

Brokers vs. Retail Investors:

Conflicting Interests and Dominated Products

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December 28, 2015

Abstract

I study how brokers distort consumer investment decisions. The market for retail convertible bonds offers a unique environment to study consumer investment decisions in a broker-intermediated setting. Using a novel data set, I find that consumers frequently purchase dominated bonds in this market – i.e., cheap and expensive versions of otherwise identical bonds exist in the market at the same time. Moreover, inconsistent with standard search models, consumers purchase more of the expensive bonds. The empirical evidence suggests broker incentives are partially responsible for the inferior investments as brokers earn a 1.12% point higher fee for selling the dominated bond. I rationalize the behavior of brokers and consumers in equilibrium by developing and estimating a search model. Consumer search is endogenously directed according to the incentives of brokers and a broker's ability to price discriminate across consumers based on the consumer's level of sophistication. I use the estimated model to disentangle and quantify the importance of search, consumer sophistication, and broker incentives. Aligning broker incentives with those of consumers' increases consumer risk-adjusted returns by over 100bps.

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1 Introduction

The prices and fees of seemingly identical financial products often differ drastically. Previous research documents price heterogeneity across mutual funds, mortgages, bonds and other financial products.¹ Does the observed price dispersion imply that some consumers are overpaying for investment opportunities? If so, what is driving this behavior? Sirri and Tufano (1998) and Hortaçsu and Syverson (2004) highlight the importance of search in a consumer’s investment decision process. However, consumer search does not happen in a vacuum. Broker intermediation plays a critical role in a consumer’s investment decision and search process. In 2010, 56% of American households sought investment advice from a financial professional.² Despite their prevalence, brokers may not be acting in the best interests of their clients. A broker may choose to subordinate her client’s interests for her own financial interests by directing her client to inferior products with high broker’s fees. While arguments such as these are abundantly available and have guided much of the policy response in the aftermath of the crisis (see section Section 913 of the Dodd-Frank Act), a rigorous empirical and theoretical investigation of this issue has been lacking. In this paper I fill this gap.

The paper has two goals. The first goal is to use novel data and a unique setting to show that consumers frequently purchase the dominated product in a market – i.e., cheap and expensive versions of otherwise identical products exist in the market at the same time – and that broker incentives are partially responsible for the inferior investments. The second goal is to rationalize the behavior of brokers and consumers in equilibrium by developing and estimating an intermediated search model. The model helps disentangle and quantify the importance of search, consumer sophistication, and broker incentives. I also use the model to investigate counterfactual scenarios surrounding the Dodd-Frank Act.

Several data challenges contribute to the lack of studies investigating these issue in detail. First, with most financial products, it is hard to find scenarios where one can easily compare products and rank one product as unambiguously dominating the other. Financial products, such as mutual funds, differ on a plethora of observable and unobservable characteristics, making direct comparisons

¹For examples, see Hortaçsu and Syverson (2004) and Elton et al. (2004) for the mutual fund industry, Gurun, Matvos and Seru (2013) for mortgages, Green Hollifield and Shürhoff (2007) for bonds, Duarte and Hastings (2012) for privatized social security plans, Christoffersen and Musto (2002) for money funds, and Brown and Goolsbee (2002) for life insurance.

²Source: Survey of Consumer Finances

of products tenuous. We may think that a consumer paying 2% for an S&P index fund is overpaying for that investment product. However, without observing all of the fund characteristics, making such claims is impossible. The problem is compounded once we allow for heterogeneity across consumer preferences and portfolio holdings. Second, little data have been available on the compensation of financial intermediaries. Did a consumer buy mutual fund XYZ or was he sold mutual fund XYZ by his broker?

I address these challenges by constructing a new retail bond data set covering reverse convertible bonds issued in the United States over the period 2008-2012. A reverse convertible is a fixed rate bond for which the final principal payment is convertible into shares of some pre-specified equity. The advantage of studying reverse convertible bonds over other financial products is twofold. First, reverse convertibles are completely characterized by a small number of dimensions, namely, a fixed coupon and an equity-linked principal payment. As a result, simultaneously issued reverse convertibles for which the payout of one reverse convertible is unambiguously dominated by another - the bond with the higher coupon - are easy to locate. Consider the following two nearly identical one-year reverse convertibles issued by JPMorgan Chase on June 30, 2008.³ One reverse convertible pays a fixed coupon of 11.25%, whereas the other pays a fixed coupon of 9.00%. Both reverse convertibles were sold to investors at a fixed par price of 100%. The final principal payment of both reverse convertibles is identical and linked to the share price of Microsoft Inc. If the price of Microsoft Inc. shares ever closes below \$22.68, the bond principal (for both bonds) is converted into equity where bond holders receive at maturity 35.27 shares of Microsoft Inc. for every \$1,000 invested.⁴ Figure 1 displays the hypothetical return to investors of the two products. Notice that the return of the 11.25% reverse convertible clearly dominates that of the 9.00%.⁵ However, in practice, consumers purchased more than 10 times as much of the dominated product. This example of a bank simultaneously issuing a dominated/superior product is not unique; I observe over 100 dominated/superior reverse convertibles in the data set.

