Product Proliferation under Rational Inattention:

Application to Health Insurance*

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Abstract

In markets with complicated products such as insurance, why do firms offer many products even when consumers appear to receive little benefit? We show that when consumers face information acquisition costs, firms may have an incentive to introduce many undifferentiated products. This allows firms to gain market share and increase markups. We document initial evidence consistent with the model using data from Medicare prescription drug insurance. Insurers that offer more duplicate or similar plans have higher cost plans. These results suggest a role for policy makers to restrict product proliferation in markets with complicated products.

Keywords: product proliferation, insurance, information frictions, rational inattention
JEL Classification: L15, I13, D83

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1 Introduction

In health insurance markets, insurers often offer many plans that can be quite difficult to compare. In standard demand models, consumers always gain from more choices. However, in insurance markets, individuals often say there are too many plans, including a majority of the elderly population eligible for Medicare prescription drug insurance.[1] Similar issues often arise in other markets for complex financial products, such as retirement plans. A growing literature has argued there can be "too much choice" in markets featuring complex products (e.g. Iyengar and Kamenica 2010; Abaluck and Gruber 2020). Why do firms offer so many products, especially similar products, if consumers often prefer simplified choice in these markets?

We develop a model in which firms may offer duplicate products when consumers face a cost of information and decide how much to research each product (Matějka and McKay 2015). This is motivated by previous work emphasizing the role of information frictions in insurance markets (e.g. Handel and Kolstad 2015; Ho et al. 2017; Bundorf et al. 2019), including recent work arguing that demand for health insurance products is consistent with consumers being rationally inattentive (Brown and Jeon 2020). Our model is also related to the broader literature on the inability of consumers to choose the best price (e.g. Grubb 2015) and how firms may obfuscate or shroud attributes to increase choice complexity or increase search cost (e.g. Ellison 2005; Gabaix and Laibson 2006; Spiegler 2006; Ellison and Ellison 2009; Ellison and Wolitzky 2012; Chioveanu and Zhou 2013; Gamp 2016; Petrikaitė 2018). By incorporating inattentive consumers, we show that firms may have an incentive to introduce undifferentiated products, allowing them to charge higher markups. The model also provides an explanation for why individuals prefer simplified choice sets.[2]

[1] In a survey of seniors eligible for Medicare Part D, Altman et al. (2006) finds that 68% favor reducing the number of available plans and 60% agree with the statement that Medicare should select a handful of plans that meet certain standards so seniors have an easier time choosing. Similarly, Cummings et al. (2009) finds that 75% of seniors favor reducing the number of plans.

[2] In standard demand models, firms may have an incentive to offer differentiated products to soften competition or deter entry (Chamberlin 1949; Scherer 1979; Champsaur and Rochet 1989). However, there is no incentive for firms to offer additional undifferentiated products in these models. These models also fail to explain why individual may prefer a smaller choice set.

We take a first step at examining the implications of the model in the context of Medicare prescription drug insurance. We identify plans offered by insurers that are very similar or identical by examining both plan characteristics and expected total cost. We document that insurers offer very similar or duplicate plans over our sample period. Consistent with theory, we find that when an insurer offers these similar plans, the insurer's plans have higher average out-of-pocket costs. Furthermore, we exploit the introduction of new plans offered by an insurer in a market and find that similar plans lead to higher out-of-pocket cost, suggesting the relationship is causal.

In the Medicare Part D market, as well as other health insurance markets, regulators have expressed concern about proliferation of undifferentiated products. Our results suggest that this concern is warranted. When consumers are inattentive, limiting the proliferation of products, especially similar products offered by the same firm, can potentially decrease market power and benefit consumers.

2 Theoretical Framework

This section presents a simple model of product proliferation when consumers are rationally inattentive. This discrete choice setting with rational inattention follows Matějka and McKay (2012) and Matějka and McKay (2015), however we allow firms to offer multiple identical products in addition to setting prices. This is also related to recent work examining the welfare effects of new product introduction under rational inattention (Joo 2020).

