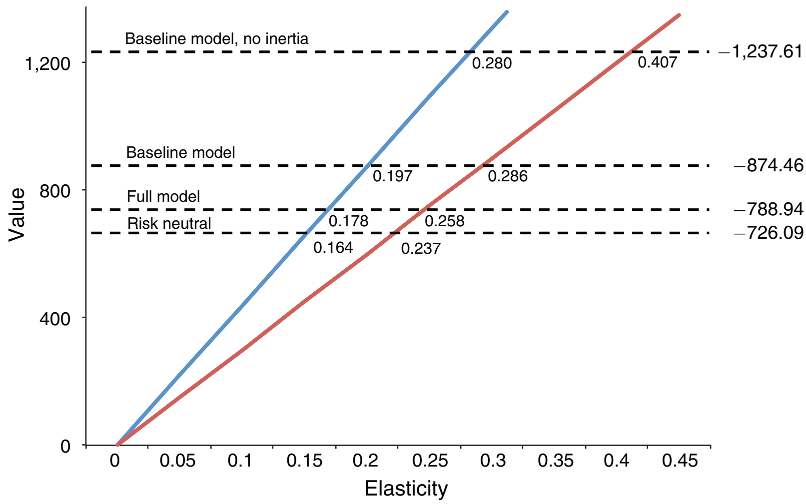

Figure 6

Notes: This figure describes the minimum price elasticity necessary to justify the forced switch to the HDHP for each of the choice models studied. The horizontal lines represent the mean consumer surplus change due to increased risk exposure for the different models studied. The upper diagonal line shows the relationship between total cost savings (y-axis) from reduced expenditures in the HDHP for a given price elasticity of utilization ξ (x-axis) when forgone medical expenditures are assumed to be "purely wasteful." The second diagonal line shows these costs savings net of the value of forgone under the assumption that care is valued at the average marginal price paid in the HDHP. These lines imply lower and upper bounds on the minimum price elasticity necessary to justify the menu design change if consumers rationally utilize medical care.

more than their marginal price. While the marginal consumer price in the PPO is always zero, if we take the marginal price in the HDHP to be the average price paid $\left(p_{HDHP} = \frac{\Sigma_K \mu_{F_k, HDHP}}{\Sigma_K \mu_{TME_k, HDHP}}\right)$, rational consumers should value the foregone services at a rate in between zero and the marginal HDHP price.[63] In this simple model, we can bound the welfare loss to consumers from services foregone below $p_{HDHP} \times \Delta TC$. Consequently, we can bound the minimum elasticity necessary to justify the switch to the HDHP between the ξ that equates ΔTC with the change in consumer surplus, ΔCS, and the ξ that equates $(1 - p_{HDHP}) \times \Delta TC$ and ΔCS.

The bottom half of Table 6 presents the bounds on the minimum elasticity necessary to justify the forced switch to the HDHP from a social welfare perspective. The first column presents the lower bound for this minimum elasticity (foregone spending is purely wasteful) while the second column presents the upper bound on this minimum elasticity (foregone spending is valued at consumers' marginal prices). Figure 6 illustrates these calculations in depth. It plots the candidate price

[63] This back of the envelope calculation ignores the fact that the HDHP is a nonlinear contract where the marginal price consumers face at any point in time is unclear and depends on their expectations about their end of year spending. See Aron-Dine et al. (2012) for an extensive treatment of this issue. See Cardon and Hendel (2001) for a sophisticated empirical treatment of the demand for medical services. See Baicker, Mullainathan, and Schwartzstein (2015) for a discussion of cases where consumers forgo care that society should value for them at higher than their marginal prices: it is plausible, especially given our analysis here, that consumers at times make suboptimal care decisions from a social perspective due to choice and information frictions.

elasticity of utilization ξ on the horizontal axis and the resulting total cost savings on the vertical axis, net of the assumed care value foregone by consumers. The figure then compares total cost savings from the policy change to the consumer welfare losses from increased risk exposure implied by each of the different choice models. Since total net cost savings are increasing in ξ, for all ξ greater than some threshold ξ^* the social savings from switching to the HDHP exceed the consumer welfare loss from increased risk exposure under that policy.