The second advantage of studying reverse convertibles is that the Securities and Exchange Commission (SEC) requires all bond issuers to disclose the fees/commissions paid to brokers. Reverse

³CUSIPS: 48123LAM6 and 48123LBR4

⁴The principal payment on both reverse convertibles is capped at par.

⁵The example of unambiguously dominated structured products is interesting when contrasted with the work of Carlin (2009) and C  lerier and Vall  e (2014). Banks could easily make the differences across products less salient by changing either the convertible price or the underlying equity; however, they often choose not to.

convertible bond issuers, rather than consumers, compensate brokers with fees for selling reverse convertibles. In the previous JPMorgan example, JPMorgan paid brokers a commission of 3.09% for selling the worse 9.00% reverse convertible and only 2.15% for selling the better reverse convertible. This data therefore allows me to quantify the degree to which broker incentives influence consumer choice.

FIGURE 1: DOMINATED REVERSE CONVERTIBLE EXAMPLE

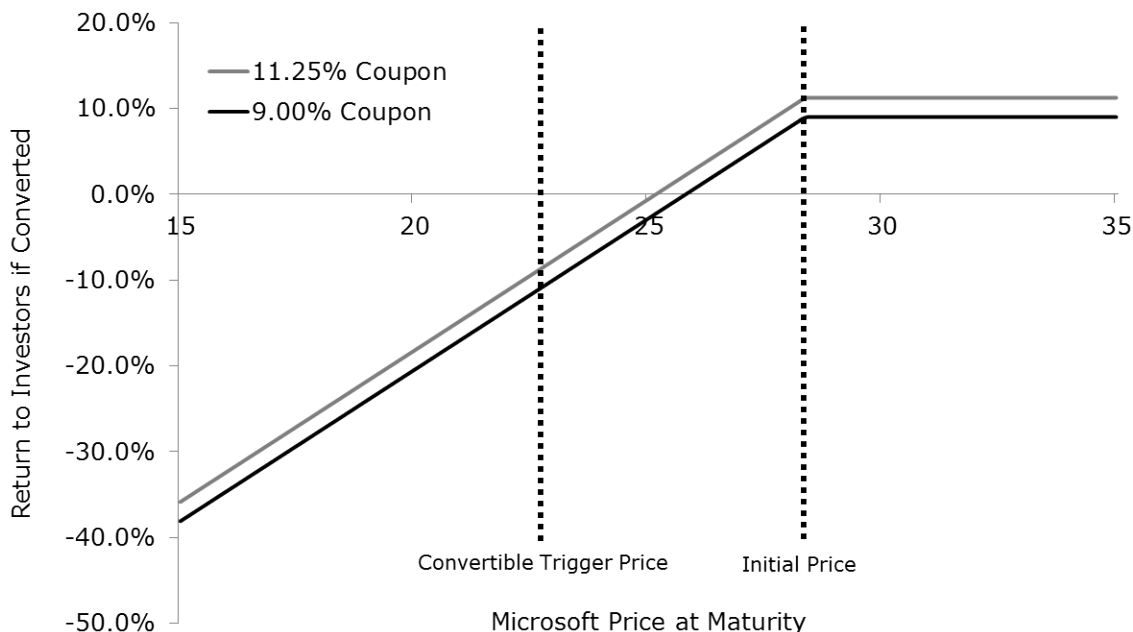


Figure 1 Notes: The figure displays the return to investors for two one-year reverse convertible bonds linked to the price of Microsoft Inc. that were issued by JPMorgan Chase on June 30th, 2008. The reverse convertibles pay monthly coupons of 9.00% and 11.25%, respectively. If the share price of Microsoft Inc. ever closes below the convertible trigger price of \$22.68 during the life of the reverse convertible, the issuer will pay the bondholder 35.27 shares of Microsoft Inc. per \$1,000 invested ($\$1,000/\text{Initial Price}$) rather than 100% of the principal amount invested. The final principal payment paid by the issuer is capped at par (100%). The above figure displays the final return to investors provided the principal has been converted into equity. Note that the 11.25% convertible always yields a 2.25% higher return than the 9.00% convertible.

The first part of my paper reveals three stylized empirical facts. First, the risk-adjusted returns of reverse convertibles exhibit substantial dispersion, and consumers often fail to purchase the best available financial product. The standard deviation of risk-adjusted returns in the data set is over 2.40%. Second, when better and worse products are available, consumers actually purchase more of the worse product. Third, the evidence suggests the incentives of brokers do not align with the incentives of consumers. All else equal, consumers collectively tend to purchase more products

with higher fees, and products with higher fees have lower payoffs.⁶ I argue that the incentive and information asymmetry between brokers and consumers helps rationalize product issuance and the behavior of consumers.

