Research Dialogue | Issue no. 169
September 2020

TIAA Institute

Overpaying and undersaving: Correlated mistakes in retirement saving and health insurance choices

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Abstract

Decisions about retirement saving and health plans are among the most important and complicated financial decisions people make in the workplace. It has been established in multiple settings that many employees make mistakes in each of these decisions, and we document that these mistakes are costly in the setting that we investigate. Little is known, however, about mistakes across multiple domains, which may provide opportunities for targeted information interventions or other assistance. We document a significant and substantial positive correlation in mistakes across both important domains. Based on our definitions of mistakes, many employees overpay substantially for health insurance while undersaving for retirement, creating an opportunity to shift resources across domains and improve welfare.

We thank Wenqiang (Robin) Cai, Jiafeng Wu, and Yutong Chen for excellent research assistance and Brent Davis for helpful comments. This project received funding from the TIAA Institute and the Wharton School's Pension Research Council/Boettner Center, and from the UVA Bankard Fund for Political Economy. The content is solely the responsibility of the authors and does not represent official views of the above-named institutions.

1. Introduction

Decisions about retirement saving and health plans are among the most important financial decisions people make in the workplace. Non-wage benefits have accounted for an increasing share of employee compensation in recent decades (Anand 2017), but the complexity of benefits choices and tax incentives makes it difficult to make optimal decisions or even follow rules of thumb that approximate optimal decisions. An extensive literature documents information frictions and behavioral biases in the choice of retirement saving that lead to sub-optimal choices (Madrian and Shea 2001, Benartzi and Thaler 2004, 2007, Choi, Laibson, and Madrian 2011). A separate literature shows that people often make mistakes in choosing health insurance plans (Handel 2013, Loewenstein et al. 2013, Handel and Kolstad 2015, Bhargava, Loewenstein, and Sydnor 2017, Ericson and Sydnor 2017). Both strands of literature show that mistakes can be quite large in magnitude. For example, remarkable recent evidence suggests that half of employers offer plans that appear to be second-order stochastically dominated under reasonable assumptions about likely spending (Liu and Sydnor 2018), and choosing the wrong plan costs their employees over $500 on average per year. Yet, many employees–even those who are new or under active-choice regimes–continue to choose them.

To date, that research has proceeded on two independent tracks, each looking separately at mistakes in a single domain. In this paper, we unite the two strands by testing whether people who make mistakes in choosing a health insurance plan also make mistakes in retirement saving decisions. Understanding correlations in mistakes across domains may offer guidance on how to target assistance across multiple types of decisions, as well as how to evaluate the consequences of offering choices in benefits for different types of employees within firms.

While mistakes in each domain are costly in isolation, the errors can be substantially larger when evaluated together and over the course of many years. Reducing mistakes in one domain may produce spill-over effects in the other. For example, erring in choosing a health insurance plan leaves people with less money to save, posing a major barrier for retirement preparedness.

Data limitations have previously prevented studies from evaluating the extent to which mistakes are correlated across domains in the employee benefit setting. Researchers must first link data on health insurance choices, health insurance claims, retirement saving decisions, salary, and demographics, which is generally only possible using proprietary data from a large employer. Next, not all settings offer a set of choices in both domains that can be identified by researchers as mistakes for all or even some employees, no matter what an individual's circumstances or preferences. This requirement is often difficult because economic theory is rich enough to rationalize most behaviors, and much information is unobserved by the econometrician, particularly in such complicated choices. To make progress on this research question, one therefore needs both detailed data and institutional features that permit the researcher to diagnose mistakes without resorting to untestable assumptions.

We use four years of administrative data from a large higher education employer to study the frequency of mistakes across domains. In this setting, we can identify health insurance choices that are clear mistakes and that are large in magnitude for many, and perhaps most, employees. This involves failing to choose a low-coverage health insurance plan that is considerably cheaper than the other two options–and that a small minority of employees choose. Notably, we document that this formulation of offerings is common among peer universities and, as found by Liu and Sydnor (2018), a broader set of firms. We can also identify some retirement plan choices that are almost certainly mistakes, and some choices that are likely mistakes. An almost-certain mistake is not making voluntary contributions and therefore forgoing employer matching contributions, especially for the approximately half of employees who are offered a substantial match. A second likely mistake is saving below target levels recommended for consumption smoothing over the life cycle (Munnell, Golub-Sass, Webb, 2011).

Consistent with other research, we document that mistakes are very common in both health insurance and retirement plan choices. For their health insurance plan, a large majority picks the high- or medium-coverage plans when those plans are, for almost all employees, second-order stochastically dominated under reasonable and even conservative assumptions about the distribution of expected spending, meaning that higher spending outcomes are always more likely than in the low coverage plan. One important distinction in our setting is that the stakes of the decision are substantial. On average, employees who do not choose the low-coverage plan overpay for health insurance by nearly $1,700 in expectation, versus the estimate in Liu and Sydnor (2018) of $500. For one-third of employees, this error costs over 3% of pretax salary. We similarly find that likely mistakes are relatively common in retirement plan choices. About one-third of employees forgo matching contributions, and a large majority save below reasonable benchmarks in their retirement plans, summing together employee and employer contributions.

Next, we document a significant and substantial positive correlation in mistakes across both important domains. People who spend too much on a health insurance plan are 23% more likely to forgo matching contributions. Studying the factors correlated with each combination of mistakes could provide guidance for how to best target assistance. Using multinomial logits, we find that employees with lower salaries and longer tenure have higher rates of mistakes in both domains, and employees who are younger, have shorter tenures, and have higher income are less likely to make mistakes in either domain.

With many employees overpaying substantially for health insurance while undersaving for retirement, it creates an opportunity to shift resources across domains and improve welfare. For example, mistakes in health insurance are largest for those who make no voluntary retirement contributions: their overpayments are close to 4% of their pretax salary, on average. With the same resources, they could make substantial retirement contributions instead and get a 50% match for at least some of their contributions. As a share of salary, these mistakes are particularly prominent at the lower end of salary distribution. Policies that can steer consumers to use premium savings from lower health insurance payments to fund retirement accounts have the potential to produce sizable welfare gains to workers.

It is worth emphasizing that many employers, including the one we study, provide copious information designed to assist employees in making choices about both health insurance and retirement plan accounts.[1] Yet considerable research, for example related to consumer protection (Bubb and Pildes 2014), demonstrates that simply providing information does not help solve the problem. Our results suggest that employers explore targeted assistance and decision aids for particular subsets of employees.

In addition to linking together research on mistakes in health insurance and retirement saving, our paper relates to other work on consumer decision making in household finance. Several studies examine whether risk preferences are stable across different financial domains. Einav et al. (2012) use data on employee benefit choices from a large manufacturing firm and find that only about 30% of employees make consistently risk-averse choices across their health insurance and 401(k) plans. Unlike in our setting, no choice was dominated in either of their domains, which prevented them from exploring the possible role of mistakes in financial planning in explaining their results. Using data on auto and home insurance from a large insurer, Barseghyan, Teitelbaum, and Xu (2018) find a positive correlation in the amount of risk taken when stakes are of similar magnitudes. Yet, they document that households incurring more risk in choices with small stakes incur less risk for choices with large stakes, and vice versa. This negative correlation within households is inconsistent with stable risk preferences. Our research further relates to other empirical irregularities documented in household finance, such as the frequency with which households simultaneously hold both high-interest credit card debt and low-interest savings (Gross and Souleles 2002). Such apparent “mistakes” may reflect some combination of mental accounting (Thaler

[1] For example, employers often provide side-by-side comparisons of the main features of health insurance and retirement plans, and instructional videos on plan rules, tax benefits, and other plan features to aid decision-making.

1985, 1990), present-bias (Laibson 1997, Laibson. Repetto, and Tobacman 2003), lack of financial literacy (Lusardi and Mitchell 2014), and other factors.

The paper proceeds as follows. Section 2 describes the institutional setting and data. Section 3 describes our approach to measure mistakes in both health insurance and retirement decisions. Section 4 presents our main empirical results on the prevalence of mistakes in each domain and correlations across domains. Section 5 analyzes the characteristics associated with making mistakes across and within domains. Section 6 discusses the findings in the context of potential mechanisms and policy implications, and offers directions for future research.

2. Setting and data

2.1 Setting

The large public university that we study offers faculty a complicated set of retirement plan and health insurance choices. In this section, we describe the university administrative data set on employees, and discuss the health insurance and retirement plan choices that employees face. In the following sections, we define choices that represent mistakes in each domain.

The administrative data from the university (described in more detail in Friedberg, Leive, and Cai 2020) report annual earnings, semiannual demographics, monthly retirement plan contributions as a percent of earnings, annual health insurance choices, and annual health care claims data of each employee and dependent. Our data on earnings is collapsed into bins (of $10,000-$20,000 intervals) in order to eliminate the possibility that an individual can be identified. Demographic information consists of employee gender, age collapsed into bins (generally of five-year intervals) and marital status (which is incompletely collected). We further observe category of employment (faculty versus staff), division of the university (academic or medical), and the hiring date for each employee.

We focus on choices over the years 2014-2017, following the introduction of a third health insurance plan that was somewhat different from the other two.[2] In addition to two conventional plans that differed in how high premiums were and how much medical cost they covered, the university introduced a high-deductible plan (HDHP) with a health savings account (HSA) in 2014.[3] The HDHP/HSA plan has substantially lower premiums and, with the high deductible, offers lower coverage than the other two plans. We therefore characterize the three plans offered as the high-, medium-, and low-coverage plans. In spite of these terms, all the plans are relatively generous, as we demonstrate in Section 3.

Our data report employee health insurance choices among the three plans (along with their choice of family coverage).[4] We observe annual health spending as reported on insurance claims, divided into dollars paid by insurance and dollars paid out-of-pocket by employees, and separately for in-network and out-of-network care. To protect confidentiality, the employer has aggregated our claims data to the annual level for each employee and dependent rather than provide granular line-item claims detail. We discuss in Section 3 our approach to modeling health care costs and assessing decision quality using our claims information.

The retirement choices available to employees are also described more fully later on in Section 3. Employees differ in their eligibility for a university-sponsored defined contribution (DC) plan with required contributions and

[2] We use health care claims data starting a year earlier, in 2013, since we use the prior year's spending to predict the distribution of possible spending outcomes that an individual faces in the current year.

[3] An HSA is a tax-preferred personal savings vehicle in which contributions are tax deductible (even from FICA taxes, unlike retirement saving plans), investments grow tax deferred, and withdrawals are tax free if used to finance health care, including costs incurred in previous years. Income tax is owed on withdrawals for non-qualified expenses, as well as a penalty if funds are withdrawn prior to age 65. Funds in HSAs are not "use it or lose it", as they are for flexible spending accounts (FSAs). FSAs for services other than vision and dental are only available for the medium- and high-coverage plans.

[4] The four options, based on family structure, are employee, employee and one child, employee and spouse, or family coverage, which covers any number of children.

a state-sponsored hybrid plan. Employees can choose additional voluntary contributions, which can be directed to a 403(b) plan and to a state-run 457 plan, with Roth versions of both available.[5] More details of both the retirement and health insurance options are described in Appendix A.

