CONSUMER RESPONSES TO PRICE TRANSPARENCY ALONE VERSUS PRICE TRANSPARENCY COMBINED WITH REFERENCE PRICING

CHRISTOPHER WHALEY
TIMOTHY BROWN
JAMES ROBINSON

ABSTRACT

Efforts to spur patient price shopping by providing access to price transparency tools have been met with limited success. One potential reason is the absence of financial incentives. This paper uses data from a large employer that implemented a price transparency platform and subsequently implemented a reference pricing program for laboratory and diagnostic imaging tests. We find no price shopping effects when the price transparency tool is offered alone. However, combining price transparency with reference pricing leads to significant shifts in consumer choice of facility, resulting in a 27 percent reduction in the average price paid per laboratory test and a 13 percent reduction in price paid per imaging test. A variety of public and purchaser initiatives have sought to further the development and adoption of price transparency tools. Our results imply that these tools will capture the attention of consumers, and influence their behavior, only if patients have strong financial incentives to care about prices.

KEYWORDS: price transparency, reference pricing, price variation
JEL CLASSIFICATION: D83, I11, I13

I. Introduction

Because of widespread variation in prices, the market for health-care services among the commercially insured population provides a large opportunity for patients and payers to save money by price shopping (Franzini et al. 2014; Cooper et al. 2015). Prices for common services often vary by orders of magnitude with little relationship existing between price and quality (Hussey, Wertheimer, and Mehrotra 2013). To spur patient price

Christopher Whaley (corresponding author, cwhaley@rand.org), RAND Corporation, Berkeley Center for Health Technology, and School of Public Health, University of California, Berkeley. Timothy Brown, Berkeley Center for Health Technology and School of Public Health, University of California, Berkeley. James Robinson, Berkeley Center for Health Technology and School of Public Health, University of California, Berkeley.

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shopping, some employers and insurers have recently implemented programs designed to encourage patients to receive care from less expensive providers. These programs typically address two underlying barriers to price shopping: patients have little information about prices, and insurance coverage has traditionally distorted the incentives to select less expensive providers. This paper examines the effects of two programs, price transparency and reference pricing, that were implemented sequentially by a nationwide grocery retailer, Safeway, and addresses each underlying barrier to price shopping. The sequential implementation of the programs allows for the first comparison between the effect of price transparency alone and the effect of combining price transparency with financial incentives.

To address information barriers about health-care prices, many employers and insurers now provide access to "price transparency" websites and mobile phone applications that allow patients to view provider prices. These websites and mobile phone applications range in operability and user-friendliness, and the initial evidence suggests that despite the sizable opportunity for price shopping, price transparency alone does little to shift consumers to low-priced providers. An early study of price transparency websites finds that actively searching for providers leads to an approximately 14 percent reduction in prices for laboratory tests and imaging tests, but has only an approximately 1 percent effect for physician visits (Whaley et al. 2014; Whaley 2015). However, only a small share of consumers actually shopped and so the overall effects are limited. A similar study finds that gaining access to a price transparency website leads to an approximately 1 percent increase in medical spending (Desai et al. 2016). The relatively small price transparency effect is likely in part due to low overall use of price transparency tools (Sinaiko and Rosenthal 2016; Mehrotra et al. 2017). A study of a telephone-based price transparency tool finds that active use of the tool leads to a 10 to 17 percent reduction in prices, although simply providing access to the tool only leads to a 1.6 percent reduction in prices (Lieber 2017). The lack of a strong response to price transparency has led to some to caution that price transparency may not be a solution to reducing health-care spending (Volpp 2016).

The second underlying barrier to price shopping is the lack of consumer incentives to seek care from less expensive providers. Generous insurance coverage has traditionally shielded consumers from provider prices. However, as a means to give consumers "skin in the game" to shop for less expensive providers, many employers have implemented high-deductible health plans (HDHPs). In 2015, 24 percent of those who receive insurance coverage through an employer were enrolled in an HDHP (Claxton et al. 2015). Almost a decade earlier, in 2006, this share was only 4 percent. The empirical evidence finds that overall, HDHPs lead to little price shopping (Sood et al. 2013; Haviland et al. 2016). This result is true even when HDHPs are combined with price transparency (Brot-Goldberg et al. 2017). However, a more recent study that looks at service-specific price shopping finds that enrollment in HDHPs leads to a 13 percent reduction in laboratory test prices, but has no effect on price shopping for physician office visits (Zhang et al. 2017).

One alternative to HDHPs is reference pricing. Under reference pricing, the payer sets a maximum reimbursement threshold for "shoppable" services. Patients who receive

care from providers with prices above this threshold are responsible for the full marginal difference between the provider's price and the maximum reimbursable amount. Unlike HDHPs, which primarily impact the extensive margin of utilization, reference pricing is designed to focus on the intensive price margin, or price shopping (Whaley, Guo, and Brown 2017).

This paper builds on two previous studies of the Safeway reference pricing program (Robinson, Whaley, and Brown 2016a,b). This paper extends the previous papers in three distinct ways. The primary difference is that in this paper, we both theoretically and empirically compare the effects of price transparency alone with the effects of price transparency combined with reference pricing. We find no evidence of price shopping in the initial months where only the price transparency tool is offered. However, we do find a sizable reduction in prices, approximately 27 percent for laboratory tests and approximately 13 percent for imaging tests, when price transparency is combined with the financial incentives of the reference pricing program. Second, we examine the distributional responses to each program. For laboratory tests, we find strong evidence of a shift from the middle of the distribution to the lower price percentiles. For imaging tests, we find a shift from the middle of the distribution to the tails of the distribution. Finally, we show that these results are robust when using an alternative comparison group.

This paper is unique to the literature on price shopping in health-care markets in that it provides the first within-firm comparison of two different incentive schemes. This within-firm comparison is important because of the potential for selection into price transparency or reference pricing. We find that when offered price transparency alone, Safeway employees do not shop. However, when subject to a different incentive scheme, reference pricing, approximately a year later, there is substantial price shopping. The Safeway population is perfectly able to price shop, but the incentives have to be aligned and must be reasonably high powered. Previous price transparency studies have not addressed whether price transparency combined with other programs, such as reference pricing, can succeed where price transparency alone has been less successful than anticipated.

The lack of a price shopping effect for price transparency tools, even when combined with HDHPs, may not be surprising given the absence of a change in the marginal financial incentives for consumers. This paper uses a theoretical search costs model to show how reductions in search costs, through the introduction of price transparency, leads to little change in consumer choices under the presence of traditional insurance coverage. However, by changing the marginal out-of-pocket prices between high- and low-priced providers, reference pricing amplifies the effects of reduced search costs. As this model makes clear, simply lowering consumer search costs without a sufficient change in financial incentives should not lead to changes in patient behavior.