2.1 Consumers' Problem

Individuals choose between N alternatives indexed by j. The total cost of each alternative is v_j, which is initially unobserved to the decision maker unless the individual acquires costly information. In the case of insurance, v_j may represent expected out-of-pocket cost. Understanding out-of-pocket cost requires understanding the details of complex insurance contracts, requiring costly research. In this simple model, we assume that products are undifferentiated and individuals wish to minimize

cost. The payoff from alternative j is given by

$$u_j = -v_j \tag{1}$$

The individual's decision problem is to choose an information strategy in order to maximize the expected value of the chosen option minus the information cost. The information cost is entropy-based, measuring the reduction in uncertainty between prior and posterior beliefs. A key result in Matějka and McKay (2015) is that the choice probability of selecting option k conditional on a realization of $\mathbf{v}$ can be expressed as

$$P_k = \frac{P_k^0 e^{(-v_k)/\lambda}}{\sum_{j=1}^{N} P_j^0 e^{(-v_j)/\lambda}} \tag{2}$$

where λ is the unit cost of processing information and P_k^0 is the expected choice probability of choosing k based on the prior before the realization of signal.[3] In general, demand for the lowest cost option is decreasing in the information acquisition cost.

2.2 Firms' Problem and Equilibrium

There are two firms in the market, indexed by $i \in \{A, B\}$. Both firms are endowed with a technology that produces identical products at the same cost, denoted by c. We start by assuming the number of products sold by each firm is exogenous. Firm i sells N_i identical products, and the total number of products in the markets is N. We let $\mathcal{J}$ denote the set of all products in the market, and $\mathcal{J}_i$, the set of products sold by firm i.

[3] This probability can be obtained by solving the following problem given prior G:

$$\max_{P_1^0,..,P_N^0} \int_{\mathbf{v}} \lambda \log \Sigma_j P_j^0 e^{(-v_j)/\lambda} G(d\mathbf{v}) \text{ s.t. } \sum_j P_j^0 = 1,\ P_j^0 \geq 0\ \forall j.$$

Firm i maximizes profits given by

$$\max_{v_k} \sum_{k \in \mathcal{J}_i} s_k(v_k - c).$$

We assume that before researching options, consumers believe all options are a priori homogeneous, implying $P_k^0 = \frac{1}{N}$ for all k. The market share of firm i is then given by

$$s_i = \frac{\sum_{k \in \mathcal{J}_i} e^{-v_k/\lambda}}{\sum_{j \in \mathcal{J}} e^{-v_j/\lambda}}.$$

Therefore, demand is similar to the standard logit model but has a different interpretation.[4]

The first-order condition with respect to v_k is

$$-\frac{1}{\lambda}(v_k - c) + 1 + \frac{\frac{1}{\lambda}e^{-v_k/\lambda}(v_k - c_k)}{\sum_{j \in \mathcal{J}} e^{-v_j/\lambda}} + \sum_{l \in \mathcal{J}_i \setminus \{k\}} \frac{\frac{1}{\lambda}e^{-v_l/\lambda}(v_l - c_l)}{\sum_{j \in \mathcal{J}} e^{-v_j/\lambda}} = 0. \tag{3}$$

The symmetry of the first-order conditions implies that firm i will price its products the same at $v_k = v_i$ for all $k \in \mathcal{J}_i$. This implies that firm i's optimal price is given by

$$v_i^* = c + \frac{\lambda}{1 - s_i} \tag{4}$$

The market share of firm i can be expressed as

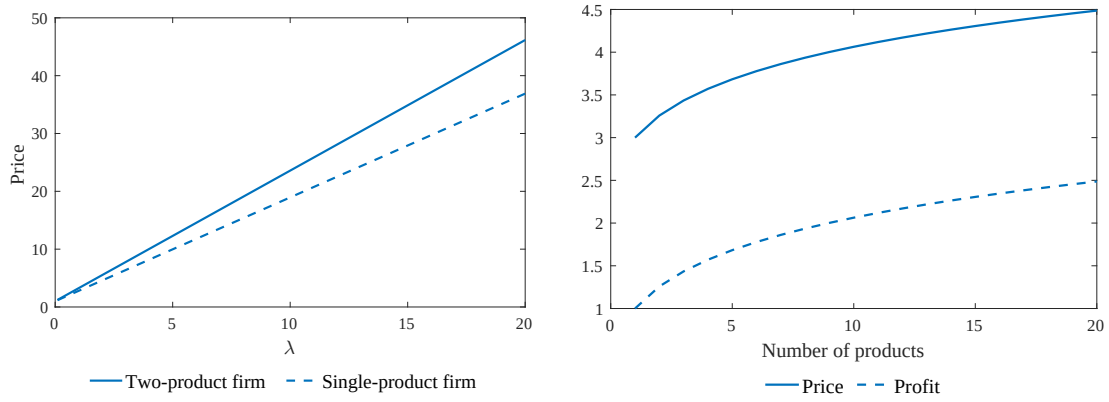
$$s_i = \frac{N_i e^{-v_i/\lambda}}{N_i e^{-v_i/\lambda} + N_{-i} e^{-v_{-i}/\lambda}}. \tag{5}$$