2.2 Sample selection and descriptive statistics

We select our sample to focus on employees with the opportunity to make choices in both domains. Starting with records for 24,939 employees during the 2014-2017 period, we restrict the sample to the following employees: (i) staff or faculty; (ii) full-time employees; (iii) under age 65; (iv) annual salaries over $20,000; (iv) enrolled in the employer's health insurance plan; and (v) not in their first year of tenure. The first two restrictions exclude those whose benefit choices differ from the standard options studied in this paper (dropping about 17% of employees from the initial sample). In focusing on staff and faculty, we exclude post-docs, house staff, and a small number of employees with other non-standard employment designations. We drop employees over age 65 since Medicare coverage becomes available for most, and that itself represents a separate choice (dropping about 4% of the initial sample's employees). We exclude employees with very low salaries since they may also face different choice sets via Medicaid or highly subsidized Affordable Care Act coverage, or be employed full time but for only part of the year (dropping 7% of the initial sample's employees). We exclude employees who opt-out of the health insurance plan (dropping 6% of the initial sample's employees).[6] Finally, we drop the employee's first year of employment (but keep later years) for two reasons. First, the first year is generally a partial year (e.g., September-December) and so features a different calculation of health insurance costs. Second, our earlier study of retirement plan contributions found that some employees gradually ramp up their voluntary contributions within the first year, and often do not contribute in the first three months (Friedberg, Leive, and Cai 2020). This last restriction drops about 9% of the initial sample's employees. This selection process yields a final analytic sample of 17,145 employees spanning 49,233 employee-years.

Table 1 presents descriptive statistics for the sample. 54.5% work in the academic division, and 45.6% in the medical division. Employees in the academic division earn higher salaries ($80,746 vs. $66,182) and are over three years older (47.9 vs. 43.3).[7] The academic division is split evenly between men and women, while women comprise 75% of employees in the medical division. Tenure with the employer is long in comparison to other U.S. settings; the average is 11.5 years in the academic division and 8.9 years in the medical division.

Among health insurance options, we observe a large share of employees choosing the high-coverage health insurance plan. Roughly 60% of the sample choose the high-coverage plan in both divisions (58% in the academic division and 61% in the medical division), about one-third choose the middle-coverage plan, and 6-7% choose the low-coverage plan. We will come back to these sharp differences in plan choice later on because they are critical to our interpretation of mistakes. Around half of employees have family coverage. Average total health spending is $8,514 in the academic division and $8,796 in the medical division, while average out-of-pocket spending is about $1,300 in both divisions.

[5] The 403(b) and 457 options are subject to separate, identical IRS contribution limits, each equal to the 401(k) limit, meaning that public-sector university employees are able to contribute twice as much to retirement plans as can most other employees. The tax-deferred and Roth options of each are jointly subject to the contribution limit.

[6] While opting out might or might not itself be a mistake, we have no way of knowing what other coverage options such employees have (e.g., through a spouse).

[7] We do not adjust any salary or spending measures for inflation since doing so would also require adjusting insurance deductibles, copayments, etc. Inflation was fairly low during this period.

Table 1. Descriptive statistics

	Academic Division		Medical Division	
	Mean	SD	Mean	SD
Job characteristics				
Annual salary ($)	80,746	51,288	66,182	34,419
Faculty (%)	0.35	0.48	0.00	0.04
Academic division (%)	1.00	–	0.00	0.00
Tenure with employer (years)	11.50	9.44	8.88	9.09
Demographic characteristics				
Age	46.87	10.74	43.30	11.95
Female (%)	0.49	0.50	0.75	0.43
Single (%)	0.28	0.45	0.53	0.50
Married (%)	0.32	0.47	0.17	0.37
Health insurance characteristics				
Family coverage (%)	0.53	0.50	0.47	0.50
Household size	2.13	1.34	1.89	1.17
Low-coverage plan	0.07	0.26	0.06	0.23
Middle-coverage plan	0.35	0.48	0.33	0.47
High-coverage plan	0.58	0.49	0.61	0.49
Employee insurance premium	1,827	1,436	1,726	1,332
Employer insurance premium	8,172	3,430	7,593	3,127
Out-of-pocket spending	1,303	1,531	1,298	1,527
Total health spending	8,514	31,099	8,796	27,961
Retirement plan characteristics				
Voluntary contribution (403(b) + 457)	4.84	8.33	3.62	5.12
403(b) participation (tax deferred)	0.65	0.48	0.56	0.50
Roth participation (403(b) + 457)	0.10	0.30	0.12	0.32
Number of employee observations	9,348		7,797	
Number of employee-year observations	28,216		21,017	

Notes: Table presents means and standard deviations of demographic and outcome variables in sample. Administrative data on faculty at a large public university during 2014-2017. Descriptive statistics calculated separately by employees in academic division (columns 1 and 2) and medical division (columns 3 and 4). The last two rows present the number of unique employees and the number of employee-years. Salaries are not adjusted for inflation.

In terms of retirement saving, about 80% are required to have or choose the university DC plan rather than the state DB (for employees hired before 2014) or hybrid DB-DC plan (for employees hired in 2014 or later). Employees contribute 4.3% of salary to voluntary retirement plans, with higher rates in the academic division than medical division (4.8% vs. 3.6%). Within the academic division, 65% participate in 403(b). This rate is slightly lower among employees in the medical division (56%). About 10% of employees in both divisions contribute to Roth accounts (either 457 or 403(b)), with slightly more participation among medical division employees. Again, we will discuss these choices more carefully later on in Section 3.

3. Definition of mistakes in health insurance choices and retirement saving

In this section, we describe our approach to defining mistakes in key employee benefit domains. With health insurance choices in particular, we are able to make use of rich data on spending patterns to characterize expectations about health care costs across health insurance plan choices. Then, we discuss our approach to defining mistakes in retirement saving choices.

3.1 Premiums and cost sharing of health insurance plans

As noted earlier, the university began to offer three health insurance options in 2014, when we begin our analysis. All three have been relatively generous, with high overall shares of costs born by the employer. Based on claims across the sample period, the actuarial value of the plans, defined as employer payments as a share of employer plus employee out-of-pocker (OOP) payments, was about 88% in expectation for the high-coverage plan, with employees paying 12% out-of-pocket; about 85% for the medium-coverage plan; and about 77% for the low-coverage plan.[8] Similar to other employers, the university contributes the same amount in premiums for each plan, and plans with more generous coverage have higher employee premiums, which are intended to cover the marginal cost of coverage. Overall, the employer's premium contributions amount to 82% of total health care spending (OOP payments plus plan-paid spending).[9] Each plan had the same provider network, so differences between plans were only based on premiums and other plan parameters (deductible, co-pay, co-insurance rates, annual out-of-pocket maximum) determining financial risk.

The major differences across plans are in premiums and, for the low-coverage plan, the high deductible together with the employer contribution to the HSA. For example, annual premiums were $2,904, $1,092, and $360 for the high-, medium-, and low-coverage plans in 2015, for employee plus spouse coverage. While the deductible was $500, $1,000, and $4,000, respectively, the employer made an HSA contribution of $1,500 that year for the low-coverage plan, unconditional on any contribution by employees. Other plan parameters were relatively more similar; the co-insurance rate was 10% in the high-coverage plan, compared to 20% in the medium- and low-coverage plans. The annual out-of-pocket maximum was also similar across plans, at $10,000, $11,000, and $12,000 in 2015 for the high-, medium-, and low-coverage plans. Notably, deductibles and premiums grew relatively faster in the medium- and high-coverage plans over time. For example, the annual premium for a family rose from $2,904 in 2015 to $3,471 in 2017 in the high-coverage plan, but it only rose from $360 to $381 in the low-coverage plan.

We note in Table A2 that the structure of the health insurance plans that we study are common in many peer institutions. We collected information, which is generally publicly available, on the public and private universities that the university we study designated as its peer group. Fourteen out of 19 have an HDHP/HSA plan, and among those 14, nine make substantial contributions

[8] The definition of actuarial value does not include employee premiums. In 2014, the deductibles were lower for the high- and medium-coverage plans, making the percentage of spending covered by the plan 90% and 87%, respectively.

[9] On average, total health care spending equals $9,879, and employer premiums equal $8,080.

(for example, between $600 and $2,000 for family plans) to the HSA. Similarly, the premium difference between the low- and high-coverage plans is often extremely large. This fits with broader evidence from employers reported in Liu and Sydnor (2018), confirming that the plan offerings are generally typical.

3.2 Constructing spending distributions

In order to evaluate employee choices, we first need to project their out-of-pocket and total costs under each plan. Consistent with other work, we assume employees have rational expectations about their future spending risk, and we allow those beliefs to depend on demographics and past health spending. Our specific approach to construct these beliefs is driven by the nature of our data. Since we have information on demographics and annual OOP and total costs for each employee and any dependents, we use the empirical distribution of OOP costs for individuals with similar demographics and similar lagged health spending. In particular, we first divide individuals into groups based on 10-year age bins and gender. We then split these groups into terciles of lagged total health spending, in year t – 1. To construct the OOP distribution under each of the three plans in year t, we take draws from the distribution of observed OOP among people who choose that plan in year t within the sub-group based on age, gender, and lagged cost tercile. We then add OOP for each person in the family to construct the distribution under each plan at the family level. Appendix D describes this process in greater detail.

A few things about this procedure deserve comment. The main alternative would be to use each plan's cost parameters to project OOP for a given level of total costs. However, we found that plan details are too complicated for this to yield an accurate forecast of OOP costs given our aggregated cost data; in particular, not having line-item claims data means that we do not know what types of health care services are being used, and many services have different co-pays or co-insurance rates (described in more detail in Appendix A). On the other hand, our approach of using the empirical distribution for relatively finely disaggregated groups of the population makes use of the observed spending and how that spending maps to out-of-pocket payments under each plan. The assumption embedded in this approach is that employees would consume a similar mix of services to those enrolled in a different plan who share the same age, gender, and (lagged) cost tercile. Finally, given the limitations of our data, our analysis focuses on modeling the distribution of in-network spending, which accounts for over 98% of total spending during our sample period.

3.3 Measuring health insurance mistakes

We demonstrate in this subsection that, for nearly all employees, the low-coverage plan should be chosen under minimal assumptions about risk preferences. Our assessment of mistakes corresponds to checking for second-order stochastic dominance (SOSD) in the cost distribution associated with enrolling in each plan.[10] A consumer with a utility function that is non-decreasing and concave prefers a gamble that second-order stochastically dominates an alternative gamble. Because our focus is on uncertain costs, consumers should choose the plan that is second-order stochastically dominated. In our case, it means that higher spending outcomes are always less likely under one plan than under the others.

We define costs for each insurance plan as the sum of premiums and OOP costs, less any employer HSA contributions. We scale premiums by $1–\tau$, where τ is the employee's marginal tax rate, to account for the tax preference for premiums. Appendix B describes our procedure for imputing marginal tax rates for each employee. We treat the employer's HSA contribution as a premium reduction in calculating the costs of the low-coverage plan. Given that the HSA has superior tax preferences to all other savings products as analyzed in Leive (2020), the value of HSA contributions are worth at least this amount.