From a policy perspective, the results of this paper suggest that price transparency information alone leads to modest behavioral changes. Instead, the largest behavioral responses occur when price information is paired with strong financial incentives. This finding is relevant because approximately 20 percent of large employers offer price transparency programs, but far fewer offer reference pricing and similar programs (Mercer 2016). This paper demonstrates that, at least among one employer population, information

about prices alone is not sufficient to change consumer behavior, but combining information with incentives can induce substantial price shopping.

The rest of the paper proceeds as follows. Section II provides institutional background. Section III presents a conceptual model on how price transparency and reference pricing change consumer search. Section IV describes our empirical approach while Section V describes the data used. Section VI presents our main results and Section VII examines the distributional effects of the programs. Section VIII presents a robustness test and Section IX concludes.

II. Institutional Background

In August 2010, Safeway provided access to an online price transparency tool provided by Castlight Health that allows employees and their dependents to view provider prices. The online tool displays information on the provider's negotiated price (the allowed charge) and the amount the patient is expected to pay. This estimated patient cost-sharing amount takes into account patient deductibles, copayments, and coinsurance. The tool also displays information on provider location, quality, and patient satisfaction. During this time, Safeway had an HDHP with a deductible of $1,200 but had not implemented reference pricing. Because of the deductible, Safeway patients had a financial incentive to use the price transparency tool.

During the next year, 2011, Safeway implemented an insurance benefit program, which was also designed and implemented by Castlight Health, that uses targeted patient cost-sharing to incentivize price shopping: reference pricing. In March 2011, Safeway implemented reference pricing for laboratory tests, and in November 2011, Safeway implemented reference pricing for diagnostic imaging tests (e.g., CT scans and MRIs). For these common and "shoppable" services, the reference pricing program requires patients to pay the full marginal price above a prespecified reference payment limit, the "reference price." If a patient receives care from a provider with a price below the reference price, then the patient is only responsible for standard cost-sharing (e.g., copay, coinsurance, and deductible payments). If a patient receives care from a provider priced above the reference limit, then standard cost-sharing applies only up to the reference price. Above the reference price, the consumer is responsible for the entirety of the difference between the provider's price and the reference price. Any spending above the reference price does not count towards the patient's deductible threshold or annual out-of-pocket maximum. In addition, patients who have reached their deductible or out-of-pocket maximum are still responsible for the entire amount above the reference price.

The reference price is set for each individual laboratory test and imaging services and for each local market at approximately the 60th percentile of the price distribution. Previous studies have found that by the last observed year of the program, the reference pricing program led to a 32 percent reduction in prices for laboratory tests, a 12.5 percent reduction in prices for CT scans, and a 10.5 percent reduction for MRIs (Robinson, Whaley, and Brown 2016a,b). In 2010, the year before the introduction of the reference pricing program, laboratory tests and imaging services accounted for 5.6 percent and 9.7 percent, respectively, of the $174 million Safeway spent on medical services. Among the broader

commercially insured population, laboratory tests and imaging account for 8.0 percent and 4.9 percent of medical spending (Robinson, Brown, and Whaley 2017).

Laboratory and diagnostic imaging tests are an ideal service for a program like reference pricing as there is little or no difference in clinical quality between providers, but there is substantial variation in provider prices. In the data used for this study, the average within-market ratio of prices between the 75th and 25th price percentiles is 2.4 for laboratory tests and 5.3 for diagnostic imaging services. For both types of diagnostic tests, this variation in prices is largely driven by differences in two competing organizational structures. Both tests have traditionally been performed in both the hospital and the physician office. In recent years, however, alternative sites, specifically independent laboratory chains and freestanding imaging centers, have grown rapidly. The presence of distinct low-priced providers makes the reference pricing program easier to understand and implement. In essence, the program aims to increase the agency that patients have over their testing facility and thereby shift patients from facility-based testing centers and towards the less expensive independent providers.

III. Conceptual Model

We start with a conceptual model of how lowering consumer search costs through the addition of price transparency changes consumer decision making. We use this model to compare the expected changes in consumer decision making under no changes in financial incentives (i.e., implementing price transparency alone) with changes in financial incentives (i.e., introducing both price transparency and reference pricing).

This model assumes that each consumer i receives one unit of care from a diagnostic test (lab test or imaging test) provided by provider $j \in J$ at time t. When fully informed, consumer utility is given by

$$U_{ij} = \alpha + \beta X_{ij} - \gamma OOP(p_j) \quad (1),$$

where X_{ij} represents the nonprice attributes of the service (e.g., quality, distance between the patient and the provider, and patient satisfaction). Because many health-care decisions are made based on provider recommendations, X_{ij} can also include whether a diagnostic test facility is recommended by the patient's physician. $OOP(p_j)$ represents patient cost-sharing, which is a function of the provider's price, p_j. We define $OOP(p_j) = cp_j$, where $c \in [0, 1]$ represents the patient's coinsurance rate. For simplicity, this cost-sharing schedule omits copay and deductible payments, but the results are similar if these types of cost-sharing are included. The β parameter measures consumer responsiveness to nonprice attributes, while the γ parameter represents consumer price sensitivity.

This framework can be used to examine the effects of changes in consumer search costs (Stigler 1961). With a given search cost ν and for a given provider $k \in J$, the patient will decide to continue searching as long as the expected benefit of searching is greater than the patient's search costs:

$$E[U_{ij}] - U_{ik} > \nu \quad (2).$$

For a given search cost, the patient selects the provider with the highest expected indirect utility among the considered providers:

$$j_i^* = \arg\max_{j \in J}(U_{ij}|\nu) \tag{3}.$$

Thus, holding the nonprice attributes, X_{ij}, constant, the expected out-of-pocket costs are given by $OOP(p^*|X_{ij}, \nu)$, where p^* is the price of the chosen provider.

To examine the effects of changing search costs on prices, consider two search costs ν_1 and ν_2 such that $\nu_1 < \nu_2$. With these search costs and holding X_{it} constant, the difference in out-of-pocket prices is given by

$$\begin{aligned} OOP(p^*|X_{ij}, \nu_2) - OOP(p^*|X_{ij}, \nu_1) &= cp_2^* - cp_1^* \\ &= c(p_2^* - p_1^*) \\ &< 0 \end{aligned} \tag{4}.$$

Because patient cost-sharing is an increasing function of p_j, reducing search costs will also lower the cost of the service as patients select less expensive providers (Stigler 1961; Hortacsu and Syverson 2004; Ho, Hogan, and Morton 2015). Intuitively, lowering search costs through the introduction of price transparency should have the effect of reducing patient cost-sharing, which under traditional insurance coverage can only be done through selecting less expensive providers. However, the price-reducing effects of decreased search costs are limited by the presence of insurance coverage.