In the second part of the paper, I rationalize the behavior of brokers and consumers in equilibrium by developing and estimating a search model. The model helps disentangle and quantify the importance of search, consumer sophistication, and broker incentives. In the model, consumers sequentially search for investment products with the aid of a broker. The key innovation is that the search of consumers is intermediated by a broker. Brokers service their customer base by offering different products to each client. Brokers select products to offer each client based on the quality of the financial product and the underlying broker's fee. In other words, broker profit maximization endogenously determines the distribution of products that consumers observe. Consumers ultimately decide whether to purchase the offered product or continue searching. Consumers differ in their level of financial sophistication (measured as search costs), and brokers utilize the full product space to price discriminate across consumers based on the consumer's level of financial sophistication.

The model introduces two frictions that are consistent with the empirical data. First, consumers must engage in costly search for products which explains why consumers might purchase inferior products. Second, brokers are incentivized to show high-fee products, which makes finding better products relative to worse products potentially harder for consumers. Broker's incentives in conjunction with consumer search help explain why consumers generally fail to purchase the best available products. I structurally estimate this model using the reverse convertible data set to determine whether the frictions in the model and associated costs are economically meaningful.

The model provides sharp insights that are useful in understanding consumer and broker behavior beyond just the reverse convertible market. First, the model helps to evaluate if the search costs and broker behavior that help rationalize the empirical facts documented earlier are "reasonable". Second, I can assess the total cost of each friction. For example, the model estimates suggest the median consumer spends roughly \$150 (in terms of the opportunity cost of time and the cost of delaying investment) searching for a \$10,000 investment. Third, I am able to show that aligning broker incentives with those of consumers' would increase consumer risk-adjusted returns by over

⁶The finding that high fee products have worse risk-adjusted returns is consistent with evidence Gil-Bazo and Ruiz-Verdú (2009) find in the mutual fund industry.

100 percentage points (pp). This result speaks directly to policies passed as a part of the Dodd-Frank Act where the regulators may soon hold brokers to a fiduciary duty. Holding brokers to a fiduciary duty would force brokers to act in the best interest of their clients, which could result in consumers holding better financial products.

This paper relates to the economics and finance literature regarding price and quality dispersion in financial products. Previous work including but not limited to Massa (2000), Hortaçsu and Syverson (2004), Choi et al. (2010), Wahal and Wang (2011), and Khoran and Servaes (2012) indicate the law of one price may fail to hold in the mutual fund industry. Similarly, Anagol et al. (2012) find similar evidence in life insurance markets in India. One limitation of previous studies is that much of the observed dispersion in prices and quality of financial products could potentially be rationalized by unobserved product characteristics and preference heterogeneity. This paper offers the cleanest setting for studying retail financial markets. All consumers would be unambiguously better off purchasing the superior reverse convertible over the dominated convertible regardless of the consumer's preferences or portfolio.

Researchers have documented the potential broker and consumer information and incentive asymmetry arising in consumer finance (Livingston and O'Neal 1996, Mahoney 2004, Bolton et al. 2007, Bergstresser et al. 2009, Woodward and Hall 2012, Christoffersen et al. 2013). I find evidence consistent with Bergstresser et al. (2009), Anagol et al. (2012), and Christoffersen et al. (2013) suggesting that brokers may direct consumers into high-fee products. This paper builds on the preceding work by studying financial distribution in a clean setting in which identifying the conflict-of-interest problem is easier. In the data set, I observe all product characteristics as well as the fees paid to brokers. By directly comparing the dominated and superior products, I can isolate the effect of broker's fees on product issuance. The previous research suggests that underlying economic frictions in the market for reverse convertibles, search and broker incentives, apply to a much broader set of financial markets.

The remainder of the paper is laid out as follows. In Sections 2 and 3, I describe the reverse convertible data set and some fundamental features of the reverse convertible market. In Section 4, I analyze the reverse convertible data set and examine the characteristics of reverse convertibles purchased by consumers. In Sections 5 and 6, I develop and then structurally estimate a search model of financial distribution. I report the corresponding structural estimation results in Section

7. In Section 8, I use the structural estimates to quantify the inefficiencies in retail financial markets and evaluate the proposed regulatory response. Lastly, Section 9 concludes the paper.

2 Institutional Background: Reverse Convertibles

The empirical analysis focuses on the market for equity reverse convertible bonds. A standard fixed-rate bond consists of a set of fixed coupon payments and final principal payment at maturity. Reverse convertible securities are similar to fixed-rate bonds except the final principal payment can be converted into shares of equity. At maturity, investors receive 100% of their principal provided that the underlying equity remains above the pre-specified convertible trigger price. If the equity falls below the convertible trigger price during the life of the bond, investors receive a fixed number of equity shares rather than the full principal amount.⁷ The value of the shares may be worth substantially less than the initial principal amount invested.