[10] For two distributions F and G, F SOSD G if and only if $\int_{-\infty}^{x} G(y)dy \geq \int_{-\infty}^{x} F(y)dy$ for all x, so that the probability of y occurring always is greater with distribution G than with distribution F.

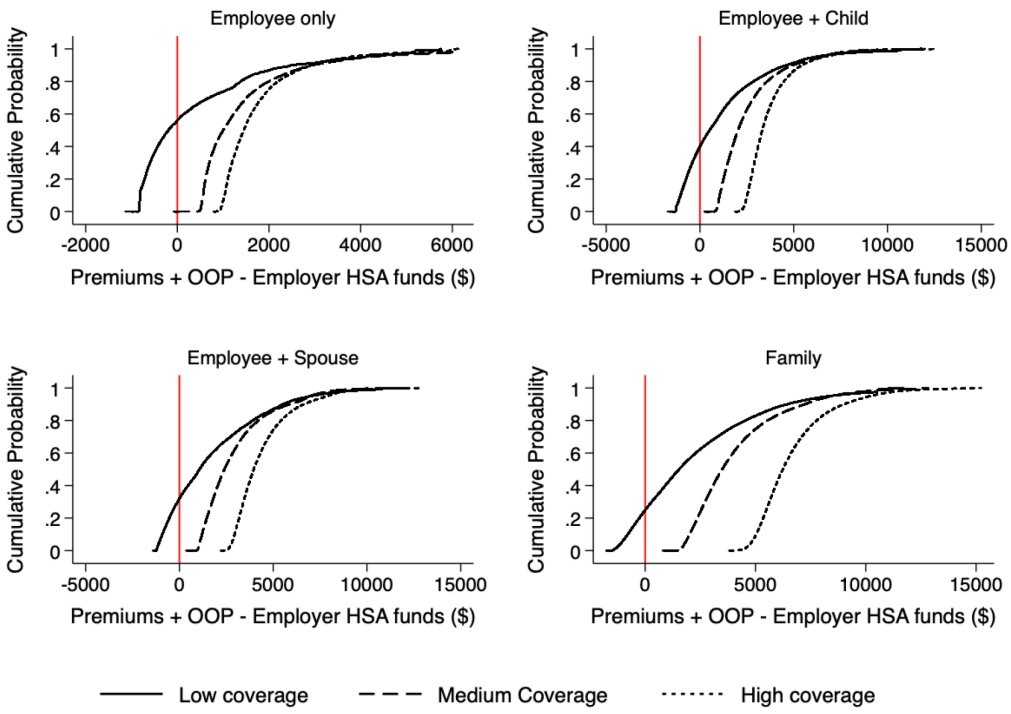
For over 99.8% of employee-years in our sample, we find that the cost distribution in the high-coverage plan exhibits SOSD over the cost distribution from the other two plans. For over 97% of employee-years in our sample, the distribution in the medium-coverage plan dominates that of the low-coverage plan. The reason why the low-coverage plan is the preferred choice for nearly everyone is the employer's large HSA contribution, along with the much lower premiums and only somewhat-higher risk sharing compared to the other two plans. We exclude this small minority of observations from our analysis for whom we cannot determine whether mistakes occur in the health insurance domain to focus on those for whom one plan should be unambiguously preferred.

A more stringent definition of mistakes would be first-order stochastic dominance (FOSD), which means one gamble yields a higher value in each state of the world (i.e., for each possible realization of costs). A person who prefers more consumption to less would prefer the gamble that FOSD an alternative choice. We view our additional assumption of concave utility to be fairly weak in this context, and so consider SOSD instead as a reasonable criterion for establishing mistakes. Furthermore, we note below that the low-coverage plan is FOSD by a higher coverage plan for about 30% of the sample, and is often very close to FOSD in the cases when a higher-coverage plan sometimes has lower cost realizations.

To illustrate these concepts, Figure 1 presents cumulative distribution functions (CDFs) of health care costs for the three plans in 2017 separately by the four different types of family coverage. These graphs pool all employees and the costs they would face in each plan and do not represent any given employee's expectations. Each employee will face a particular distribution of costs under each plan according to their marginal tax rate and their age, gender, and lagged health spending, along with that of any dependents. As an illustration for a single employee, Appendix Figure C1 presents the cases for 40-year-old male and female employees with employee-only coverage, a marginal tax rate of 25%, and who are in the median tercile of lagged health spending.

In both the individual example and when considering all employees together as in Figure 1, the differences in possible spending outcomes between the three plans is stark. The low-coverage plan almost always has the lowest costs, followed by the medium-coverage plan, and the high-coverage plan has the highest costs. Due to the employer's HSA contribution to the low-coverage plan, much of the CDF lies below zero, so the plan is heavily subsidized. Notably, the greatest spending differences are at low levels of health care costs; this may be contrary to people's intuition as they may believe that, in case of catastrophic spending outcomes, they would pay much more under the low-coverage plan. But in fact, because the high deductible would get exhausted in this eventuality and the OOP maximum is similar under all three plans, spending outcomes are quite similar under all three plans when high health care costs are incurred. Over time, the differences in costs between plans have grown as premiums and deductibles rose in the medium-coverage and particularly the high-coverage plan. Appendix Figure C2 shows the CDFs for 2014, which show patterns that are qualitatively and quantitatively similar to Figure 1.

Figure 1. Cumulative distribution functions of health care costs in 2017



Notes: Figure plots empirical cumulative distribution functions (CDFs) of health care costs across all employees under each available health insurance plan in 2017. The low-coverage plan is second-order stochastically dominated by the other plans. The distribution for the low-coverage plan located to the left of the vertical red line at zero denotes the fraction of cost realizations that would result in negative costs due to the employer HSA contribution.

To estimate a dollar value associated with making the wrong choice, we calculate the expected costs under each plan. The difference between the expected costs in the chosen plan and those of the low-coverage plan represent the amount of overpayment for health insurance. The expected costs are always lower under the low-coverage plan than under the medium-coverage plan, but by a smaller amount than under the high-coverage plan. In our analysis in Section 4, we consider both the amount of overpayment (in expectation) as well as the binary measure of not choosing the low-coverage plan.

3.4 Measuring retirement mistakes

The main retirement outcome we examine involves contributions to available plans, which include the tax-deferred and Roth versions of the 403(b) and 457 plans. Choosing how much to save has first-order implications for lifetime wealth and consumption. We consider two approaches to defining likely mistakes in retirement saving. Our stricter definition focuses on forgoing matching employer contributions, and broader definition on having total contributions (employee and employer) that fail to reach a benchmark fraction of earnings. This characterization of mistakes is less definitive than in

the case of health insurance, for a few reasons. One is that the health insurance decision affects financial outlays in a single year only, in contrast to retirement saving decisions, for which saving in another year is a relatively close substitute for saving this year. Another is that our data on insurance claims for the entire population help pin down spending expectations, whereas family structure, past financial circumstances, and expectations of life expectancy and future spending needs (all of which may change the marginal utility of saving versus consuming in a particular year) are both quite heterogeneous and unobservable in our data set. Since we find, though, that observed saving behavior for many in our sample lies well below what either reasonable theoretical predictions or common rules of thumb suggest, this gives us confidence in our definition of saving mistakes.[11]

As our narrow definition, we classify employees who forgo matching employer retirement contributions as making a mistake. We view failing to obtain the match as a mistake because people can immediately borrow against their voluntary contributions, and if they left employment immediately after getting the match, they would still come out ahead, given that the penalty for early withdrawals is 10%. The matching opportunities in our setting differ across divisions, so we take into account key details in establishing this standard. The match is substantial for most employees in the medical division, at 50% for contributions up to 4% of salary, and lacking auto-enrollment, we treat a zero contribution rate for medical division employees as a mistake. The match is smaller for the academic division, at 50% for contributions up to $960 per year. Because new academic division employees have been defaulted into the match since 2008, we treat not contributing as a mistake for earlier hires and contributing below the default rate as a mistake for employees hired since then.

Our second, broader definition of a mistake is contributing less in voluntary saving than the amount of retirement saving needed to reach 15% of salary each year. While individual saving targets vary due to many factors (which are often unobservable to us), we take 15% salary as a benchmark to meet life cycle savings needs for most consumers. This amount is often recommended as a rule of thumb online, even though Munnell, Golub-Sass, and Webb (2011) show that it is conservative for many individuals.[12] It is reasonable to expect the assets to be saved in the employer retirement plan, moreover, because of the substantial tax preferences, low expenses, and easy loan terms, all of which overcome the penalty for early withdrawal well before age 59½.

The voluntary contribution rate needed to reach this 15% threshold differs between the academic and medical division and based on the employee's date of hire, because of differences in required DC contributions and, for employees participating in the state retirement system, in DB plan parameters. For employees in the DC plan, we account for the required employer and employee contributions and matching schedules specific to division and start date in order to calculate

[11] Additional mistakes are also observable and quite frequent in our setting. For example, if someone has contributed the maximum to their university-sponsored 403(b) plan but not made additional contributions to the state-sponsored 457 plan, that is likely to be sub-optimal. Not making a mix of contributions between tax-deferred acounts and Roth accounts is also sub-optimal because it leaves saving exposed to uncertainty in future tax rates. Brown, Cederburg, O'Doherty (2017) analyze the optimal mix of retirement saving allocated between tax-deferred and Roth accounts, and show all but the lowest-salaried workers should split their contributions between pretax and post-tax accounts. These mistakes are second-order in contrast to the decisions we focus on, though. In addition, investing in high-cost funds when lower-cost funds with the same risk profile exist would constitute a mistake (Ayres and Curtis 2015), as would dividing contributions equally among similar funds, as would failing to rebalance. Our data lack information on portfolio choices, however, and so we cannot investigate decisions on asset allocation.

[12] They compute the savings rate needed to finance a replacement rate of consumption in retirement relative to pre-retirement earnings of 80%–itself a rule of thumb, but one that allows a single or married household with pre-retirement earnings of $50,000 to finance post-retirement spending needs that correspond to observed patterns in the Consumer Expenditure Survey. They assume a 4% rate of return and calculate Social Security income for a typical individual, and then calculate savings rates per year. For someone beginning to save at age 25 and intending to retire at age 65, the necessary savings rate is 15% per year.

the amount of voluntary contributions required to reach the 15% threshold.[13] For employees in the DB plan, we compute retirement benefits available for a representative employee (one who retires at age 65 with 30 years of service) and determine the additional voluntary contribution rate required to have the lump-sum equivalent amount of retirement assets.[14]

4. Results

This section first documents the prevalence and size of mistakes in each domain separately, and then analyzes the correlation and magnitudes of mistakes across domains. We find that mistakes are very common in health insurance choices, with a large majority of employees picking the expensive plan, and another third choosing the medium-coverage plan, even though both are second-order stochastically dominated. These mistakes are considerable in magnitude for many employees. We also find that mistakes are common in the retirement plan, with 36% not contributing at all and 80% contributing less than 15%, when summing the voluntary, required, and matching contribution rates.