Now consider the case of reference pricing. Under reference pricing, patient cost-sharing is a nonlinear function of the provider's price, p_j. More formally, letting c represent the coinsurance rate and R represent the reference price, cost-sharing is defined as

$$OOP(p_j) = \begin{cases} cp_j & \text{if } p_j \leq R \\ cR + (p_j - R) & \text{if } p_j > R \end{cases} \tag{5}.$$

If the provider's price is below the reference price ($p_j \leq R$), then patient cost-sharing is simply the sum of the coinsurance rate multiplied by the provider price. If the provider's price is above the reference price, $p_j > R$, then patient cost-sharing is equal to the sum of the coinsurance rate reference price multiplied by the provider price and the entire difference between the provider's price and the reference price.

This nonlinearity in the cost-sharing schedule changes the marginal incentives for consumers. Under reference pricing, $\frac{\partial U}{\partial p} = \gamma c$ for providers below the reference price, which is the same as under traditional insurance coverage, and $\frac{\partial U}{\partial p} = \gamma$ for providers above the reference price. This comparative static makes clear the intent of the reference pricing program. When patients are exposed to the program, they are responsible for the entire marginal cost above the reference price.

In this scenario, the difference in cost-sharing is given by

$$OOP(p^*|X_{ij}, \nu_2) - OOP(p^*|X_{ij}, \nu_1) = \begin{cases} c(p_2^* - p_1^*) & \text{if } p_1^* \text{ and } p_2^* \leq R \\ c(p_2^* - R) - p_1^* + R & \text{if } p_1^* \geq R \text{ and } p_2^* \leq R \\ p_2^* - p_1^* & \text{if } p_1^* \text{ and } p_2^* \geq R \end{cases} \quad (6).$$

If both p_1^* and p_2^* fall below the reference price, then there is no difference in prices between the reference pricing and non–reference pricing environments. However, if the initial price, p_1^*, is above the reference price, then the reduction in prices following a reduction in search costs is greater than in the non–reference pricing environment. Intuitively, the financial incentives of reference pricing amplify the price-reducing effects of reductions in search costs, while the presence of insurance coverage attenuates the effects of reductions in search costs.

This simple model implies that assuming search costs are reduced equally, the incentives to price shop under an HDHP are greater than or equal to the incentives of price shopping under reference pricing. In an HDHP, and assuming that the consumer is below the deductible, the difference in patient cost-sharing is $p_2^* - p_1^*$. For the five most common laboratory and imaging tests, Online Appendix Table 1 (http://www.mitpressjournals.org/doi/suppl/10.1162/ajhe_a_00118) calculates the expected savings under three scenarios—reference pricing, HDHPs below the deductible, and coinsurance, which includes HDHPs above the deductible. Especially for laboratory tests, a single test is unlikely to account for the entire $1,200 deductible. Reference pricing incentivizes moving from the 75th to the reference price, while HDHPs incentivize moving below the reference price. In all cases, the expected savings are larger for the HDHP scenario, even when the absolute price differences are relatively small. However, with the exception of Zhang et al (2017), there is very empirical little evidence of price shopping in HDHPs.

IV. Estimation Strategy

We next empirically compare differences in price trends between the Safeway and Anthem populations, before and after the implementation of price transparency and the addition of reference pricing. We estimate the effects of each program separately for laboratory tests and imaging services. For each, we estimate the effects of both the price transparency and the addition of reference pricing to price transparency as

$$\ln(price_{ikt}) = \alpha + \gamma_1 SFWY_i + \gamma_2\, post\ transparency_t \times SFWY_i + \gamma_3 postRP_t \times SFWY_i + \psi_k CPT_k + X_i + T_t year_t + \tau_t month_t + \varepsilon_{ikt} \quad (7).$$

In this expression, $\ln(price_{ikt})$ measures the primary dependent variable, the log-transformed negotiated price for the service test k received by patient i at time t. This price is commonly referred to as the claims "allowed amount" or "allowed charge" and captures total spending by the insurer, employer, and patient. We include allowed amounts for both

the facility and professional fees. $SFWY_i$ indicates that patient i receives insurance coverage through Safeway (with Anthem being the comparison group). Within each service type (laboratory and imaging tests), CPT_k includes fixed effects for each of the laboratory test and imaging test current procedural terminology (CPT) codes. X_i contains patient demographics (age, gender, three-digit zip code), and $year_t$ and $month_t$ contain year and month fixed effects, respectively.

The key variables of interest are the $post\ transparency_t \times SFWY_i$ and $postRP_{kt} \times SFWY_i$ interaction terms. The first term measures the change in prices following access to the online price transparency tool for Safeway enrollees, which occurred in August 2010. The second interaction term measures the additive effect of combining price transparency with the targeted consumer incentives of reference pricing, which occurred in March 2011 for laboratory tests and November 2011 for imaging services. We omit the $post\ transparency_t$ and $postRP_t$ main effects because we include year fixed effects.[1]

A causal interpretation of each interaction term requires two assumptions. First, we must assume that both the Safeway and Anthem populations would have experienced the same trends in the absence of either program. We empirically test this assumption in Figures 2 and 3. Second, we must assume that no asymmetrical contemporaneous shocks occurred that might influence prices or price shopping, in other words, any contemporaneous shocks that occurred equally affected the treatment (Safeway) and comparison (Anthem) groups. While this assumption is by nature untestable, we are unaware of any asymmetric contemporaneous shocks. Moreover, the price transparency and reference pricing programs are implemented midyear rather than in January, when most other benefit designs occur, which limits concerns of influences due to other asymmetric benefit design changes.

To control for potential time-varying changes, we add several controls to this baseline model. We add year by month interactions to control for seasonal time trends. To control for market-level time trends that might impact prices, we add fixed effects for year interacted by market, which we define as the patient's three-digit zip code. We similarly control for year and CPT code interactions to account for test-specific technology shocks that may either increase or decrease the price of a given diagnostic test. We estimate each regression using ordinary least squares (OLS) and cluster standard errors at the CPT-code level. The results are robust to alternative clustering approaches.

V. Data

A. SAFEWAY MEDICAL CLAIMS DATA

Our primary source of data is the universe of all Safeway medical claims between 2010 and 2013. During this period, Safeway used Cigna as its insurance carrier. Both the price transparency and the reference pricing programs were only implemented for Safeway's nonunionized employee populations. We thus include only nonunionized employees and

1 However, a robustness test that replaces the year fixed effects with the two post-period main effects has similar results.

their dependents.[2] These data contain the specific type of laboratory or imaging test, which are identified by CPT codes, the negotiated price between the laboratory test provider and Safeway's insurer, and the portions of the negotiated price paid by the patient and by Safeway. Basic patient demographics such as age, gender, and three-digit zip code are also included.