Combining equation (4) and equation (5), we obtain the following expression for firm i's share:

$$s_i = \frac{N_i e^{-1/(1-s_i)}}{N_i e^{-1/(1-s_i)} + (N - N_i)e^{-(N-N_i)/(N-N_i-1+s_i)}}.$$

[4]Demand with rational inattention takes a more complicated form if a subset of product characteristics are initially unobserved and require costly information acquisition. See Brown and Jeon (2020). This model yields similar implications for product proliferation.

Figure 1
Predicted Price and Profit by λ and Number of Products



a. By Marginal Cost of Information b. By Number of Products

Notes: Panel a. shows how prices of the products offered by each firm vary with λ for $N_A = 2$ and $N_B = 1$. Panel b. shows the price and profit of firm A as a function of its number of duplicate products (N_A) when λ is fixed at 1 and N_B at 1. Marginal cost is set to 1.

The equilibrium prices can be solved numerically based on the system of equations (4) for all i and equation (5).

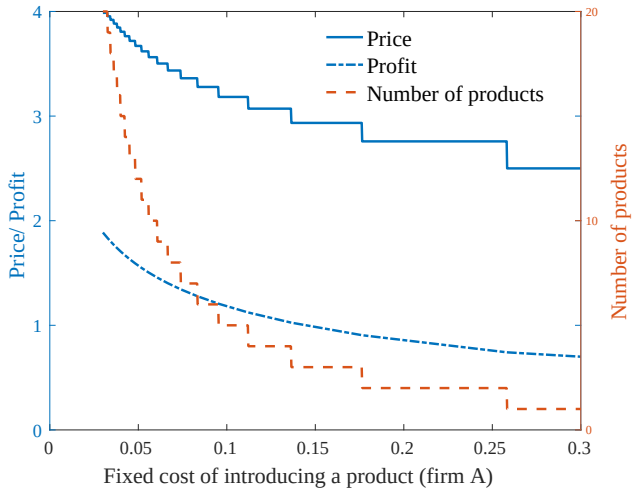
Figure 1 panel a. shows simulated equilibria while varying λ and fixing the number of products at 2 for both firms. When $\lambda \to 0$, the firms engage in Bertrand competition and $v_i = c$. However, markups increase as the unit cost of processing information rises.

Figure 1 panel b. shows that the price and profit of a firm increase with its number of products when λ and the rival's number of products are fixed. In other words, a firm that offers additional duplicate products is able to soften competition and set higher prices in equilibrium.

2.3 Endogenous Product Offerings

We now assume that firms face a fixed cost of introducing each additional product and choose how many products to offer. In the first stage, firms choose how many products to offer, and in the following stage they determine prices given the number of products. From section 2.2, we know that given the number of products for each firm in the market, N_i, firm i's market share and price

Figure 2
Simulated Equilibria under Endogenous Number of Products



Notes: Chart shows how equilibrium price, profit, and number of products change as we vary the fixed cost of introducing new products for firm A (F_A) while fixing the fixed cost of introducing new products for firm b (F_B) at 0.3.

are given as follows.

$$s_i^* = \frac{N_i e^{-\frac{1}{1-s_i^*}}}{N_i e^{-\frac{1}{1-s_i^*}} + (N - N_i)e^{-\frac{1}{s_i^*}}}$$
$$v_i^* = c + \frac{\lambda}{1 - s_i^*}$$

Then, firm i's profit is $\frac{s_i^*}{1-s_i^*}\lambda - N_i F_i$ where F_i denotes firm i's fixed cost of introducing a product. Using the computed shares from the second stage decisions, we can express payoffs for each possible combination of number of products as functions of λ and F_i alone, and solve for an equilibrium. We simulate equilibria while varying the fixed cost for firm A and holding the fixed cost of firm B constant. As shown in Figure 2, as the fixed cost of firm A decreases, the firm offers more products while increasing prices, which results in an increase in firm profits.

These results indicate that firms have an incentive to offer additional products even when the products are undifferentiated and there is a cost of introducing products. In equilibrium, a firm offering more duplicate products than its rival has relatively higher prices since it faces softer price competition. This effect is exacerbated when the products are more complex, i.e. λ is large. In the

model, consumers would benefit from limiting product proliferation.