A reverse convertible essentially combines a standard fixed rate bond and an equity put option into one financial product. By buying a reverse convertible, the bondholder effectively sells the issuer a knock-in European put option. As illustrated in Figure 1, the bondholder is short a Microsoft Inc. knock-in put option that is struck at the initial share price of \$28.35 and knocks-in at the convertible trigger price of \$22.68. The issuer uses the premium earned from the knock-in put option to fund the broker's fee and the coupon paid to the bondholder.

2.1 The Market for Reverse Convertibles

Reverse convertibles offer a unique setting for understanding consumer investments and studying retail financial distribution. The financial industry largely recognizes reverse convertibles as the “Gold Standard” of retail structured products. Banks issued almost \$5 billion of reverse convertibles in the US in 2011 and \$50 billion globally, the bulk of which were purchased by retail investors.⁸ Reverse convertibles are largely an access product, allowing purchasers to sell equity options/volatility, which makes these products desirable for retail consumers rather than for companies and professional investors. Reverse convertibles provide investors with an opportunity earn

⁷In practice two different common types of reverse convertibles exist: single observation and continuous observation. The previous discussion describes a continuous observation reverse convertible. The single versus continuous observation reverse convertibles differ with respect to the principal payment at maturity. A single observation reverse convertible is converted into equity if the equity price is below the convertible trigger price at maturity rather than if the equity price is ever below the convertible trigger price. Figure A-1 in the appendix walks through an example of a single observation reverse convertible.

⁸Source: Bloomberg

a relatively interest rate⁹ on a standard three month to two year fixed rate bond by taking some additional equity risk. To protect retail consumers, the SEC requires disclosure of the details of each reverse convertible issued, including broker's fees. Though relatively simple, reverse convertibles are often synonymous with structured products which are often criticized for their opaqueness and high costs.¹⁰ The complexity and prevalence of reverse convertibles makes them of particular importance when analyzing some of the new proposed SEC broker regulations.

One of the primary advantages of studying reverse convertibles is that that they are relatively easy to compare and contrast. Reverse convertibles are completely characterized by a small number of observable dimensions. A reverse convertible consists of an issuer, fixed coupon, broker's fee and equity put option. Additionally, it is common practice for banks to issue reverse convertibles that are unambiguously dominated. Banks frequently issue two reverse convertibles with the exact same risk and payout profiles; however, one reverse convertible will have a relatively high fixed coupon and a low broker's fee while the other has a relatively low fixed coupon and a high broker's fee. By studying the purely dominated/superior reverse convertibles, I am able to measure how consumers and brokers trade-off coupon and fees while controlling for all other product characteristics.

2.2 Reverse Convertible Market Structure and Distribution

The reverse convertible market consists of three players: product issuers, brokers and retail consumers. Product issuers, banks, create and issue reverse convertibles. Brokers purchase reverse convertible bonds from the product issuer and then sell the bonds to retail consumers..

Figure 2 illustrates the reverse convertible distribution process. Typically, at the beginning of each month product issuers create a suite of available reverse convertibles that will be issued at the end of the month. The issuer fixes all of the characteristics of each reverse convertible, including the broker's fee, at the beginning of each month.¹¹ Over the course of the month, issuers market available reverse convertibles to brokers who then solicit orders from retail consumers. At the end of the month all of the orders are accumulated and the reverse convertible is issued such that demand is completely satisfied. Issuers sell the reverse convertibles at a fixed par price of 100% minus the

⁹The interest payments for the average reverse convertible in the sample exceeded ten percent per annum; the interest rate for a corresponding fixed rate bond was less than two percent over the same period.

¹⁰See Stoimenov and Wilkens (2005), Henderson and Pearson (2011) and Szymanowska et al. (2009) for further details.

¹¹Since the initial equity price is not known prior to issuance, the convertible trigger price is fixed and expressed as a percentage of the initial equity price.

fixed broker's fee. Brokers then sell reverse convertibles to the end consumer at a fixed price of par (100%).¹² For each product sold, brokers earn the broker's fee. Since issuers pay the fee, it represents a transfer from the issuer to the broker. Consequently consumers are ambivalent over the broker's fee conditional on the risk and return of the product.

For regulatory reasons, issuers sell reverse convertibles through brokerage houses rather than selling them directly to consumers. SEC regulations such as the Securities Act of 1933 restrict the marketing of financial products to end consumers. Any materials used to market an SEC registered security (such as the reverse convertibles studied here) must be vetted for legal and compliance reasons and formally filed with the SEC. Since creating marketing materials can be a costly and lengthy process relative to the marketing period (typically one month), issuers do not market reverse convertibles directly to consumers.¹³ Rather, issuers choose to sell reverse convertibles to brokers who market them to consumers directly.