We restrict the sample to all laboratory and imaging tests received in an office-based or independent laboratory/imaging setting. We exclude tests received in inpatient, emergency department, and skilled nursing facility settings because laboratory and imaging tests in these settings are exempted from the reference pricing program. This sampling leaves a total of 341,350 laboratory tests and 6,080 diagnostic imaging service claims among the Safeway population.

B. ANTHEM LABORATORY AND IMAGING CLAIMS

Our second data source consists of all laboratory test and diagnostic imaging claims for enrollees of a large, nationwide insurer, Anthem Inc., over the same time period. This sample includes approximately 250 million claims. To ease computational load, we use a random 5 percent sample of Anthem claims that is matched based on geography to the Safeway population at the three-digit zip code level. We apply the same sample restrictions as in the Safeway data. Across the 2010–13 period, we use 2.1 million laboratory test claims and 31,670 imaging tests from the Anthem population.

During this period, Anthem did not implement reference pricing for either laboratory tests or imaging services. However, some employers in the Anthem population may have implemented price transparency tools, but we are unable to observe the potential price transparency programs among the comparison population. To reduce concerns of potential attenuation bias, in Section VIII, we estimate a robustness test that uses an internal comparison group of the Safeway laboratory and imaging tests not covered by the reference pricing program and find nearly identical results.

For each sample, Table 1 displays summary statistics. For both laboratory and diagnostic imaging tests, the Safeway and Anthem populations have similar demographics. Prices in 2010 are also similar for both populations. Figure 1 shows the geographic regions included in this study. The patient population is largely concentrated in the western US states, but there is also a presence in the Midwest and mid-Atlantic regions.

VI. Results

A. CHANGES IN PRICES

Table 2 presents the differences-in-differences regression results from equation 7 for laboratory tests. The first column controls for patient age and gender, and it includes fixed effects for year, month, CPT code, and three-digit zip code. In the first row, we do not find that access to the price transparency platform reduced laboratory test prices, despite

2 We unfortunately do not have access to data from the unionized Safeway population, which prevents us from using this population as a within-Safeway comparison group.

TABLE 1. Summary statistics

	Safeway		Anthem	
	Mean	SD	Mean	SD
Panel a: Laboratory tests				
Patient age	44.47	12.26	45.98	12.39
Percentage male	40.86%	49.16%	42.08%	49.37%
2010 price	$28.39	$37.11	$28.60	$42.60
N patients	30,453		184,293	
N observations	341,350		2,101,861	
Panel b: Diagnostic imaging				
Patient age	46.73	11.69	45.97	12.32
Percentage male	42.25%	49.40%	44.44%	49.69%
2010 price	$618.76	$451.43	$626.16	$606.19
N patients	3,868		28,495	
N observations	6,080		31,670	

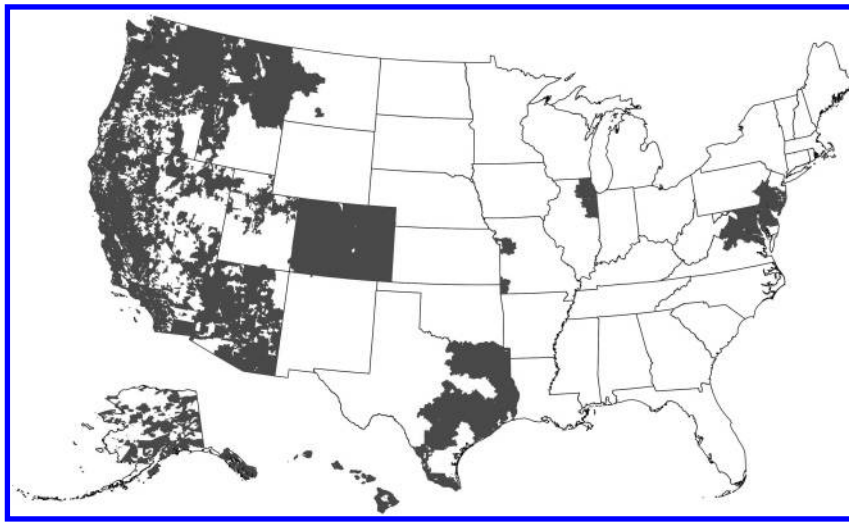
the financial incentives of the existing HDHP. However, following the introduction of reference pricing, we find a 27.2 percent reduction in prices.[3] In columns 2–4 we add the year by month, year by three-digit zip code, and year by CPT code interactions. These additional controls do not change the results. The magnitude of the combined reference pricing and price transparency effect is approximately twice the size of the HDHP price shopping effect found in Zhang et al. (2017).

Applying the percentage reduction due to the combination of price transparency and reference pricing to the average laboratory test price in the pre–reference pricing period for the Safeway population, $28.39, results in a $7.73 reduction due to combination of the price transparency and reference pricing programs. Multiplied by the volume of tests following the launch of the reference pricing program results in a $1.69 million reduction in spending on laboratory tests due to the combination of price transparency with reference pricing.

The main Safeway effect indicates that at baseline, prices for the Safeway population were approximately 7 percent lower than for the Anthem population. This difference in prices is due to both differences in baseline prices between the Cigna and Anthem populations and the composition of the Safeway population relative to the Anthem population. In column 1, the year fixed effects show a slight decrease in prices for both populations during this time period. While we do not test the causes of this overall trend decrease, one potential explanation is the growth of independent laboratory testing facilities

3 Because the dependent variable is log-transformed, the coefficients can be interpreted as percentage changes by applying $\exp(\beta) - 1$.

FIGURE 1. Geographic distribution of study population



Note: This figure plots the geographic distribution of the population included in this study.

during this time period. The savings due to the combination of reference pricing and price transparency are in addition to these baseline and time differences in prices.

Table 3 presents the results for imaging tests. For all four specifications, we find minimal impacts of price transparency on prices. All four coefficients are positive, but are not statistically significant. However, the results in all four columns show sizable reductions in imaging test prices following the implementation of reference pricing. The effects range from a 12.5 percent reduction in the specification with year by three-digit zip code fixed effects to a 13.6 percent reduction in the specification with year by month interactions. At the mean pre–reference pricing Safeway price of $644, these reductions imply an $80.2 to $87.5 reduction in the average cost per imaging test due to the combination of price transparency and reference pricing, which results in an approximately $197,000 reduction in spending on imaging tests.