3 Evidence From Medicare Prescription Drug Insurance

To provide initial evidence on product proliferation, we examine prescription drug plans offered under Medicare Part D. The complexity of choosing an insurance plan in this market has been well documented.[5] There are over 1,000 Medicare Part D plans offered across 39 markets. Only 10 insurers account for nearly 90% of enrollment. Over our sample period, the average individual chooses between 27 plans in her market. The Centers for Medicare and Medicaid Services (CMS) has been concerned with the number of similar plans offered by each insurer in the Medicare Part D market, motivating statutory and regulatory changes starting in 2011 to try to simplify plan offerings.[6]

We use administrative data from Medicare Part D to examine the number of similar plans offered by insurers in each market, defined as a Medicare Part D region in each year. For the analysis, we use a 5% sample of Medicare Part D claims over 2010 to 2015.

We use two methods to identify similar or duplicative plans offered by an insurer. As our main measure, we examine plans with the same or very similar plan characteristics. In particular, we classify a plan as duplicative if the coverage in the gap (i.e. donut hole) is the same, the generic coverage is the same, the deductible is in the same percentile, cost sharing is in the same percentile, and the quality rating is in the same percentile as another plan offered by the insurer in the market.[7] When identifying duplicate plans we do not count the original plan, e.g. if an insurer offers three identical plans then there are two duplicates.

Insurers may design plans with different benefit designs that end up resulting in similar out-of-pocket cost for individuals. To capture this, we construct an alternative measure of similar plans by calculating each plan's expected out-of-pocket cost for each individual based on the benefit design

[5] See discussion in Brown and Jeon (2020).

[6] For background see Hoadley et al. (2013).

[7] We also examine alternative quantiles for defining similar characteristics (e.g. same ventile) and results are very similar. For further details about these characteristics see Abaluck and Gruber (2016).

using the calculator from Abaluck and Gruber (2016).[8] A plan is defined as similar for a given individual if it results in total cost (out-of-pocket cost plus annual premium) that is in the same ventile of the cost distribution as another plan offered by the insurer. In addition, we also consider plans with cost in the same percentile.

Table 1
Similar Plans Offered by Insurers in Choice Set

	Mean	SD
Out-of-pocket cost	700.1	176.4
Annual premium	642.7	78.9
Total cost	1342.8	190.5
Plan risk	18.3	121.8
Avg plans with same/similar characteristics	3.36	3.51
Avg plans with same/similar cost	3.92	4.15
Plans in Choice Set	26.5	6.9

Notes: The unit of observation is a geographic market by year.

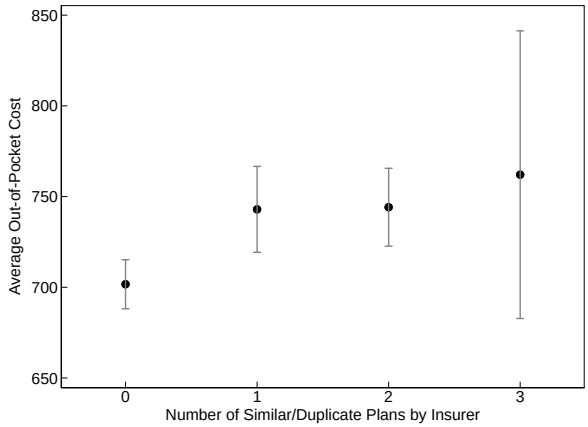
The average number of similar plans offered by insurers in each market as defined using our primary measure is summarized in Table 1. The table also shows the average annual premium and out-of-pocket cost. The average individual has 3.4 plans in her choice set that are similar or identical to other plans offered by the same insurer. This implies that over 10% of plans could be removed without affecting the variety of plans available to the individual. Our alternative measure of similar plans implies 15% of plans could be removed. Given that our measure of similar plans is conservative, we view this as a lower bound on the percent of plans that could be removed without substantially changing plan variety.

The two measures of plan similarity show similar trends (see Online Appendix). Consistent with the CMS regulation that tried to limit insurers from offering too many plans, there is a reduction in similar plans starting in 2011 according to the cost measure. However, even after this policy change, there are still a significant number of plans that are similar according to our classification. For our analysis, we focus on the measure of plan similarity based on plan characteristics. Results using our alternative measures are presented in the Online Appendix.

[8]This is done for all plan in each individual's choice set, including the chosen plan. Plan risk is calculated in a similar way. Details of this procedure can be found in Brown and Jeon (2020).