3 Data and Summary Statistics

The empirical analysis uses a new reverse convertible bond data set constructed for this paper. The data set covers US, SEC registered, one year maturity reverse convertibles issued over the period 2008-2012. Issuance data, specifically the date, coupon, and size details are from Bloomberg and the Mergent Fixed Income Securities Database data sources. Details on each reverse convertible's broker's fees, initial equity share price and convertible trigger price were manually collected from the corresponding Form 424V filings found on the SEC EDGARS website. The data set is supplemented with equity volatility data from Option Metrics and Credit Default Swap (CDS) data from Markit.

Table 1 displays the summary statistics of the data set. The mean and median issuance size in the sample was \$1.64 million and \$665 thousand respectively.¹⁴ On average, reverse convertibles paid a coupon of 10.50% per annum. The option premium measures the value of the put options

¹²The majority of reverse convertibles are fixed price par offerings which means that they must be sold at a fixed price of par. On occasion, certain banks will issue reverse convertibles as variable price re-offerings which means they could theoretically be sold at a discount.

¹³Previous research such as Jain and Wu (2000), Cronqvist and Thaler (2004), Barber et al. (2005), Cronqvist (2006), and Hastings et al. (2013) find that advertising plays a critical role in the competition and demand for financial products.

¹⁴ To ensure that the data set is limited to retail consumers, the largest 1% issuances (exceeding \$17.51 million) are dropped from the data set.

embedded in each reverse convertible expressed as a percentage of the notional invested.¹⁵ The one year credit default swap (CDS) spread reflects the default risk for senior unsecured debt which corresponds to the issuer credit risk inherent to each reverse convertible bond.

Reverse convertibles are almost exclusively issued by banks. Five banks: ABN Amro, Barclays Bank, JPMorgan Chase & Co, UBS and Royal Bank of Canada, dominate the issuance market for one year reverse convertibles, making up over 80% of the market over the period 2008-2012. Apple Inc. served as the most popular underlying equity to link reverse convertibles to. Other popular underlying equities include Bank of America Corporation, General Electric Company, Caterpillar Inc., and JPMorgan Chase & Co.

Figure 3 plots the dispersion in terms of the risk neutral value of each reverse convertible. The standard deviation of risk-adjusted value is over 2.40%. The results suggest the investor purchasing the best reverse convertible would earn a return that is over 10% higher than the investor purchasing the worst reverse convertible on a risk-adjusted basis. Relative to the average risk-free rate over the period studied, 0.60%, the dispersion in risk adjusted value is substantial.

4 What Type of Reverse Convertible Bonds Do Consumers Buy?

In this section, I examine the characteristics of reverse convertibles purchased by consumers. More often than not, consumers fail to purchase the best available product. Using the unique features of the reverse convertible data set, I systematically show that this is driven by the incentives of brokers. Brokers are incentivized to sell inferior products.

The primary advantage of studying reverse convertibles is the prevalence of dominated products. As described in the introduction I define a reverse convertible as being dominated if there exists another reverse convertible with the same issuer, convertible payout, issue date and price with a higher coupon rate. In the data set of 3,066 reverse convertible bonds, 142 of the reverse convertibles either dominate or are dominated by another reverse convertible. Essentially one in ten markets studied contains a dominated product. If I were to broaden the definition of dominated products in terms of the risk neutral fair value, essentially every market contains a clearly dominant

¹⁵Option prices were calculated according to the Black Scholes (1973) formula for standard European options and the Reiner and Rubinstein (1991a 1991b) formulas for knock-in options. For a summary of the formulas see Haug (2007). I assume each underlying equity pays a constant dividend. The implied dividends are backed out from Option Metrics option price data.

or dominated product. On average, the risk neutral fair market value of the best product is 2.08% higher than the worst product available in a market.

Figure 4 Panels A-C plot the average characteristics of the dominated and superior reverse convertibles. On average, the coupon and subsequent return of the superior reverse convertible is 1.60% points higher than the corresponding dominated reverse convertible. Panel B indicates that, on average, consumers collectively purchased 16% more of the dominated product. Not only are consumers buying dominated products, but they are also actually purchasing more of them relative to the superior product.