As an additional test, Figure 2 plots the regression-adjusted monthly difference in laboratory test (panel a) and advanced imaging (panel b) prices between Safeway and Anthem patients. Laboratory test prices between Anthem and Safeway patients are neither economically nor statistically different in the pre–price transparency period, which supports the parallel trends assumption. There is a slight decrease in prices in the month prior to the introduction of the reference pricing program, which suggests the possibility of an anticipatory response to the program. The implementation of reference pricing in March 2011 leads to a sizable decrease in prices paid. This decrease remains constant for the remainder of the post–reference pricing period. The stability of the post–reference pricing effect suggests that reference pricing for laboratory tests leads to a one-time reduction in costs, rather than a change in the growth of costs.

TABLE 2. Differences-in-differences estimates of the effects of price transparency alone and price transparency combined with reference pricing—laboratory tests

	(1)	(2)	(3)	(4)
	ln(price)	ln(price)	ln(price)	ln(price)
Dependent variable				
Safeway X price transparency access	0.004	−0.009	0.005	0.004
	(0.008)	(0.008)	(0.007)	(0.008)
Safeway X reference pricing	−0.318[a]	−0.310[a]	−0.317[a]	−0.319[a]
	(0.019)	(0.019)	(0.020)	(0.019)
Safeway	−0.075[a]	−0.069[a]	−0.078[a]	−0.075[a]
	(0.023)	(0.023)	(0.022)	(0.023)
2011	−0.019[a]	0.004	−0.009	0.211[a]
	(0.004)	(0.005)	(0.033)	(0.002)
2012	−0.035[a]	−0.034[a]	0.025	0.294[a]
	(0.007)	(0.007)	(0.032)	(0.002)
2013	−0.039[a]	−0.028[a]	0.152[a]	0.080[a]
	(0.011)	(0.010)	(0.033)	(0.002)
Controls				
CPT, month, three-digit zip code fixed effects	X	X	X	X
Year X month fixed effects		X		
Year X three-digit zip code fixed effects			X	
Year X CPT code fixed effects				X
Observations	2,442,653	2,442,653	2,442,653	2,442,653
R^2	0.352	0.352	0.355	0.353

Notes: This table presents the regression results from equation 7 and compares laboratory test price trends between the Safeway and Anthem populations. In each column, the dependent variable is the log-transformed price for each laboratory test. Each column includes CPT code, month, and three-digit zip code fixed effects. Columns 2–4 include year by month, year by three-digit zip code, and year by CPT code fixed effects, respectively. Robust standard errors clustered at CPT-code level are in parentheses. [a]$p < 0.01$, [b]$p < 0.05$, [c]$p < 0.10$.

Panel b presents similar results for diagnostic imaging services, but because of the smaller sample size, it uses quarters instead of months. This figure also confirms the parallel pre-trends assumption. Prices between the Safeway and Anthem populations are not statistically different until following the implementation of the reference pricing program. However, unlike the laboratory test results, the price differences between the Safeway and Anthem populations revert back to their pre–reference pricing differences by the end of the sample.

Based on the evidence of anticipatory responses, Online Appendix Tables 2 and 3 present similar results, but exclude the month prior to the implementation of the reference

TABLE 3. Differences-in-differences estimates of the effects of price transparency alone and price transparency combined with reference pricing—imaging tests

	(1) ln(price)	(2) ln(price)	(3) ln(price)	(4) ln(price)
Dependent variable				
Safeway X price transparency access	0.035	0.055	0.037	0.036
	(0.031)	(0.035)	(0.029)	(0.031)
Safeway X reference pricing	−0.136[a]	−0.146[a]	−0.133[a]	−0.141[a]
	(0.032)	(0.033)	(0.031)	(0.033)
Safeway	0.194[a]	0.183[a]	0.190[a]	0.197[a]
	(0.050)	(0.052)	(0.050)	(0.049)
2011	−0.008	0.077[b]	0.281	−0.038[a]
	(0.015)	(0.037)	(0.179)	(0.013)
2012	0.001	−0.054	0.461[a]	0.015
	(0.014)	(0.039)	(0.105)	(0.015)
2013	−0.009	0.007	−0.396[a]	0.028[b]
	(0.011)	(0.048)	(0.114)	(0.011)
Controls				
CPT, month, three-digit zip code fixed effects	X	X	X	X
Year X month fixed effects		X		
Year X three-digit zip code fixed effects			X	
Year X CPT code fixed effects				X
Observations	37,750	37,750	37,750	37,750
R^2	0.139	0.140	0.149	0.142

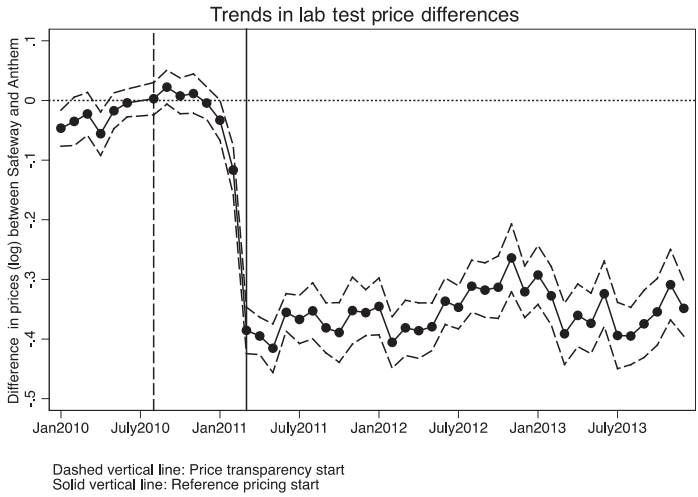
Notes: This table presents the regression results from equation 7 and compares imaging price trends between the Safeway and Anthem populations. In each column, the dependent variable is the log-transformed price for each imaging test. Each column includes CPT code, month, and three-digit zip code fixed effects. Columns 2–4 include year by month, year by three-digit zip code, and year by CPT code fixed effects, respectively. Robust standard errors clustered at CPT-code level are in parentheses. [a]$p < 0.01$, [b]$p < 0.05$, [c]$p < 0.10$.

pricing program, February 2011 for laboratory tests and October 2011 for imaging tests. The results are nearly identical to the main results.