In Figure 3 we examine the relationship between the number of similar plans that an insurer offers in a market and the average out-of-pocket cost for plans offered by the insurer in that market. Insurers that do not offer the similar plans have plans that result in out-of-pocket costs of $702 on average. Insurers that do offer similar plans have plans that result in out-of-pocket cost of $744 on average for the same individuals. This difference is statistically significant. This provides initial evidence that insurers that offer similar or duplicate plans provide less generous benefit design, resulting in higher out-of-pocket cost. In contrast, we do not see a positive correlation between an insurer offering similar plans and average premiums, which can be easily compared across plans.[9]

Figure 3
Relationship between Similar/Duplicate Plans and Average OOP Cost



Notes: Similar/duplicate plans offered by an insurer defined as plans with the same or very similar characteristics. One duplicate plan indicates there are two plans offered by an insurer that are the same or very similar. Insurers with over 3 similar plans (1.6% of observations) not shown.

Caution should be taken interpreting this relationship as causal. The primary concern is that insurers that offer similar or duplicative plans differ in other ways. As an additional test, we control for plan characteristics as well as insurer and year fixed effects that capture unobserved differences across plans. Identification comes from variation across markets and across time in plan offerings by a given insurer. In particular, we exploit the introduction or removal of duplicate plans offered by an insurer. We use the following specification:

[9] If anything, the relationship is negative. See Appendix Figure A-2.

$$OOP_{jrt} = \beta HasSim_{jrt} + \alpha X_{jrt} + \gamma_j + \theta_t + \varepsilon_{jrt}, \tag{6}$$

where j indexes insurer, r indexes Part D region, and t indexes year; OOP_{jt} is the average out-of-pocket cost of all plans offered by the insurer in the market; $HasSim_{jrt}$ is an indicator for whether the insurer offers similar plans in the market; X_{jrt} are plan characteristics including plan quality and risk. The term γ_j and θ_t indicate insurer and year fixed effects respectively. To account for correlation within insurer across time in out-of-pocket cost, standard errors are clustered at the insurer level.

The regression results are presented in Table 2. The results imply that an insurer that offers very similar or duplicate plans in a market offers plans with out-of-pocket costs that are $49 higher. This result is quite consistent across a number of specifications with and without insurer fixed effects, year fixed effects, and controls for plan characteristics. This suggests that unobserved differences across plans are not driving the results.

Table 2
Relationship between Similar/Duplicate Plans and Average OOP Cost
Regression Results

	(1)	(2)	(3)	(4)	(5)
Has similar/duplicate plan	34.8**	54.7**	56.0**	43.9*	49.5**
	(16.1)	(22.6)	(24.8)	(24.5)	(22.2)
Plan risk			−0.47***		−0.47***
			(0.00)		(0.00)
Plan quality			−17.35		−11.46
			(14.03)		(18.06)
Insurer FEs	No	Yes	Yes	Yes	Yes
Year FEs	No	No	No	Yes	Yes
Adjusted R2	0.002	0.090	0.644	0.123	0.659
Observations	1,866	1,858	1,855	1,858	1,855

Notes: Estimates from OLS regression where dependent variable is an indicator for whether an insurer offers a duplicate plan as defined by plan characteristics. Standard errors clustered at the insurer level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In the Appendix, we present results using the alternative measure of similar plans based on plan cost. Using this measure, there is also a strong correlation between insurers offering similar plans and average out-of-pocket cost. Regression results with plan controls and insurer fixed effects also

imply that similar plans are associated with higher out-of-pocket cost. This result is also robust to different quantiles used to define plans with similar cost.

4 Conclusion

This paper studies equilibria in markets where consumers face a cost of acquiring information about available products and firms choose the number of products and prices. In the model, firms have an incentives to offer undifferentiated products. Given the difficulty in comparing products, this gives firms additional market power, increasing markups. In the context of Medicare Part D, we provide initial evidence that insurers that offer many similar plans have less generous benefit design, consistent with the model. Given that firms may be responding to other incentives as well, such as the incentive to attract beneficiaries in the low-income subsidy program, future work should continue to examine these issues in Medicare Part D.

Although we focus on health insurance markets, the framework has implications for other settings featuring products that are difficult to compare such as consumer finance products and online retail. Future work can also examine product proliferation in other settings featuring information frictions, as well as incorporate firms' endogenous choice of product complexity.