FIGURE 4: DOMINATED AND SUPERIOR PRODUCTS

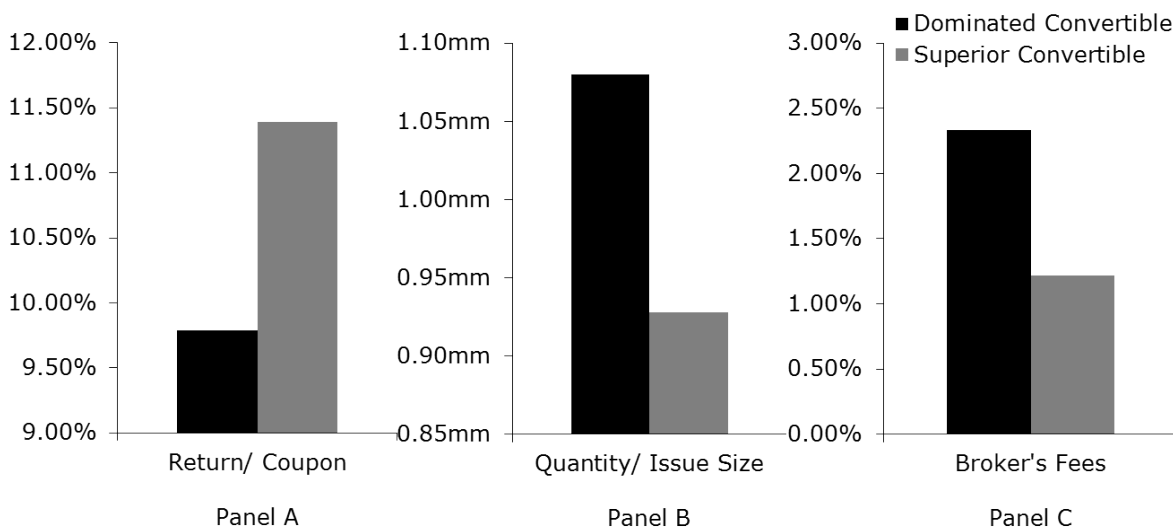


Figure 4 Notes: The figure displays the average characteristics of all of the dominated and superior reverse convertibles in the data set. The data set covers all US-issued, SEC-registered, one-year reverse convertible bonds. A reverse convertible is defined as dominated if a reverse convertible exists with the same issuer, issue date, price, underlying equity, and principal payment structure, with a higher fixed-rate coupon.

The result that consumers purchase more of the dominated product is critical because a standard search model would not predict this finding. In fact, a standard search model would predict the exact opposite: consumers should purchase more of the superior product. Consider a simple example in which two products exist, with one clearly superior to the other. In a simple undirected search model, consumers find each product with equal probability. When a consumer searches and finds the superior product, he simply purchases it and stops searching. If a consumer searches and finds the inferior product, consumers with low search costs continue searching for the superior product, whereas consumers with high search costs purchase the inferior product. Hence, consumers

will purchase more of the superior product, provided consumers see both products with equal probability.¹⁶

Figure 4 illustrates the main points of the empirical and theoretical analysis of the paper. Panel A suggests the consumer’s investment problem is fundamentally a search problem. I argue that consumers buy inferior reverse convertibles simply because they are not aware of the better convertible. However, Panel B suggests there may be more to the story beyond a simple search model. Consumers collectively purchase more of the dominated product. Last, Panel C shows the average fee paid to brokers for selling reverse convertibles. On average brokers, earned a 1.12% point higher commission for selling the dominated product. I argue and show more formally in the proceeding section that the brokers and the incentives of brokers play a critical role in determining demand for reverse convertibles.

4.1 Issuance Size vs. Product Characteristics

In this section, I formally analyze the types of financial products purchased by consumers and the role of brokers. Theoretically, both consumers and product issuers should value reverse convertibles based solely on their risk and return. In other words, under a risk-neutral framework, a reverse convertible should be valued based on its coupon, issuer credit risk, and embedded equity put option. I rely on two specifications to examine the relationship between product characteristics and issuance. I first regress bond-issuance size on the product-specific coupon, fee, embedded option premium, and issuer CDS spread:

$$Size_j = \beta Fee_j + \alpha Coupon_j + \gamma^{Opt} Option_Premium_j + \gamma^{CDS} CDS_j + Fixed_Effects \quad (1)$$

I also include issuer, month, and equity fixed effects and control for the type of reverse convertible issued (single vs. continuous observation). The observations are reverse convertible bond issuances such that j indexes a particular reverse convertible bond. One of the key variables of interest is the relationship between issuance size and broker’s fee. Recall that conditional on the risk and return of a product, consumers should be ambivalent over the broker’s fee.

As a robustness check, I estimate a corresponding demand specification in which I restrict the

¹⁶See Hortaçsu and Syverson (2004) for another example with a simple search model.

data set to the set of dominated/superior products. I estimate the regression of quantity issued on broker's fees and coupon and include a fixed effect for each set of dominated/superior reverse convertibles. The fixed effect captures all other product characteristics other than the product fee and coupon. When I restrict products to the set of dominated/superior products I am able to control for all product characteristics.

Table 2 displays the regression estimates corresponding to equation (1). Columns (1)-(4) include the results for the full data set, whereas columns (5) and (6) display the regression results corresponding to when the data set is restricted to the dominated/superior products. The relevant coefficients not only have the expected sign, but are also statistically significantly different from zero. As expected, the product-issue size is positively correlated with coupon and negatively correlated with equity option premium and issuer credit risk. The results from column (3) indicate that a one percentage point increase in coupon is associated with a \$110,800 increase in issue size. Similarly, a one percentage point increase in equity put option premium is correlated with a \$61,800 decrease in issue size, whereas a one percentage point increase in issuer credit risk (CDS spread) is correlated with a \$431,400 decrease in issue size. Under a risk-neutral framework, one would expect consumers to trade off coupon one for one with both CDS spread and option premium, such that $\alpha = -\gamma^{Opt} = -\gamma^{CDS}$. Overall, the results suggest consumers trade off coupon and option premium roughly one for one but appear relatively averse to credit risk. One potential explanation for this finding is that the data set covers the peak and aftermath of the 2008 financial crisis. With the collapse of Lehman Brothers and Bear Sterns, consumers may have been more sensitive to the default risk of investment banks.