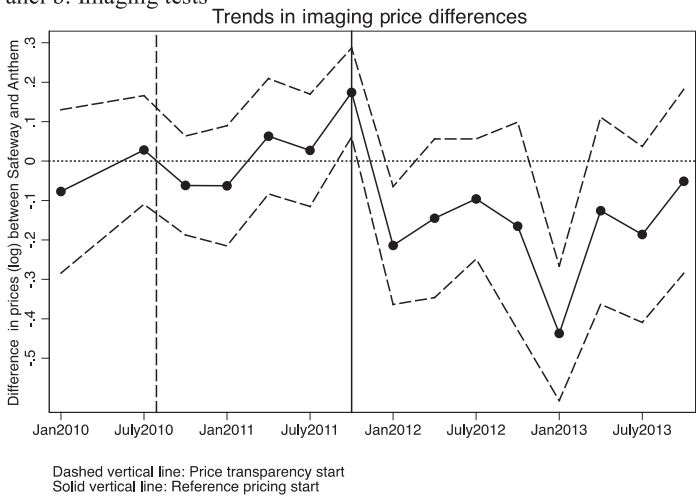
These reductions in prices are driven by shifting consumer demand from high-priced to low-priced providers. While expanded reference pricing programs may lead to reductions in provider prices, the Safeway population is geographically dispersed and does not have a concentrated population within any market. We are thus unlikely to see provider responses to the Safeway reference pricing program. However, expanded programs may induce supply-side competition in markets with a large concentration of patients who are subject to reference pricing programs (Whaley and Brown 2017).

FIGURE 2. Trends in price differences between Safeway and Anthem

Panel a: Laboratory tests



Panel b: Imaging tests

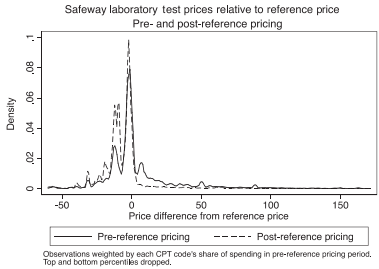


Notes: These figures plot regression coefficients that compare price differences between the Anthem and Safeway populations. The top panel presents monthly differences in laboratory test prices, while the bottom panel presents quarterly price differences for imaging tests. The dependent variable is the log-transformed price for each test. The dashed vertical line indicates the implementation of price transparency, while the solid vertical line indicates the start of the reference pricing program. Each regression includes controls for CPT code, patient age, gender, and three-digit zip code. The error bars represent 95 percent confidence intervals using robust standard errors clustered at CPT-code level in parentheses.

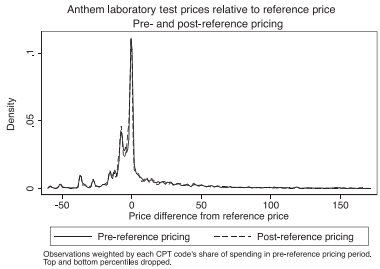
FIGURE 3. Distribution of prices relative to reference price

Panel a: Laboratory tests

(a) Safeway treatment group

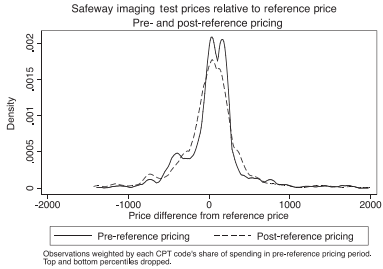


(b) Anthem comparison group

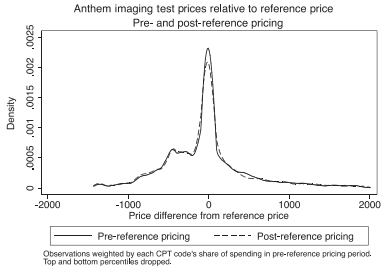


Panel b: Imaging tests

(a) Safeway treatment group



(b) Anthem comparison group



Notes: Each figure plots the distribution of prices relative to the reference price. Relative prices are calculated by subtracting the reference price from the observed procedure price. Panel a presents relative price distributions for laboratory tests, while panel b presents distributions for imaging tests. In each panel, the left figure (a) presents the relative price distribution for the Safeway population, while the right figure (b) presents the relative price distribution for the Anthem population. Each distribution is weighted by the population-specific share of spending in the pre–reference pricing period for each CPT code. The top and bottom percentiles are dropped from each distribution.

VII. Distributional Effects

While the main results present the mean effects, understanding the distributional effects is important because price transparency and reference pricing provide information and financial incentives, respectively, to avoid high-priced providers. Thus far the results have examined only the mean effects and do not consider where in the price distribution the effects are occurring.

Descriptive evidence on the effect of the program on the distribution of prices is shown in Figure 3, which plots the pre– and post–reference pricing time period differences in prices relative to the reference price. The relative prices are calculated by subtracting the reference price, specific to each CPT code and geographic market, from each observed price. For each distribution, we drop the top and bottom percentiles. To avoid attributing changes in the use of specific tests to changes in the distribution of prices, each figure is

weighted by the population-specific share of spending attributable to each CPT code in the pre–reference pricing period.

Panel a plots the distributions of relative prices for laboratory tests. For the Anthem population, the distributions of relative prices are similar in the pre– and post–reference pricing periods. However, for the Safeway population, we find a downward shift in the distribution of relative prices. Panel b presents the distributions for imaging tests. For the Anthem population, both the pre– and post–reference pricing distributions are similar. For the Safeway population, there is a noticeable shift in the distribution of relative prices.

Online Appendix Figure 1 presents similar distribution plots, but plots the density of log-transformed prices for each service and population, before and after the implementation of reference pricing. The price densities are consistent with the distributions in Figure 3.

To more formally test for distributional price differences, we estimate changes in the probability of having a test below the 10th, 25th, and 50th price percentiles, or above the 50th, 75th, and 90th price percentiles. We define these price percentiles specific to each population and three-digit zip code and use observations from the pre–reference pricing period to define the percentiles. For each price percentile threshold, we estimate the same regression as equation 7, but replace the price-dependent variable with the probability of having a test below or above the selected price percentile.

These results are shown in Table 4. The top panel presents the laboratory test results, while the bottom panel presents the imaging test results. Following the implementation of the price transparency program, the probability of receiving a test priced below the 10th, 25th, and 50th price percentile decreased by 5.7, 5.7, and 3.2 percentage points, respectively. The probability of having a test priced above the 50th price percentile increased by 2.3 percentage points. These results imply that following the introduction of price transparency, the distribution of laboratory test prices for the Safeway population increased relative to the Anthem population.

However, following the addition of reference pricing, and relative to the Anthem population, Safeway patients were much more likely to receive care lower in the distribution. The probability of receiving a lab test with a price below the 10th, 25th, and 50th price percentiles increased by 8.4, 12.0, and 18.3 percentage points, respectively. The probability of receiving a lab test priced above the 50th and 75th price percentiles decreased by 3.8 and 3.6 percentage points, respectively. Following both the price transparency and price transparency combined with reference pricing programs, there was no change in the probability of receiving a laboratory test above the 90th price percentile.

The relatively small shift above the 50th price percentile suggests that most of the mean effect is driven by changes in the middle of the price distribution. The absence of any reduction in the probability of having a lab test above the 90th price percentile suggests that patients did not respond to either the price transparency or reference pricing programs by shifting demand away from the highest-priced providers. This result is surprising, as avoiding the highest-priced providers can lead to the largest financial savings for the patient.