The minimum elasticity necessary to justify the menu redesign is 0.280 for the baseline model, when foregone spending is purely wasteful. This elasticity is 0.197 for the inertial baseline model, 0.178 for the full model, and 0.164 under a simple risk neutral model. Thus, as the models incorporate information frictions and hassle costs and the mean consumer welfare loss from risk exposure due to the policy change decreases, this policy becomes more attractive and is justifiable at lower ξ. The upper bound on the minimum elasticity to justify the policy change, when foregone medical care is valued at the marginal price, is 0.407 in the baseline model, 0.286 in the inertial baseline model, 0.258 in the full model, and 0.237 for the risk neutral model.[64] While no specific externally valid conclusions should be drawn from these numbers given the specific setting and plan menu studied here, our analysis illustrates how an employer insurance decision or insurance regulation decision could be directly impacted when the underlying choice model includes detailed measures of information frictions and hassle costs.

VI. Conclusion

In this paper we leveraged novel, individually linked, administrative, and survey data to show that both information frictions and perceived hassle costs are important factors for consumer health insurance choices at the large employer we study. We quantified the monetary implications for a variety of specific frictions, and revealed that including these friction measures in an expected utility framework typical of the structural insurance literature has potentially important implications for risk preference estimates. In our setting, omitting the typically unobserved friction measures leads to higher estimates of consumer risk aversion, which in turn directly impacts welfare analysis. In a simple counterfactual analysis designed to highlight the welfare implications of our results, we find that, when we omit our additional friction measures from the model, the consumer welfare loss from risk exposure is approximately double that when these measures are included. While the direction and magnitude of this welfare result are specific to our setting, the analysis illustrates that accounting for these typically unobserved choice frictions can have potentially important implications for both choice and welfare analyses in insurance markets.

Many past studies have noted the potentially important role of information frictions and hassle costs in insurance markets, but few have been able to study frictions in depth, primarily as a result of data limitations. The analysis we perform was made possible by directly linking survey and administrative data at the individual level,

[64] Since these results are based on the case where stated time and hassle costs are assumed to be non-welfare-relevant, or the counterfactual HDHP has the same such costs as the PPO, we note that these minimum elasticities will increase as true HDHP time and hassle costs increase.

and highlights both the additional advantages and potential concerns that leveraging survey data implies. While the survey conducted brings much new and valuable data to the analysis, those data should be interpreted with some caution because of issues like (i) selection bias on unobservable characteristics; (ii) confirmation bias; and (iii) consumer experiential learning and forgetting. For such reasons, identification using survey data will almost always be more open to interpretation than identification using exogenous variation in administrative data.[65] Nevertheless, we argue that integrating survey data with administrative data can produce valuable insights, especially when it is highly unlikely one can obtain rich enough administrative data to answer certain questions, as in our setting.[66]

From a survey design perspective, we asked simple questions that consumers could easily understand and took a conservative stance in our main analysis on the exact structural meaning of their answers. An alternative, more ambitious, approach could ask survey questions designed to elicit rich measures of consumer beliefs that could be used directly in a structural framework. This approach would place a greater burden on both question framing and consumer sophistication in responding to questions, but could yield a more completely specified structural decision process. An additional extension along these lines could also seek to directly elicit risk preferences as in, e.g., Dohmen et al. (2005). In our analysis, the ability to directly compare our results to the structural health insurance literature is a key benefit of not taking this approach, though integrating such measures could be an interesting complement. In addition, while our analysis is framed in terms of information frictions, there are direct links with the literature on behavioral decision-making that could be further explored (see, e.g., Barseghyan et al. 2013 or Abaluck and Gruber 2011).

Finally, this paper does not focus on the industrial organization implications of our results, which could be interesting to study in future work. In markets where consumers have many potential insurance choices, such as Medicare Part D or the state exchanges proposed in the ACA, the information frictions and relative plan hassle cost differences could be much larger than those we document in our setting with only two primary plan options. While our analysis focused on the demand and welfare implications of measuring such frictions in a simple setting, examining the equilibrium implications of these frictions could be interesting, especially thinking about how firms price to consumers with frictions or the implications of frictions for adverse selection in the marketplace. Federal and state insurance exchange regulators could administer similar surveys in order to better estimate risk preferences, more precisely optimize market design, and answer questions about market equilibrium. Similarly, as large self-insured employers adjust to the ACA and consider whether to move employees toward plans with less risk protection, they may be able to perform analyses similar to those here to make more efficient decisions.

[65] We note that some of these concerns could be mitigated by (i) incentivizing some or all consumers to respond to the survey and (ii) optimal timing for administering the survey.

[66] This is true broadly for other markets and other empirical questions in economics. See, e.g., Hastings et al. (2013) for an example of linked survey and administrative data in the context of the economics of education.

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