We classify employees into four types based on their choice patterns across each of the two domains, and we also discuss magnitudes of the mistakes, both in dollar terms and relative to annual salary. These analyses do not consider the role of any demographic or other observable characteristics, so we can obtain the unconditional correlations in mistakes across domains. Later, we examine the associations between observables and the four types we classify.

4.1 Mistakes in health insurance choices

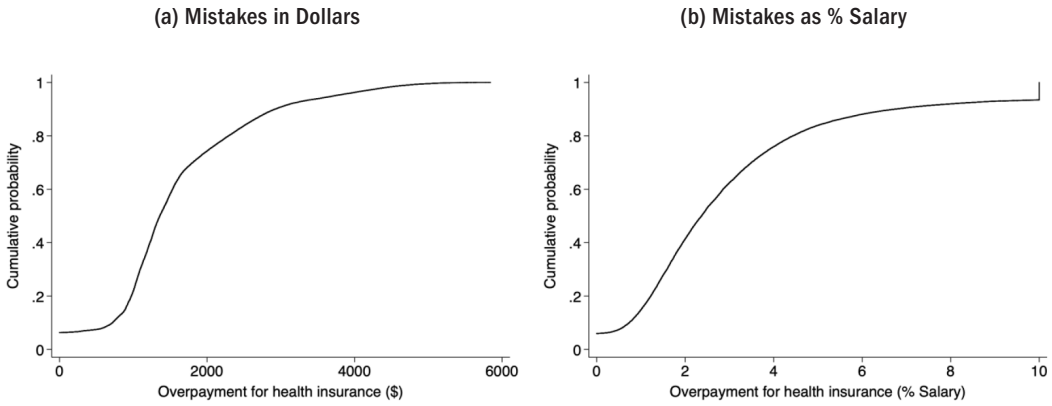
Figure 2 shows the distribution of overpayments for health insurance, defining overpayments as the sum of premiums and expected out-of-pocket payments net of employer HSA contributions in the chosen plan relative to the optimal plan. As we noted earlier, mistakes arise because the low-coverage plan is advantageous for a large fraction of employees, but only a small fraction chooses it.

Consequently, a full half of the sample make mistakes costing at least $1,350 a year, and 25% make mistakes costing over $2,000, in expectation (Figure 2a). Figure 2b presents the distribution of mistakes in relation to salary. The mistakes exceed 2% of pretax salary for over half of the sample, 3% of pretax salary for a third, and 4% for a fifth. The magnitudes of these errors are extremely large.

[13] Even though the HSA provides a superior tax-advantaged account for retirement saving (see Leive 2020), we restrict attention to 403(b) or 457 accounts to measure voluntary retirement saving. Our data do not include HSA withdrawals or balances (only contributions), and so we cannot assess using the account as a savings vehicle.

[14] These calculations assume that an individual spends 4% of their assets each year after retirement, another common benchmark. An employee who leaves or retires earlier will need to save more for retirement because their DB plan benefits will be lower.

Figure 2. CDF of overpayments for health insurance



Notes: Figure 2(a) plots the distribution of mistakes (in expectation) across all employees over all years in the sample in dollar terms. Figure 2(b) plots mistakes as a fraction of employee pretax salary.

Across all employees, the fraction choosing the high-coverage plan declined from 66% in 2014 to 51% in 2017. This decrease coincided with the rise in premiums in this plan described earlier, and shown in Appendix A. Yet, most employees left the high-coverage plan for the medium rather than the low-coverage plan, perhaps because of the unfamiliarity of the HDHP/HSA feature of the low-coverage plan. The fraction choosing the low-coverage plan increased from 5.1% in 2014 to only 8.9% in 2017. Despite the large premium differences and tax-advantaged employer contributions to the HSA, the low-coverage plan has remained an unpopular option. Over 90% thus make a mistake four years after the introduction of the HDHP/HSA. Among those who make mistakes, the average overpayment has increased from slightly less than $1,500 in 2014 to over $1,800 in 2017 as premiums have risen, particularly in the high-coverage plan.

4.2 Mistakes in retirement saving choices

Mistakes in retirement saving are also common, as Figure 3 shows. Figure 3 displays voluntary contributions (dashed line), since our narrow definition of mistakes involves employees making no contributions and forgoing any match. It also displays total contributions (solid line, including employer contributions and an equivalent accounting of DB plan accumulations), since our broad definition of mistakes involves failing to meet the 15% total contribution benchmark.

Over one-third of employees across both divisions do not participate in any voluntary plan, thus forgoing matching contributions. This share declined a little, from 37.4% in 2014 to 35.7% in 2017. In addition, over 80% of employees did not save enough in voluntary plans to reach a total of 15% of salary in retirement plans. This share declined from 82.1% in 2014 to 79.2% in 2017.

Figure 3. CDF of total contribution rates for retirement

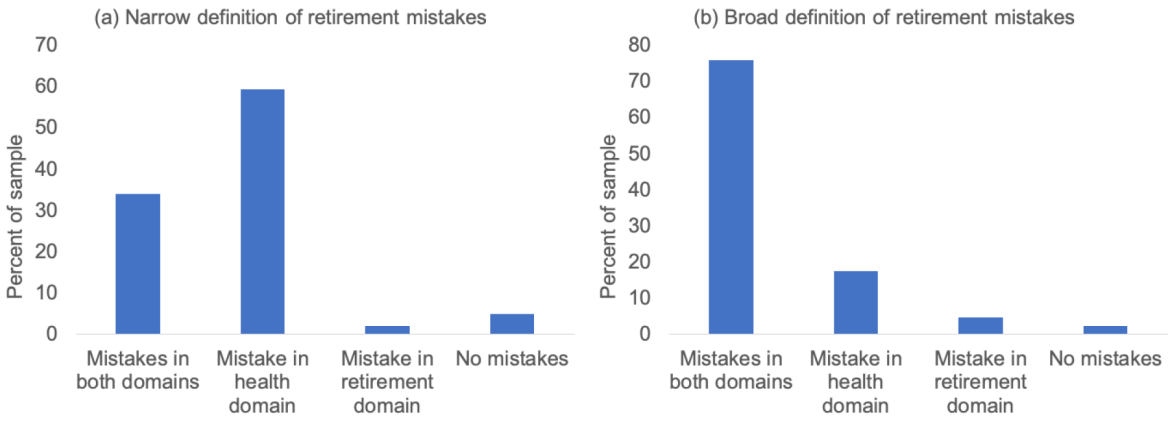
Notes: The figure plots the distribution of total contribution rates to the retirement plans available, as a fraction of employee pretax salary. Total contribution rates are the sum of voluntary, required, and matching contributions from employees and the employer to the 403(b) and 457 plans, both tax deferred and Roth, along with an implicit contribution rate reflecting the value of expected future benefits for employees enrolled in the state DB plan.

4.3 Mistakes across domains

This sub-section presents our main results for how mistakes correlate across domains. First, Figure 4 tabulates our binary measures of mistakes to classify four types of employees based on their choices in retirement and health insurance domains: (1) made mistakes in both domains; (2) made mistakes in health insurance only; (3) made mistakes in retirement only; and (4) did not make mistakes in either domain. We separate these results by our two definitions of retirement mistakes. We combine academic and medical divisions since the relative mix of types is fairly similar across divisions. Appendix Figure C4 presents results split by division.

In considering our narrow definition of mistakes for retirement saving (Figure 4a), the most common type are those who make mistakes only in the health insurance domain (59%). The least common type are those who only make mistakes in the retirement domain (2%). Just over one-third of employees make mistakes in both domains, while 5% do not make mistakes in either domain. Since choosing the low-coverage health plan is rare, most employees are classified as two of the four types.

Figure 4. Proportions of types based on mistakes in health and retirement choices



Notes: The figure plots the proportion of types according to whether they make mistakes in health insurance choices, retirement saving, neither domain, or both domains. Graphs are presented separately by narrow definition of retirement mistakes (4a) and broad definition of retirement mistakes (4b). Under the narrow definition of retirement mistakes, not making any voluntary retirement contributions constitutes a mistake in the retirement domain. Under the broad definition of retirement mistakes, contributing less than the amount to reach saving 15% of salary constitutes a mistake in the retirement domain. In both cases, choosing either the high- or medium-coverage plan constitutes a mistake in the health domain.

Figure 4b presents the distribution of types based on the broader definition of mistakes in retirement saving. The most common type are now those who make mistakes in both domains (76%). Those who make mistakes only in the health plan choice amount to 17%. Slightly below 5% of employees choose the low-coverage plan but save below 15% of salary for retirement. Finally, 2.1% do not err in either choice.

We find a strong positive correlation in mistakes across domains. Table 2 shows that not choosing the low-coverage plan is associated with a 6.9 percentage point higher probability of not contributing anything to retirement plans (equal to a 23% increase from the baseline rate of 29.6% of those who choose the low-coverage plan). Regarding our broader definition of retirement mistakes, not choosing the low-coverage plan is associated with a 13.1 percentage point higher probability of failing to save 15% of salary for retirement (equal to a 19.2% increase from the control mean of 68.1%). Both correlations are highly statistically significant.

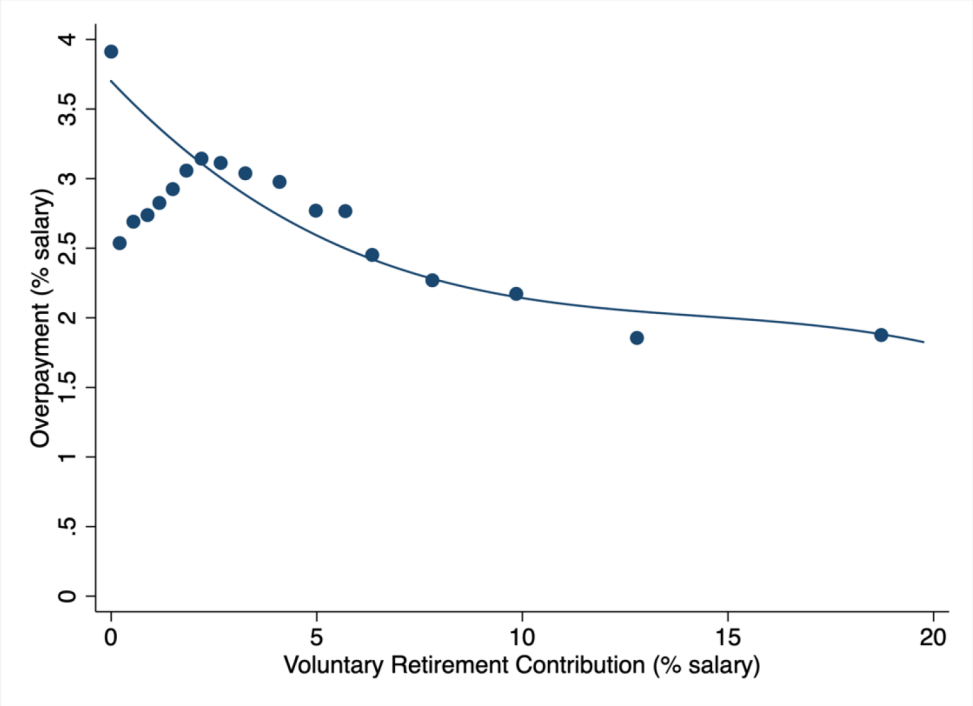
To examine the magnitudes of the decision errors, Figure 5 presents a binned scatterplot of overpayments for health insurance (where higher is a bigger mistake) against voluntary retirement contributions (where lower is a bigger mistake), both expressed as a fraction of salary. The negative relationship between them is clear. It partly reflects the feature that health insurance losses are limited in dollar terms and therefore tend to decline with salary, and partly that retirement contributions generally rise faster than salaries do. This inverse relationship is also consistent with our finding above that mistakes across domains are positively correlated based on binary measures of mistakes.