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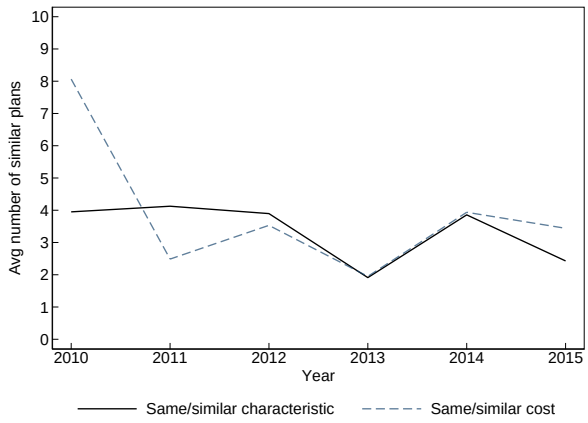
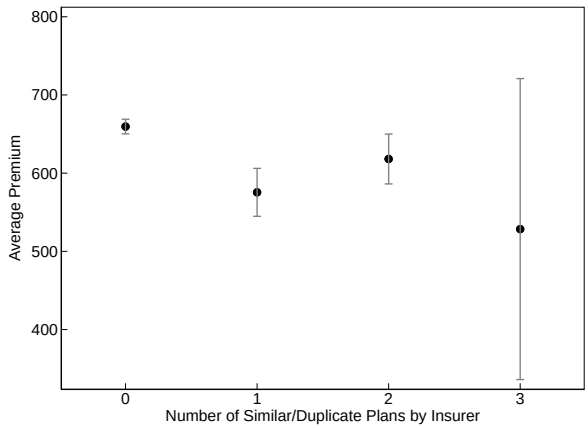
ONLINE APPENDIX

Figure A-1
Similar Plans by Year



Notes: Chart shows average number of very similar or duplicate plans in individuals' choice sets for 2010 to 2015.

Figure A-2
Relationship between Similar/Duplicate Plans and Premiums



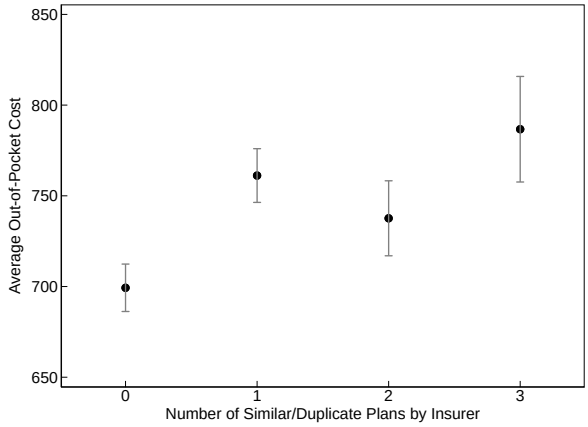
Notes: Similar/duplicate plans offered by an insurer defined as those with the same or very similar characteristics. Insurers with over 3 similar plans (2.9% of observations) not shown.

Table A-1
Relationship between Similar/Duplicate Plans and Out-of-Pocket Cost
Similarity Measure based on Plan Cost

	(1)	(2)	(3)	(4)	(5)
Similar plans have cost in same ventile					
Number similar plans	30.1**	35.7***	34.5***	33.7***	32.0***
	(13.2)	(12.5)	(11.4)	(11.0)	(9.9)
Plan risk			−0.47***		−0.47***
			(0.00)		(0.00)
Plan quality			−18.73		−13.08
			(15.07)		(18.47)
Adjusted R2	0.008	0.096	0.649	0.129	0.664
Observations	1,866	1,858	1,855	1,858	1,855
Similar plans have cost in same percentile					
Number similar plans	93.5**	104.2***	101.9***	98.2***	95.3***
	(35.5)	(31.6)	(29.7)	(26.5)	(24.8)
Plan risk			−0.47***		−0.47***
			(0.00)		(0.00)
Plan quality			−19.10		−13.87
			(15.18)		(18.65)
Insurer FEs	No	Yes	Yes	Yes	Yes
Year FEs	No	No	No	Yes	Yes
Adjusted R2	0.010	0.097	0.650	0.130	0.665
Observations	1,866	1,858	1,855	1,858	1,855

Notes: Estimates from OLS regression where dependent variable is the number of plans offered by an insurer that have a total cost in the same ventile or percentile. Standard errors clustered at the insurer level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure A-3
Relationship between Similar/Duplicate Plans and Out-of-Pocket Cost
Similarity Measure based on Plan Cost



Notes: Similar/duplicate plans offered by an insurer defined as those in which the total cost in the same ventile. Insurers with over 3 similar plans (2.9% of observations) not shown.