The regression results indicate demand is increasing in coupon and decreasing in CDS spread and option premium, but also that demand is increasing in broker's fees. In each specification, I estimate a positive and significant relationship between broker's fees and issue size, even when I restrict the data set to the set of superior/dominated products. The results from column (1) indicate that a one percentage point increase in broker's fees is correlated with a \$447,200 increase in issue size. Recall that conditional on the risk and return of a product, consumers should be apathetic toward broker's fees. One might be concerned that some omitted product characteristic that is positively correlated with fees and size might drive this relationship. However, I am able to control for all product characteristics, especially when I restrict the data set to the set of dominated/superior

products. These results suggest that brokers are more inclined to sell high-fee products.

4.2 Fees vs. Product Characteristics

The estimation results from the Table 1 suggest that all else equal, consumers buy more products with higher broker's fees. Because consumers are theoretically unaffected by the broker's fee, these results suggest brokers are directing consumers to higher-fee products. This finding raises concerns over the conflict of interest between brokers and consumers, especially if products with higher fees have lower returns and higher option premiums and issuer default risk. I examine this relationship further by estimating the following specification in which I regress the broker's fee on the set of product characteristics:

$$Fee_j = \beta_1 Coupon_j + \beta_2 Option_Premium_j + \beta_3 CDS_j + Fixed_Effects \quad (2)$$

I also include issuer, month, and equity fixed effects and control for the type of reverse convertible issued. Estimated coefficients $\beta_1 < 0$ and/or $\beta_2 > 0$, $\beta_3 > 0$ would be indicative of a conflict-of-interest problem. As a robustness check, I again restrict the data set to dominated/superior products and regress broker's fees on the product coupon, and include a fixed effect for each set of dominated/superior reverse convertibles.

Table 3 displays the estimation results corresponding to equation (2). The columns differ in terms of which co-variates are controlled for, whether the regression results are weighted by the square root of the issuance size, and the data set used. The results indicate that fees are negatively correlated with product coupon and positively correlated with equity option premium and issuer credit risk. The estimated coupon coefficients in all six specifications are negative and significant at the 1% level. The estimates indicate a one percentage point increase in coupon is associated with a 0.11% decrease in product fees. Similarly, a one percentage point increase in option premium is correlated with a 0.07% increase in product fees. The estimates from column (4) imply a one percentage point increase in the issuer's CDS spread (issuer credit risk) is correlated with a 0.08% increase in product fees. Although the magnitude of the estimated coefficients is relatively small, the average level of fees in the data set is 2.20%.

Overall, the results from the empirical analysis confirm the existing concerns in the literature that the incentives of brokers do not align with the incentives of consumers. All else equal, consumers

are more likely to buy reverse convertibles with high broker's fees. However, reverse convertibles with high fees tend to have worse payoffs. In this sense, brokers are incentivized to sell consumers inferior products.

5 Model

The heterogeneity in reverse convertible risk-adjusted returns raises the question: why do consumers buy inferior convertibles and why do issuers and brokers create and sell both good and bad convertibles? Furthermore, why are consumers actually more likely to purchase dominated products? This section develops a dynamic discrete time model of financial distribution that rationalizes consumer and broker behavior. The model is then structurally estimated and used to analyze and quantify the economic implications of the proposed broker regulations.

The key features of the model are motivated by the preceding empirical analysis and features of the reverse convertible market. The prevalence of dominated financial products suggests that the consumer's investment problem is fundamentally a search problem. Consumers buy dominated products simply because they are unaware of or unable to purchase better alternatives. In the model, consumers sequentially search over the product space with the aid of a broker. Brokers select a product to show each client based on the corresponding product specific broker's fee weighted by the probability the client purchases the product. In selecting products for a client, the objective of a broker is to maximize brokerage commissions rather than to maximize consumer utility. This formulation is supported by the results from the previous empirical section. Lastly, brokers utilize the product space to price discriminate across consumers, showing high fee dominated products to unsophisticated consumers and low fee superior products to sophisticated consumers. The key innovation in the model is that brokers endogenously direct the search of consumers according to the incentives of brokers and a broker's ability to price discriminate across consumers.