Table 2. Linear probability models: Correlated mistakes across domains

	Narrow definition of retirement mistake: Zero voluntary contribution	Broad definition of retirement mistake: Below 15% total saving rate
Mistake in health domain	0.069***	0.131***
	(0.012)	(0.013)
Constant	0.296***	0.682***
	(0.012)	(0.013)
N	47,754	47,754
R-squared	0.001	0.007

Notes: Table presents regression results of linear probability models correlating mistakes in retirement against mistakes in health insurance. Choosing either the high- or medium-coverage plan constitutes a mistake in the health domain. Standard errors clustered by employee in parentheses.
*** $p < 0.01$; ** $p < 0.05$, ** $p < 0.1$.

Figure 5. Overpayment for health insurance vs. voluntary retirement contributions



Notes: Figure presents binned scatterplots using the methods of Cattaneo et al. (2019) of overpayments in health insurance against voluntary retirement contributions, both measures as a percentage of salary. Line plots a 4th-order global polynomial.

The upshot of the negative relationship is that it creates the scope for improvements on both dimensions, particularly concentrated at the lower end of salary distribution. Consider the finding that employees who make zero voluntary retirement contributions make, on average, errors in health insurance choices *worth almost 4.0%* of their salary. In other words, they could make substantial retirement plan contributions and, in the medical division, get a 50% match if they used their savings from choosing the low-coverage plan to stock their retirement accounts. Similarly, those making retirement contributions of 5% or less still make health insurance mistakes costing over 2.5% of salary and sometimes above 3% of salary. Finally, those with fairly high voluntary contributions make errors around 2.0% of salary. We discuss how to consider the welfare implications of reallocating such saving to retirement in Section 6.

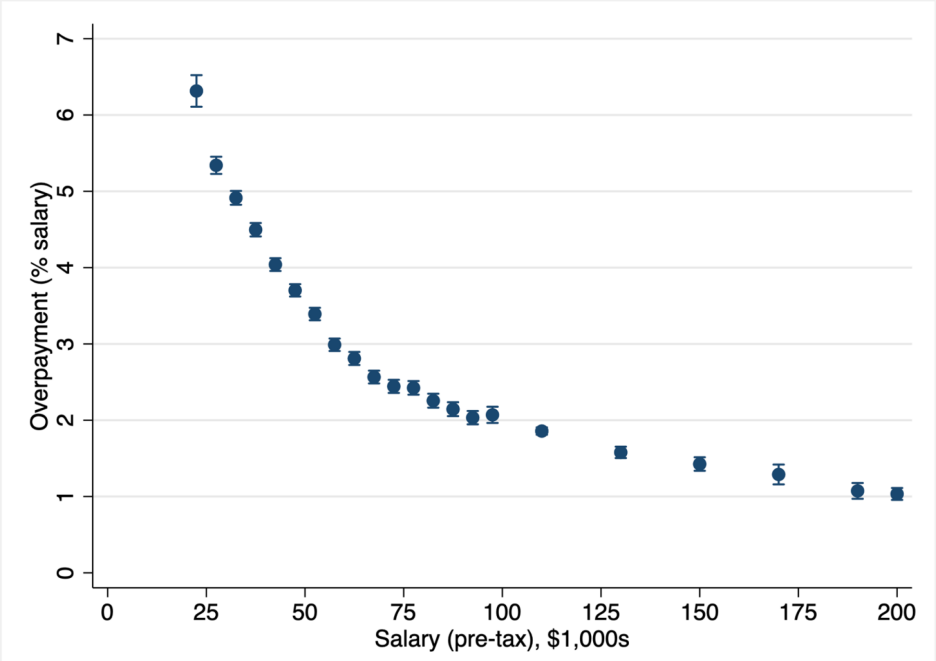
5. Characteristics associated with mistakes

This section evaluates the demographic characteristics and other observables that are associated with each of the four types of mistake patterns presented in Figure 4. Given the substantial size of the mistakes in terms of health insurance choices, we begin with an assessment of this domain in isolation, focusing on mistakes by salary level. We then present results for how the four types differ by salary level. Finally, we assess the role of other observable factors in addition to salary through multinomial logits.

Relative to salary, health insurance mistakes cost more for lower-income employees. Employees earning less than $50,000 (pretax) make errors costing over 3% salary, on average (Figure 6). Those with salaries below $40,000 incur overpayments that amount to over 4.5% of their salary.

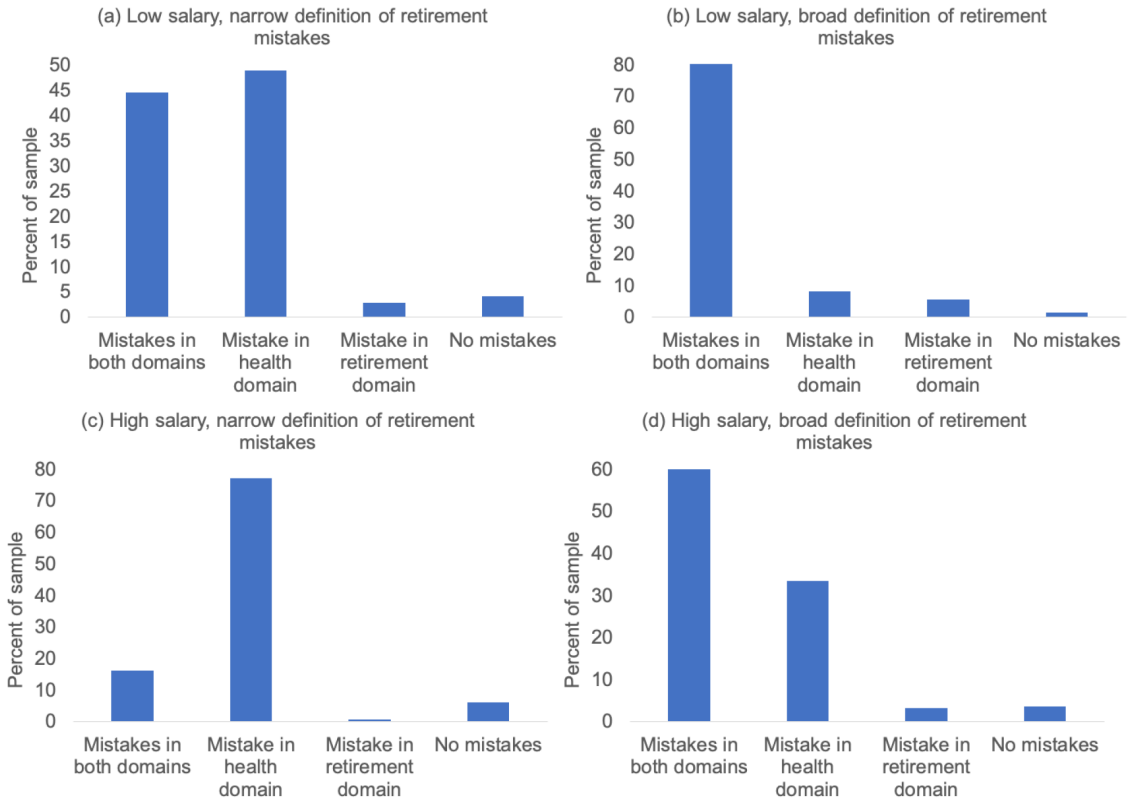
Figure 7 shows how types differ by salary, splitting the sample by employees earning less than $75,000 and employees earning at least $75,000 in annual salary. This amount equates to roughly the median across the full sample. These tabulations pool academic and medical divisions, and again report results under two definitions of mistakes in retirement saving. Higher-salaried employees are more likely to err in choosing a health insurance plan only, given their higher contribution rates to voluntary retirement plans. Yet, we still observe a strong positive correlation between mistakes across domains within salary levels. The correlations are of similar magnitudes for employees above and below $75,000 in salary.

Figure 6. Overpayment for health insurance vs. income



Notes: Figure presents binned scatterplots using the methods of Cattaneo et al. (2019) of overpayments in health insurance against employee salary, measured pretax. Whiskers denote 95% confidence intervals.

Figure 7. Proportions of types by salary level



Notes: Figure plots the proportion of types according to whether they make mistakes in health insurance choices, retirement saving, neither domain, or both domains. Graphs are presented separately by salaries below $75,000 (6a and 6b) and salaries greater than or equal to $75,000 (6c and 6d). Under the narrow definition of retirement mistakes, not making any voluntary retirement contributions constitutes a mistake in the retirement domain. Under the broad definition of retirement mistakes, contributing less than the amount to reach saving 15% of salary constitutes a mistake in the retirement domain. In both cases, choosing either the high- or medium-coverage plan constitutes a mistake in the health domain.

Table 3 presents multinomial logit results to assess the conditional associations between observable characteristics and types based on the narrow definition of retirement mistakes. The table presents marginal effects, so estimates can be interpreted in terms of predicted probabilities. Results based on the broad definition of retirement mistakes are presented in Appendix Table C2. To allow for non-linearities in age and salary, we group employees into 10-year age bins and four salary bins.