TABLE 4. Distributional effects of price transparency and reference pricing

Panel a: Laboratory tests	(1) Below 10th pct.	(2) Below 25th pct.	(3) Below 50th pct.	(4) Above 50th pct.	(5) Above 75th pct.	(6) Above 90th pct.
Safeway X price transparency access	−0.057[a]	−0.057[a]	−0.032[a]	0.023[a]	0.007	−0.004
	(0.003)	(0.004)	(0.004)	(0.008)	(0.004)	(0.003)
Safeway X reference pricing	0.084[a]	0.120[a]	0.183[a]	−0.038[a]	−0.036[b]	−0.007
	(0.010)	(0.012)	(0.011)	(0.015)	(0.017)	(0.011)
Safeway	−0.017[a]	−0.023[a]	−0.066[a]	−0.113[a]	−0.067[a]	−0.028[a]
	(0.004)	(0.005)	(0.006)	(0.013)	(0.004)	(0.004)
Observations	2,397,284	2,397,284	2,397,284	2,397,284	2,397,284	2,397,284
R^2	0.105	0.091	0.076	0.037	0.022	0.020
Baseline mean	0.046	0.123	0.334	0.383	0.193	0.073
Panel b: Imaging tests	(1) Below 10th pct.	(2) Below 25th pct.	(3) Below 50th pct.	(4) Above 50th pct.	(5) Above 75th pct.	(6) Above 90th pct.
Safeway X price transparency access	0.002	−0.018[c]	−0.008	−0.029[c]	−0.042[a]	0.008[b]
	(0.006)	(0.010)	(0.015)	(0.015)	(0.010)	(0.003)
Safeway X reference pricing	0.255[a]	0.255[a]	0.216[a]	0.163[a]	0.178[a]	0.169[a]
	(0.017)	(0.013)	(0.015)	(0.014)	(0.015)	(0.020)
Safeway	−0.030[a]	−0.086[a]	−0.165[a]	−0.162[a]	−0.092[a]	−0.053[a]
	(0.006)	(0.009)	(0.016)	(0.019)	(0.011)	(0.004)
Observations	33,075	33,075	33,075	33,075	33,075	33,075
R^2	0.086	0.053	0.032	0.027	0.031	0.042
Baseline mean	0.044	0.165	0.429	0.434	0.187	0.057

Notes: This table presents the regression results that examine the distributional effects of each program. Panel a presents results for laboratory tests and panel b presents results for imaging tests. In each column, the dependent variable is the probability that the procedure is below the 10th percentile (column 1), below the 25th percentile (column 2), below the 50th percentile (column 3), above the 50th percentile (column 4), above the 75th percentile (column 5), and above the 90th percentile (column 6). Each column includes CPT code, month, and three-digit zip code fixed effects. Robust standard errors clustered at CPT-code level are in parentheses.
[a]$p < 0.01$, [b]$p < 0.05$, [c]$p < 0.10$.

The results for imaging tests in panel b show very little distributional change following the introduction of price transparency. However, once reference pricing was combined with price transparency, there is a large increase in the probability of receiving an imaging test at both tails. The probability of receiving an imaging test priced both below the 10th price percentile and above the 90th price percentile increased by over 15 percentage points,

which is well above the baseline mean share. This result is also surprising, as it suggests that consumers may not fully understand the reference pricing program for imaging tests, even though a price transparency tool was available.

VIII. Robustness Test: Internal Comparison Group

One limitation of using the Anthem population as a comparison group is the potential that other Safeway programs may lead to the observed changes in price shopping behavior. In addition, some employers in the Anthem data may have access to either the same or alternative price transparency tools. Unfortunately, we cannot identify the employers in the Anthem data or measure their access to price transparency information. To reduce the potential bias due to these concerns, we estimate a robustness test that uses data only from Safeway, but compares price trends between laboratory tests and imaging services that were subject to the reference pricing program with those that were not. In 2010, the CPT codes covered by the reference pricing program accounted for 72.6 percent of the laboratory tests received by the Safeway population and 66.3 percent of laboratory test spending. For imaging services, the covered tests accounted for 15.6 percent of imaging test volume and 23.5 percent of imaging spending.

One potential limitation of comparing price trends for covered and noncovered services within the same employer is the potential for spillovers between shopping behavior for covered tests with noncovered tests. For example, a patient may go to a low-priced provider to receive a covered test but at the same provider receive a noncovered test. In addition, we do not observe the specific laboratory tests for which prices are displayed in the price transparency tool. The price shopping tool likely displays information for both covered and noncovered tests. For these reasons, the results that use the Anthem population as a comparison group are our primary results, but this test provides a robustness test.

With just the Safeway data, we estimate the effects of the program as

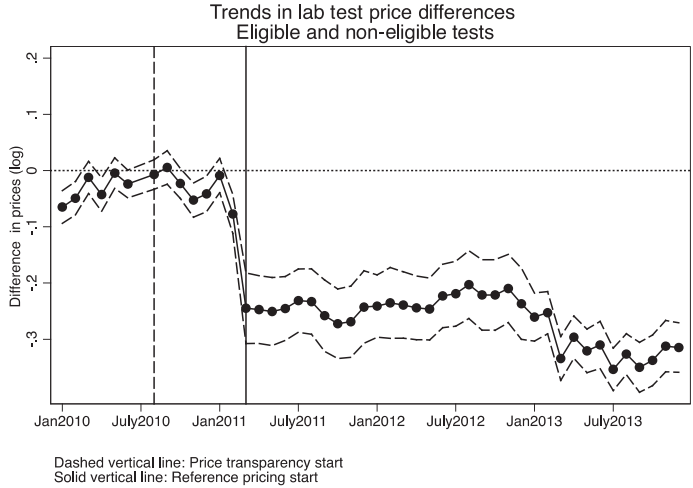
$$\ln(price_{ikt}) = \alpha + \beta_1 post\ transparency_t \times covered_k + \beta_2 postRP_t \times covered_k + \psi CPT_k + X_i + Tyear_t + \tau month_t + \varepsilon_{ikt} \quad (8).$$

In this expression, $\ln(price_{ikt})$ measures the primary dependent variable, the log-transformed negotiated price for test k received by patient i at time t. The CPT_k, X_i, $year_t$, and $month_t$ controls are the same as in equation 7. Also, similar to above, the key variables of interest are the $post\ transparency_t \times covered_k$ and $postRP_t \times covered_k$ interaction terms. The first term measures the change in prices following patient access to the online price transparency tool. The second interaction measures the additive effect of combining price transparency with the targeted consumer incentives of reference pricing. The CPT-code fixed effects negate the need for a $covered_k$ main effect. Similar to the main analysis, we estimate this equation using OLS and cluster standard errors at the CPT-code level.