Table 3. Multinomial logit: Characteristics associated with types, narrow definition of mistakes

	Type: Mistakes in both domains	Type: Mistakes in health domain	Type: Mistakes in retirement domain	Type: No mistakes
Tenure (in years)	0.005***	-0.001	-0.002***	-0.002***
	(0.000)	(0.001)	(0.000)	(0.000)
Female	-0.014	0.018*	0.000	-0.004
	(0.007)	(0.008)	(0.002)	(0.003)
Faculty	-0.040***	0.029*	0.003	0.007
	(0.012)	(0.012)	(0.003)	(0.005)
Salary bin (relative to < $45k)				
[$45k - 65k)	-0.170***	0.169***	-0.012***	0.013**
	(0.007)	(0.008)	(0.002)	(0.004)
[$65k -100k)	-0.295***	0.280***	-0.014***	0.028***
	(0.008)	(0.008)	(0.002)	(0.004)
[$100k+)	-0.442***	0.426***	-0.027***	0.042***
	(0.011)	(0.012)	(0.005)	(0.005)
Age bin (relative to < 30 years)				
[30, 40)	-0.010	0.035**	-0.007**	-0.018***
	(0.010)	(0.011)	(0.002)	(0.005)
[50, 50)	-0.014	0.047***	-0.011***	-0.022***
	(0.011)	(0.012)	(0.003)	(0.005)
[50, 59.5)	-0.026*	0.072***	-0.019***	-0.027***
	(0.012)	(0.012)	(0.004)	(0.006)
[59.5+)	-0.015	0.070***	-0.018***	-0.037***
	(0.015)	(0.016)	(0.005)	(0.008)
Academic division	-0.100***	0.075***	0.004*	0.021***
	(0.008)	(0.008)	(0.002)	(0.004)
Coverage type (relative to Family)				
Employee Only	-0.051***	0.048***	-0.003	0.005
	(0.010)	(0.011)	(0.003)	(0.004)
Employee Plus Child/Children	-0.018	0.045***	-0.016***	-0.012*
	(0.011)	(0.012)	(0.004)	(0.005)
Employee Plus Spouse	-0.018	0.039**	-0.010*	-0.011
	(0.014)	(0.015)	(0.005)	(0.007)
Year (relative to 2014)				
2015	0.002	-0.009**	0.005***	0.002
	(0.003)	(0.003)	(0.001)	(0.002)
2016	-0.009*	-0.006	0.009***	0.006***
	(0.004)	(0.004)	(0.001)	(0.002)
2017	-0.001	-0.034***	0.018***	0.016***
	(0.004)	(0.004)	(0.002)	(0.002)

Notes: Table presents marginal effects from multinomial logit of types based on mistakes made in health insurance and retirement saving. N = 47,754. Pseudo R^2 = 0.119. Standard errors clustered by employee in parentheses.
*** $p < 0.01$; ** $p < 0.05$, ** $p < 0.1$.

Compared to lowest-salaried workers, higher salaries are associated with a significantly greater share of 'No mistake' types and a smaller share of 'mistake in both' or 'mistake in retirement only' types. Higher-salaried employees are significantly more likely to make a mistake only in health insurance since many high-salaried employees choose the high-coverage plan. Age follows similar pattern to income, with differences more pronounced the older that employees are. Conditional on age and income, employment tenure is negatively associated with not making any mistakes and positively associated with mistakes in both domains. The finding for tenure may reflect the role of inertia, consistent with Handel (2013). There is some evidence that decision quality improves over time, with more employees not making any mistakes in later years compared to 2014. We are unable to determine whether this pattern is driven by experience, peer effects, or responses to the rising premiums and deductibles in the high-coverage plan over time.

6. Discussion

The choices of health insurance plan and retirement saving are often complex and involve large financial stakes. Previous work has demonstrated that consumers frequently make mistakes in each of these decisions, but whether mistakes are correlated across domains has remained an open question. Using administrative data from a large employer, we document a positive correlation between mistakes in health insurance choices and mistakes in retirement saving. The costs of mistakes are sizable in each domain, but particularly in the health insurance choice. Over 90% of employees choose a plan that is second-order stochastically dominated, and forgo over 2% of pretax salary, on average, each year. Moreover, we find people who err in health insurance choices are more likely to make mistakes in retirement planning by saving too little and forgoing employer matching funds.

This positive correlation in mistakes is important both because of the large financial consequences and because a large fraction of employees make mistakes in both domains. One-third of employees choose the wrong health insurance plan and make no voluntary retirement contributions. For these employees, the costs of health insurance mistakes is almost 4% salary per year, which could be reallocated to retirement saving or current consumption. Over 70% of employees choose the wrong plan and save below recommended levels to attain an optimal replacement income rate in retirement. Mistakes in health insurance choices thus appear to pose a major barrier to retirement preparedness for many U.S. workers.

A natural question is what mechanisms explain these choice patterns. In terms of neoclassical explanations, rational inattention does not seem plausible given the high costs of incorrect choices. Liquidity constraints are a potential explanation for choosing a low-deductible plan that otherwise appears to be dominated (Ericson and Sydnor 2018), if the timing of liquidity constraints is such that some employees are unable to pay the deductible, as well as not saving for retirement. Yet in our context, the employer's HSA funds are deposited at the beginning of the year, and the money saved on lower premiums also quickly makes up for any difference in costs that must be paid, even early in the year. On the retirement side, liquidity constraints alone seem unlikely to explain why people forgo matching funds at a 50% rate, since they can borrow against their contributions. Our finding that longer-tenured employees are more likely to make mistakes in both domains and less likely to make correct choices in each suggests a partial role for inertia, particularly since the expensive, high-coverage plan was originally the only plan offered. It does not explain the mistaken choices of many new employees, however. A number of other information frictions, behavioral biases, or lack of financial literacy (Lusardi and Mitchell 2014) could, in principle, explain these choices. We view survey evidence (e.g., Handel and Kolstad 2015) as an important direction to pursue to better understand the micro-foundations of such patterns.

Our findings highlight the importance of finding ways to target assistance to employees prone to mistakes, and to develop other strategies to improve consumer

decision making in complex financial choices. The capacity for well-targeted policies to steer people toward better choices (e.g., through interventions during open enrollment each year) offers an opportunity to improve financial outcomes over time. Our results suggest that the same people need to be targeted with assistance across multiple types of decisions, perhaps emphasizing a mental accounting approach in which benefits choices are viewed jointly, so that dollars saved in one domain might be readily shifted to another. For example, explicitly framing the lower premiums for the high deductible plan as a way to accumulate savings in an HSA or retirement plan and including simplified savings projections under different insurance choices might be an effective strategy. How such assistance is best structured is an important implementation question for employers. One concern may be that people could be flooded with too much information if this targeting is done independently–thus failing to solve, and perhaps even compounding, the initial problems in each domain. Studying which policies work best, and how such policies influence insurance decisions and saving behavior in the medium to long term as employees re-sort across plans and adjust to saving decisions, is an important subject for future research.

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Appendix A. Institutional details of health insurance and retirement plans

This appendix presents more information on the rules and options for health insurance and retirement saving offered by the employer. Table A1 presents key features of the health insurance plans–premiums, deductibles, out-of-pocket maxima, HSA availability and employer contributions–by type of coverage in 2015 and 2017. Copayments and coinsurance rates differed by plan. Coinsurance rates were lower in the high-coverage plan compared to the other two options (10% vs 20%), and these rates applied to most service categories. Copayments applied to office or outpatient visits for the middle-coverage and high-coverage plans. Copayments were $25 for primary care in the high-coverage plan and $30 in the medium-coverage plan and not subject to the deductible. Copayments for specialty care visits were twice these amounts and also not subject to the deductible for these two plans. Physical therapy, occupational therapy, chiropractic care, and acupuncture each had $40 copayments for both the medium- and high-coverage plans. Inpatient care had a $500 deductible for the high-coverage plan. For the low- and medium-coverage plans, inpatient care had 20% coinsurance after the deductible. Emergency room visits had a $200 copayment in the high-coverage plan and a 25% coinsurance rate after the deductible in the low- and medium-coverage plans. All plans covered preventive care (including physical examinations with a primary care provider, well care child visits, non-urgent diagnostic tests, lab services, and X-rays, common communicable diseases like flu shots) without out-of-pocket payments in each year. Maternity visits were also paid in full by each plan. Plans had slightly different prescription drug coverage.

The large public university that we study offers faculty a complicated set of retirement plan choices. Several distinctions are important: between the academic and medical divisions; between faculty and other employees in the academic division; and by hire date. Nevertheless, the overall choice set remains similar across many of these groups, and we have characterized mistakes in ways that can be applied uniformly across them.

Academic division, faculty. First, faculty face a one-time irrevocable choice at the outset of employment between the DB plan run by the state (described next) and the 401(a) DC plan with the mandatory contributions that we described earlier. A large majority chooses the DC plan. Second, mandatory contributions are made to the 401(a) plan. For faculty hired before July 1, 2010, the mandatory contribution rate is 10.4% from the employer. For faculty hired after, it is 8.9% from the employer and 5% from the employee.

Academic division, non-faculty employees. Non-faculty academic division employees do not have a choice and are enrolled into the state DB plan, with 5% of their pay contributed to the help finance the system. This has become less generous over time, following two changes in the state system. The DB formula was changed to reduce generosity a little and delay retirement for employees hired after July 1, 2010. It was changed again, with a much more substantial reduction in generosity for employees hired after December 31, 2013; another change at that time was that 4% of pay continued to go to the state DB system, but 1% began to go to a DC plan.

Academic division, all employees. The employer provides a limited match to the university 403(b) plan. This consists of a 50% match for contributions up to $80 per month.

Medical division, all employees. Medical division employees do not have a choice and are enrolled in a medical system DC plan. For employees hired before October 1, 2002, the employer contributes 8% of pay, and for employees hired after, the employer contributes 4%. The match ceiling for contributions to the 403(b) plan changed at the same time. For employees hired before October 1, 2002, the match parameters were the same as for academic division employees, with a 50% match for contributions up to $80 per month. For employees hired after, it is a 50% match for contributions up to 4% of salary.

Table A1. Summary of main features for health insurance plans

	2015			2017		
	Coverage level			Coverage level		
	High	Medium	Low	High	Medium	Low
Panel A. Employee only						
Annual premium	1,080	612	228	1,275	687	228
Deductible	250	500	2,000	400	500	2,000
Out-of-pocket max	5,000	5,500	6,000	5,000	5,500	6,550
HSA available	No	No	Yes	No	No	Yes
Employer HSA contribution	No	No	1,000	No	No	1,000
Panel B. Employee + child						
Annual premium	2,580	1,020	288	3,039	1,164	288
Deductible	500	1,000	4,000	800	1,000	4,000
Out-of-pocket max	10,000	11,000	12,000	10,000	11,000	13,100
HSA available	No	No	Yes	No	No	Yes
Employer HSA contribution	No	No	1,500	No	No	1,500
Panel C. Employee + spouse						
Annual premium	2,904	1,092	360	3,471	1,284	381
Deductible	500	1,000	4,000	800	1,000	4,000
Out-of-pocket max	10,000	11,000	12,000	10,000	11,000	13,100
HSA available	No	No	Yes	No	No	Yes
Employer HSA contribution	No	No	1,500	No	No	1,500
Panel D. Family						
Annual premium	5,136	1,800	696	6,066	2,064	720
Deductible	500	1,000	4,000	800	1,000	4,000
Out-of-pocket max	10,000	11,000	12,000	10,000	11,000	13,100
HSA available	No	No	Yes	No	No	Yes
Employer HSA contribution	No	No	2,000	No	No	2,000