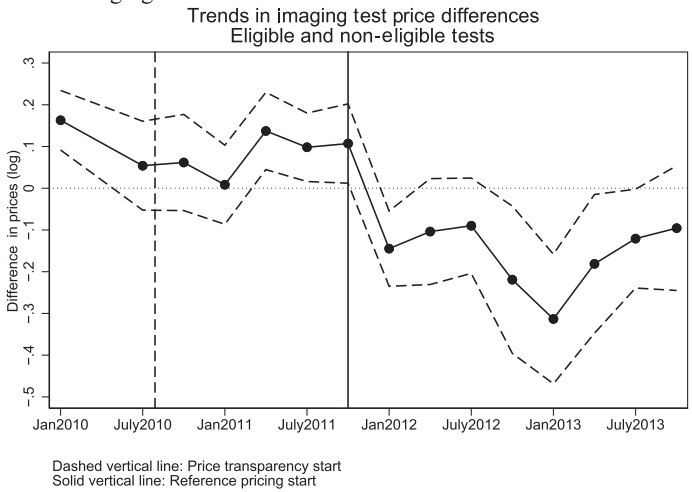
Figure 4 (panel a) plots the monthly regression-adjusted price differences between the covered and noncovered laboratory tests among the Safeway population over time. Prior

FIGURE 4. Price trends for reference pricing-eligible and non-eligible tests

Panel a: Laboratory tests



Panel b: Imaging tests



Notes: These figures plot regression coefficients from the robustness test that restricts the sample to the Safeway population and compares price difference trends between tests subject to the reference pricing program with tests exempted from the reference pricing program (equation 11). The top panel presents monthly differences in laboratory test prices, while the bottom panel presents quarterly price differences for imaging tests. The dependent variable is the log-transformed price for each test. The dashed vertical line indicates the implementation of price transparency, while the solid vertical line indicates the start of the reference pricing program. Each regression includes controls for CPT code, patient age, gender, and three-digit zip code. The error bars represent 95 percent confidence intervals using robust standard errors clustered at CPT-code level in parentheses.

to the reference pricing program, the noncovered tests are approximately 10 percent more expensive than the covered tests. There is no change in the difference following the introduction of the price transparency tool, but there is a sizable decrease following the introduction of the reference pricing program. Under reference pricing, the covered tests are approximately 12 percent lower. The difference between the pre– and post–reference pricing differences translates into a 22 percent reduction in the average cost per covered laboratory test.

Figure 4 (panel b) plots similar results at the quarterly level for imaging services. Prior to the reference pricing program, prices for the covered services are approximately 15 percent higher than prices for the noncovered services. However, following the launch of the reference pricing program, prices are approximately 10 percent lower, although there does appear to be upward trends towards the end of the sample. The difference between the pre– and post–reference pricing differences leads to a 14.4 percent reduction in the average cost per imaging service due to the reference pricing program.

IX. Conclusion

Recent efforts to encourage price shopping for health-care services have had limited success. The nascent price transparency literature suggests that simply providing patients with price information leads to only modest changes in consumer behavior. This paper leverages an innovative program implemented by Safeway that combines price transparency with targeted cost-sharing for laboratory tests. Consistent with the existing literature, we find minimal evidence of price shopping when patients are only given access to an online price transparency tool. However, combining price transparency with reference pricing spurs price shopping and leads to a 27 percent reduction in the average cost per laboratory test and a 13 percent reduction in the average cost per imaging test.

The within-employer comparison of the two programs has important implications for promoting consumerism in health care. When given only information incentives, which because of the existing HDHP, the patients had a financial incentive to use, there was minimal response by Safeway employees. However, when given the targeted financial incentives of reference pricing, the exact same employee population responded by receiving care from providers who were much less expensive. The difference in consumer responses between the two programs suggests that patients do not price shop when only given information incentives, but need targeted financial incentives to price shop.

This result is somewhat surprising given the existing financial incentive to price shop under the HDHP. We hypothesize that reference pricing is more successful than price transparency alone because it addresses both the financial and information barriers to price shopping. Reference pricing "nudges" patients to receive care from low-priced providers by identifying the providers that are below the reference price (Kahneman and Tversky 2000). Even under an HDHP, patients who use price transparency tools still have to navigate the distribution of provider prices. If search costs are high, then the increased financial incentives of an HDHP may not be enough to shop for care. Even when given access to a menu of prices, as in this study, patients still face the search costs of interpreting the information, identifying the specific tests and procedures they need, the costs of

assessing quality, and the emotional costs of receiving care from a provider other than the one recommended by their provider.

Under reference pricing, patients are directed towards a particular set of low-priced providers (i.e., nationwide laboratory chains), and they have a strong financial incentive to receive care from these providers. Under appropriately designed reference pricing programs, patients are not just given the tools to find low-priced providers. Rather, they are directed towards a small number of low-priced providers and directed away from all other providers. Thus, reference pricing addresses both the information and the financial barriers to price shopping. In this sense, reference pricing simplifies the "choice architecture" of health-care decision making for patients by steering them to low-priced providers and giving them a financial incentive to comply with the nudge (Robinson, Brown, and Whaley 2017). The results of this study suggest that similar "nudges" or other ways to simplify the provider choice process may increase price shopping in HDHPs.

This paper has several limitations. First, this paper uses data from a single employer. While the patient population is geographically dispersed, the results from this study may not be generalizable to other populations. Safeway was an early adopter of both price transparency and reference pricing programs, and it may have implemented these programs because of an anticipated response, which may not occur for other patient populations (Allcott 2015). Because we lack enrollment data, we do not examine utilization of tests. The strongest consumer response to changes in patient cost-sharing may be to decrease the use of tests altogether. Depending on the marginal value of each test, changes in utilization may be either beneficial or detrimental to patient health. In addition, the changes in consumer behavior may also spur price competition by providers. We do not measure any supply-side effects in this paper but hypothesize that any provider responses may be limited because of the geographic dispersion of the Safeway population.

Finally, our price-transparency alone results capture the initial period of price transparency. In the long term, as price transparency applications and consumer awareness to price transparency become more robust, consumer responses to price transparency may increase. Unfortunately, we are not able to examine how use of the price transparency tool influences the reference pricing results. Future work should test whether price transparency users have larger responses to the reference pricing program than nonusers. We are also unable to estimate the effects of just the reference pricing program decoupled from price transparency.

Despite these limitations, this paper shows that targeted consumer incentives can lead to meaningful behavior changes. While our results are specific to a single population, the levels of price variation that underlies the importance of programs like reference pricing exist in nearly all geographic markets. As employers and insurers seek to reduce the growth in health-care spending, this paper demonstrates that reference pricing is a feasible insurance benefit design.

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