Table A2. Summary of main plan features at other universities

		Low-coverage plan				High-coverage plan		Number of plans available
		Premium	Deductible	HSA available	Employer HSA Contribution	Premium	Deductible	
Private Universities								
1	Individual	$324	$1,500	Yes	$1,000	$1,380	$300	3
	Family	$3,480	$3,000	Yes	$1,000	$7,620	$600	
2	Individual	$408	$600	No	N/A	$2,016	$0	4
	Family	$3,768	$1,800	No	N/A	$9,036	$0	
3	Individual	$348	$1,450	Yes	$300	$804	$850	2
	Family	$3,084	$2,900	Yes	$600	$6,024	$2,550	
4	Individual	$643	$2,500	Yes	$500	$1,452	$500	3
	Family	$4,209	$5,000	Yes	$1,000	$3,402	$1,000	
5	Individual	$1,092	$1,500	Yes	$1,000	$2,448	$150	4
	Family	$3,576	$3,000	Yes	$2,000	$7,596	$450	
6	Individual	$1,512	$0	N/A	N/A	$3,168	$100	4
	Family	$5,556	$0	N/A	N/A	$8,904	$300	
7	Individual	$355	$1,500	Yes	$400	$1,288	$500	5
	Family	$1,320	$3,000	Yes	$800	$6,869	$1,500	
Public Universities								
1	Individual	$264	$1,400	Yes	$60	$1,387	$200	4
	Family	$1,465	$2,800	Yes	$120	$3,413	$400	
2	Individual	$276	$1,400	Yes	$500	$1,701	$500	5
	Family	$802	$2,800	Yes	$1,000	$5,660	$1,500	
3	Individual	$276	$1,400	Yes	$500	$1,701	$500	5
	Family	$802	$2,800	Yes	$1,000	$5,660	$1,500	
4	Individual	$0	$1,500	Yes	$0	$1,308	$0	4
	Family	$228	$3,000	Yes	$0	$4,542	$0	
5	Individual	$180	$1,350	Yes	$500	$1,680	$400	4
	Family	$772	$2,700	Yes	$1,000	$2,160	$800	
6	Individual	$0	$400	No	N/A	$408	$0	2
	Family	$3,492	$800	No	N/A	$4,188	$0	
7	Individual	$812	$0	No	N/A	$1,224	$0	5
	Family	$2,112	$0	No	N/A	$3,060	$0	
8	Individual	$0	$500	No	N/A	$1,788	$0	3
	Family	$2,820	$1,000	No	N/A	$7,896	$0	
9	Individual	$2,256	$2,800	Yes	$0	$3,948	$300	4
	Family	$5,469	$5,400	Yes	$0	$10,437	$600	
10	Individual	$0	$1,500	Yes	$0	$936	$0	4
	Family	$600	$3,000	Yes	$0	$4,548	$0	
11	Individual	$300	$1,400	Yes	$0	$2,112	$175	10
	Family	$948	$2,800	Yes	$0	$5,928	$525	
12	Individual	$372	$1,500	Yes	$750	$3,228	$250	4
	Family	$936	$3,000	Yes	$1,500	$8,040	$500	

Appendix B. Imputation of marginal tax rates

This appendix describes the procedure to impute marginal tax rates for each employee in our data. The marginal tax rates are used to adjust contributions to Roth accounts, which became available in the later period we examine, to a pretax basis. Our administrative records lack several pieces of information required for a direct calculation of the employee's marginal tax rate, including information about spousal earnings, children, other sources of income, home ownership, and relevant deductions. In addition, marital status is reported incompletely, and salary is recorded in bands to protect data confidentiality. Our approach is therefore to calculate marginal tax rates for respondents of the American Community Survey (ACS) using the National Bureau of Economic Research's TAXSIM, and then to use hot-deck imputation to assign a marginal tax rate for the employees in our sample by matching on income, age, and gender.

Step 1: ACS data

We use ACS surveys between 2011 and 2017, which record relatively comprehensive information that helps us calculate marginal tax rates. In particular, we use the following information from the survey: wage and salary income of respondent and spouse, interest received, retirement income and Social Security benefits, supplemental security income and public assistance income, state, marital status, age, number of dependents, and number of children under 13.

Step 2: Marginal tax rate calculation

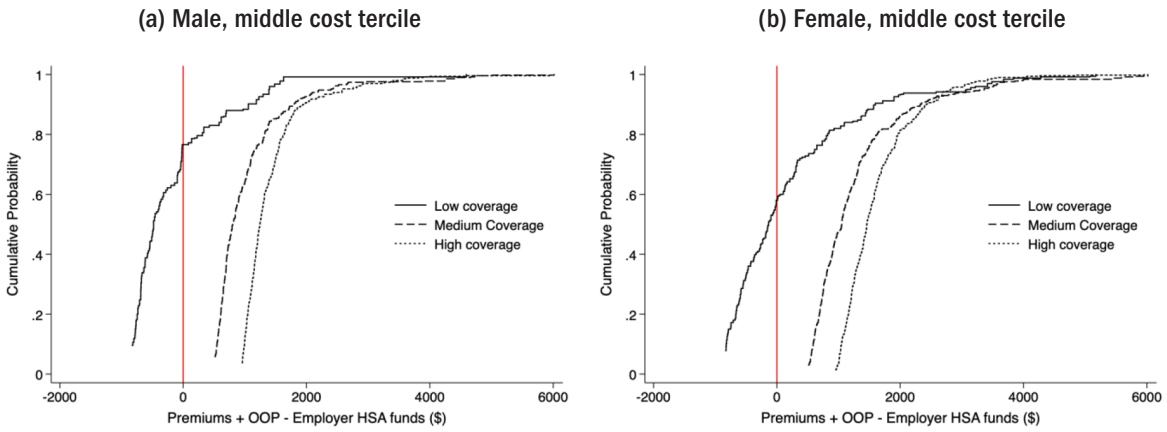
For each ACS observation, we use NBER TAXSIM to estimate the federal and state marginal tax rates based on the variables in the list above.

Step 3: Hot-deck imputation

We match individuals between our administrative data and the ACS by year, age band, income band, and gender. We then use hot-deck imputation to assign a marginal tax rate to the matched employees in our sample. The imputation is repeated five times and we take the average to construct our estimate of the employee's marginal tax rate.

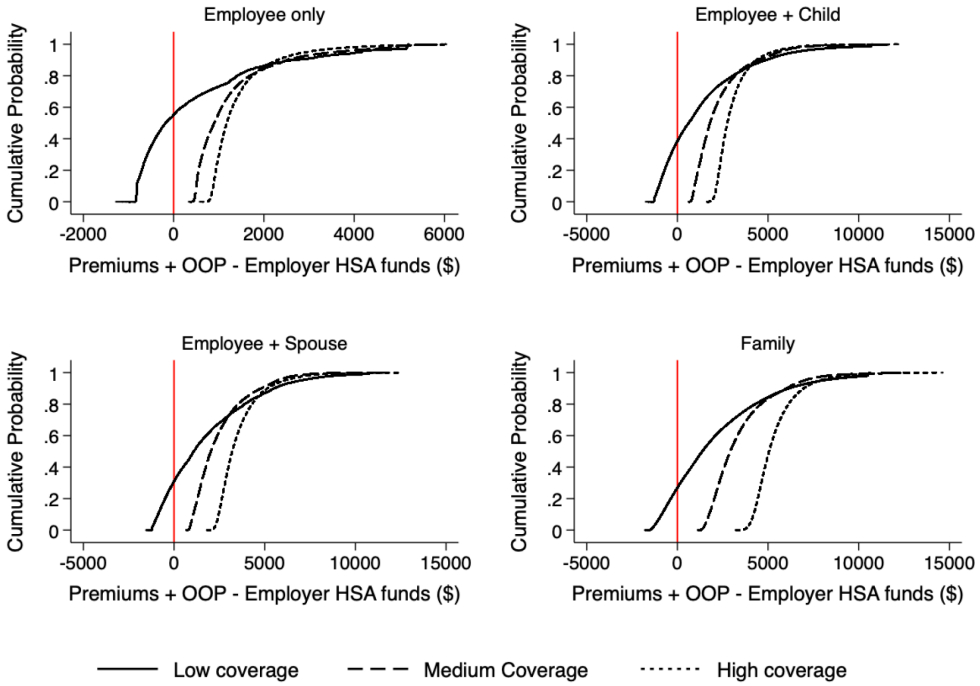
Appendix C. Supplementary analyses

Figure C1. CDFs of health care costs for 40-year-old in 2017



Notes: Figure plots empirical cumulative distribution functions (CDFs) of health care costs for a 40-year-old male (left panel) and female (right panel) in the middle cost tercile who face a marginal tax rate of 25%. The low-coverage plan is second-order stochastically dominated by the other plans for both men and women. The distribution for the low-coverage plan located to the left of the vertical red line at zero denotes the fraction of cost realizations that would result in negative costs due to the employer HSA contribution.

Figure C2. CDFs of health care costs in 2014



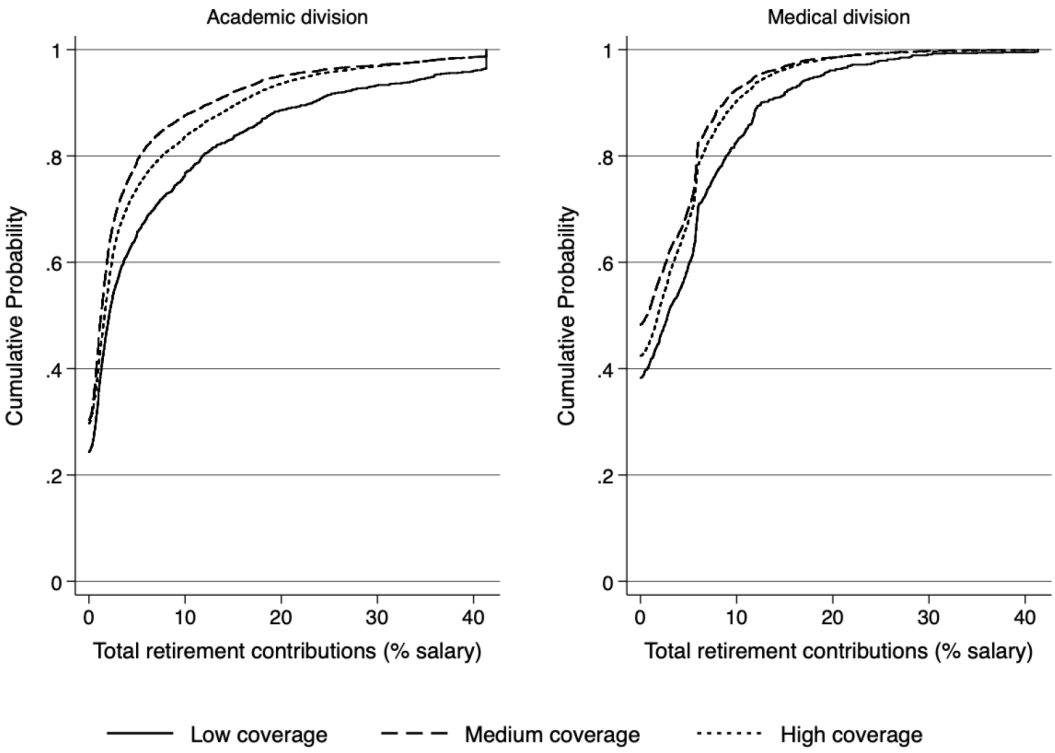
Notes: Figure plots empirical cumulative distribution functions (CDFs) of health care costs across all employees under each available health insurance plan in 2014. The low-coverage plan is second-order stochastically dominated by the other plans. The distribution for the low-coverage plan located to the left of the vertical red line at zero denotes the fraction of cost realizations that would result in negative costs due to the employer HSA contribution.

Table C1. Sample means by health insurance coverage level

	Academic Division			Medical Division		
	Health insurance coverage level			Health insurance coverage level		
	High	Medium	Low	High	Medium	Low
Annual salary ($)	83,946	75,739	79,343	70,245	58,754	65,387
Age	49.85	43.05	41.52	46.19	38.78	38.41
Faculty (%)	0.36	0.32	0.38	0.00	0.00	0.01
Academic division (%)	1.00	1.00	1.00	–	–	–
Female (%)	0.50	0.47	0.46	0.76	0.73	0.73
Single (%)	0.34	0.21	0.20	0.57	0.46	0.50
Married (%)	0.35	0.29	0.27	0.17	0.16	0.15
Tenure with employer (years)	14.17	8.03	6.97	11.00	5.54	5.39
Household size	2.02	2.33	2.03	1.85	1.99	1.77
Family coverage (%)	0.50	0.59	0.45	0.46	0.51	0.35
Employee insurance premium	2,444	1,108	359	2,250	998	303
Employer insurance premium	7,876	8,694	8,010	7,473	7,916	7,021
Out-of-pocket spending	1,249	1,354	1,485	1,237	1,352	1,643
Total health spending	10,425	6,463	3,148	10,777	6,149	2,796
Voluntary retirement contribution (403(b) + 457)	4.97	4.17	7.11	3.70	3.23	5.06
403(b) participation (tax deferred)	0.66	0.63	0.65	0.57	0.51	0.62
Roth participation (403(b) + 457)	0.07	0.12	0.19	0.11	0.13	0.19

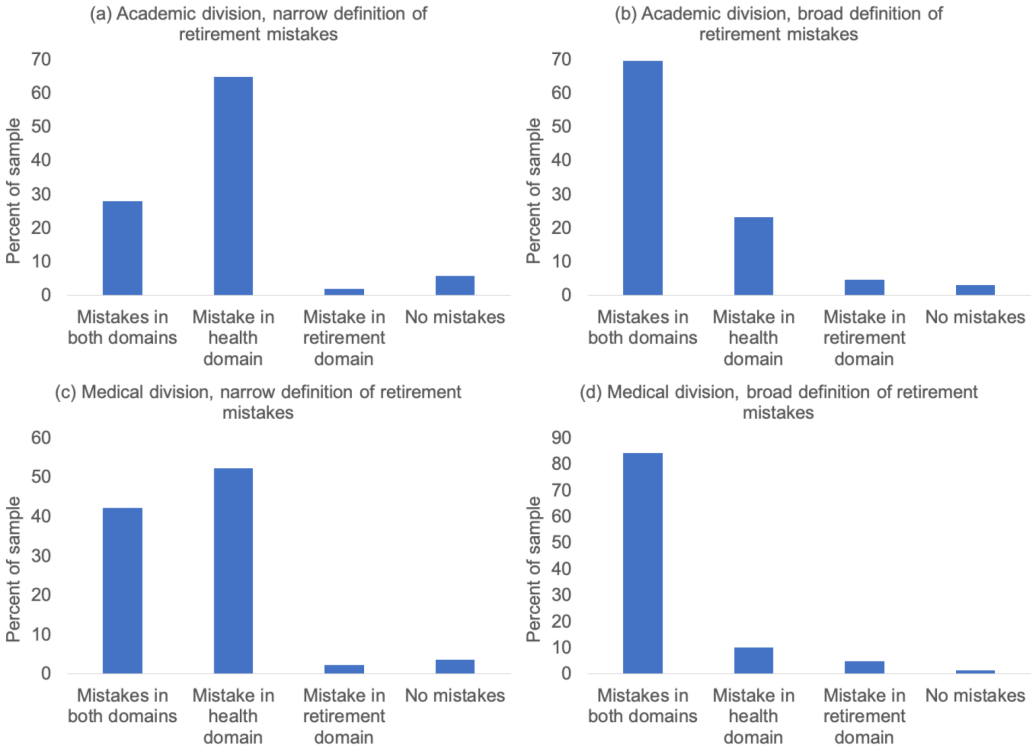
Notes: Table presents means of demographic and outcomes variables in sample by health insurance coverage level chosen. Administrative data on faculty at a large public university during 2014-2017. Descriptive statistics calculated separately by employees in academic division (columns 1-3) and medical division (columns 4-6).

Figure C3. CDFs of retirement contributions by plan and division



Note: Figure plots CDFs of voluntary retirement contributions among employees choosing each health insurance plan, separately by academic and medical divisions. Employees in the low-coverage plan make higher voluntary retirement contributions compared to employees in other plans throughout the distribution of contributions.

Figure C4. Proportions of types by academic vs. medical division



Notes: Figure plots the proportion of types according to whether they make mistakes in health insurance choices, retirement saving, neither domain, or both domains. Graphs are presented separately by academic (a and b) and medical divisions (c and d). Under the narrow definition of retirement mistakes, not making any voluntary retirement contributions constitutes a mistake in the retirement domain. Under the broad definition of retirement mistakes, contributing less than the amount to reach saving 15% of salary constitutes a mistake in the retirement domain. In both cases, choosing either the high- or medium-coverage plan constitutes a mistake in the health domain.

Table C2. Multinomial logit: Characteristics associated with types, broad definition of mistakes

	Type: Mistakes in both domains	Type: Mistakes in health domain	Type: Mistakes in retirement domain	Type: No mistakes
Tenure (in years)	0.006***	-0.002***	-0.003***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.004	0.008	-0.002	-0.002
	(0.007)	(0.006)	(0.003)	(0.002)
Faculty	-0.089***	0.080***	0.001	0.008**
	(0.009)	(0.007)	(0.005)	(0.003)
Salary bin (relative to < $45k)				
[$45k - 65k)	-0.111***	0.108***	-0.012***	0.015***
	(0.009)	(0.009)	(0.003)	(0.003)
[$65k -100k)	-0.211***	0.196***	-0.007	0.021***
	(0.009)	(0.009)	(0.004)	(0.004)
[$100k+)	-0.322***	0.304***	-0.016**	0.034***
	(0.010)	(0.009)	(0.005)	(0.004)
Age bin (relative to < 30 years)				
[30, 40)	0.037***	-0.012	-0.017***	-0.008*
	(0.011)	(0.010)	(0.004)	(0.003)
[50, 50)	0.031**	0.002	-0.023***	-0.011**
	(0.011)	(0.011)	(0.004)	(0.004)
[50, 59.5)	-0.002	0.048***	-0.036***	-0.010*
	(0.012)	(0.011)	(0.005)	(0.004)
[59.5+)	-0.024	0.081***	-0.047***	-0.011*
	(0.014)	(0.012)	(0.008)	(0.005)
Academic division	0.069***	-0.091***	0.013***	0.009**
	(0.009)	(0.009)	(0.003)	(0.003)
Coverage type (relative to Family)				
Employee Only	-0.092***	0.066***	0.011***	0.015***
	(0.008)	(0.007)	(0.003)	(0.003)
Employee Plus Child/Children	-0.062***	0.060***	-0.007	0.008**
	(0.009)	(0.008)	(0.004)	(0.003)
Employee Plus Spouse	0.012	0.015	-0.026***	-0.001
	(0.010)	(0.008)	(0.005)	(0.004)
Year (relative to 2014)				
2015	-0.010***	0.003	0.006***	0.001
	(0.003)	(0.003)	(0.002)	(0.001)
2016	-0.015***	0.000	0.012***	0.003*
	(0.004)	(0.003)	(0.002)	(0.001)
2017	-0.033***	-0.002	0.026***	0.008***
	(0.004)	(0.003)	(0.002)	(0.002)

Notes: Table present marginal effects from multinomial logit of types, based on mistakes made in health insurance and retirement saving. N = 47,754. Pseudo R^2 = 0.150. Standard errors clustered by employee in parentheses.
*** $p < 0.01$; ** $p < 0.05$, ** $p < 0.1$.

Appendix D. Construction of out-of-pocket cost distributions

This appendix details the procedure for constructing distributions of out-of-pocket costs for each employee and dependents. The approach is based on grouping people into "risk groups" according to demographics and previous health spending, and then to use the empirical distribution of out-of-pocket (OOP) payments among people in each risk group as a measure of beliefs. We first divide each insured individual according to five discrete age bins (younger than 30, 30-39, 40-49, 50-59.5, 59.5 and older) and gender (male, female). Within these groups, we further split into terciles based on 1-year lags of total health spending, combining both plan-paid spending and OOP spending. We classify people with the same grouping of age, gender, and cost tercile as being in the same risk group. To construct the distribution of out-of-pocket spending under plan j for people in risk group g, we take the distribution of observed spending of people within risk group g who chose plan j. We assign this distribution to people in risk group g who chose a different plan $k \neq j$.

To give an example, we group women aged 30-39 together, rank them by their total health spending in year t-1, and divide them evenly into three sub-groups (terciles) based on year t-1 spending. Within each tercile, we further split them based on their observed plan choice (low coverage, medium coverage, or high coverage) in year t. The empirical distribution of OOP for each of the three coverage levels is taken as the OOP distribution for each woman in that sub-group if she had chosen that coverage level.

The final step is to combine OOP distributions of each member of the family. We implement this by taking 500 draws for each employee or dependent from their group-specific OOP distribution under each plan, and sum each of the 500 draws across all family members to arrive at a distribution of OOP costs for the family. If the sum of OOP within families for any draw exceeds the plan's OOP max, we replace the OOP for that draw as the OOP max. This distribution of 500 OOP draws represents the family's belief about OOP risk under each available plan.

In constructing each OOP distribution, we pool multiple years together. Doing so ensures that each risk group based on age, gender, lagged cost tercile, and plan choice has a sufficiently large number of individuals. The only plans and years for which we construct distributions from a single year of data are the high-coverage and medium-coverage plans in 2014. Starting in 2015, the deductibles increased for these plans, raising average OOP spending by about $100. We pool 2015-2017 for constructing distributions for the medium-coverage and high-coverage plans in these years. Since cost sharing in the low-coverage plan remained roughly constant with the exception of a slight rise in the OOP max, we pool 2014-2017 in generating OOP distributions in the low-coverage plan.

It is important to note several assumptions made in this approach to constructing OOP distributions. First, we assume draws are independent within families. Draws might be positively correlated if family members have similar tastes for health care consumption that we do not model. On the other hand, OOP draws (not necessarily spending draws) might be negatively correlated due to the non-linear nature of the insurance contract. We believe modeling these correlations would introduce unnecessary complexity into this calculation without providing meaningfully different results. Second, we implicitly allow for selection on moral hazard (Einav et al. 2013) by allowing the OOP distributions to differ based on the plans people choose. But our approach of using the empirical distributions of chosen plans means we are assuming people do not vary in this dimension. Finally, we assume people have rational expectations regarding future spending risk based on their demographics and lagged spending, which is a standard assumption in modeling choices over health insurance plans.

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