5.1 Model Overview

The model involves three types of market participants: consumers, brokers (serving as financial intermediaries) and product issuers. Although largely applicable to most retail financial products, the model is tailored to the distribution of reverse convertible bonds. Product issuers create reverse convertibles and then sell them through brokers to consumers. The actions of issuers and set

of available reverse convertibles are taken as given. Rather, the model focuses on the endogenous interactions between brokers and consumers, taking the product space as given. Reverse convertibles are characterized by their payoff c (coupon), short equity put premium e , product issuer credit risk d , and broker's fee/commission f . All bonds are all sold at a fixed par price of 100%. Thus the quadruplet (c, e, d, f) defines a financial product.

Each consumer possesses demand for exactly one reverse convertible bond. Consumers sequentially search over the product space one product at a time. Brokers direct the search process of consumers, informing consumers of the available products. Each period, a broker chooses which reverse convertible bond to show her consumer client. Brokers only show one reverse convertible to each consumer at a time. The consumer elects to either purchase the bond offered or continue searching for a new investment opportunity next period. Consumers can only purchase products offered to them by brokers. If the consumer purchases the bond j , he receives utility flow $\mathcal{U}(c_j, e_j, d_j)$ and his broker receives a fee f_j , that is paid by the product issuer. If the consumer decides to continue searching, he is matched with a new broker and is offered a new product next period.

5.2 Consumer Behavior

5.2.1 Utility Formulation

Each consumer must purchase exactly one reverse convertible bond. Consumers value financial products based on their risk and return. Product j with return c_j (coupon), put premium e_j , and issuer credit risk d_j generates consumer utility $u_j = \mathcal{U}(c_j, e_j, d_j)$. Utility is increasing in return and decreasing in put premium and issuer credit risk such that $\mathcal{U}_c > 0$, $\mathcal{U}_e < 0$ and $\mathcal{U}_d < 0$. The utility function is specified as a linear function of return/coupon, equity put premium, and issuer credit risk. Issuer credit risk is measured using the corresponding one year CDS spread.

$$u_j = \alpha \text{Coupon}_j + \gamma^{Opt} \text{Option_Premium}_j + \gamma^{CDS} \text{CDS}_j \quad (3)$$

This utility formulation is roughly consistent with the risk neutral fair value of a reverse convertible. If consumers value reverse convertibles according to the risk neutral prices, consumers should be willing to trade off coupon and equity put premium and issuer credit risk roughly one for one such that $\alpha = -\gamma^{Opt} = -\gamma^{CDS}$ (assuming no discounting).

There are two important things to note regarding the utility formulation. First, neither the price of a reverse convertible nor the broker's fee enters the consumer's utility function. This is because all reverse convertibles are sold at a fixed price of par (100%). The broker's fee is paid by the product issuer rather than the consumer. In this sense, the broker's fee represents the portion of profits shared between the issuer and the broker. Conditional on the risk and return of a product, consumers are apathetic regarding the broker's fee.

Second, the utility formulation implies that the products are vertically rather than horizontally differentiated. Notice that the utility specification does not include an unobserved product and consumer specific error term. Consequently, consumers possess a clear rank ordering over the product space.

5.2.2 Consumer Search

Costly search prevents consumers from simply searching across all products and purchasing the product yielding the highest utility. There are two types of consumers, Searchers (sophisticated investors) and Non-Searchers (unsophisticated). By definition Non-Searchers always purchase the first product offered while Searchers may search across the product space. The fraction of Searchers in the population is denoted ω_S . Each period, Searchers must pay a search cost v_i in order to observe a new product offer from a broker. Search costs are heterogeneous across Searchers and are distributed $v_i \sim F(\cdot)$. Non-Searching consumers all face prohibitively high (infinite) search costs such that they never search across products. Consumer types (Searcher/Non-Searcher) reflect the information observed by brokers. Brokers observe a consumer's type and preferences but not his exact search cost. Thus brokers have incomplete information regarding the exact level of financial sophistication of each customer. Neither search costs nor consumer type are observed by the econometrician. As shown in the proceeding section, brokers will select different products to show different consumer types and will essentially price discriminate across Searching and Non-Searching investors.

Searching consumers sequentially search for the optimal investment among the discrete product space $\{u_1, u_2, \dots, u_n\}$. Products are numbered such that $u_j \leq u_{j+1}, \forall j$. While searching, a consumer receives an offer from a broker each period and then must elect to either purchase the offered bond or continue searching. If the consumer decides to continue to search he pays a search cost v_i and receives

an offer from a new broker in the preceding period. All subsequent product offers are drawn i.i.d. from either the stationary distribution $H_S(\cdot)$ or the stationary distribution $H_{NS}(\cdot)$ depending on whether the consumer is a Searcher or Non-Searcher. As will be discussed in the proceeding section, the key innovation in the model is that the distribution of products observed by Searchers and Non-Searchers $H_S(\cdot)$ and $H_{NS}(\cdot)$ are endogenously determined based on the incentives of brokers. In equilibrium, consumer beliefs about $H_S(\cdot)$ and $H_{NS}(\cdot)$ are correct and completely rational. As discussed in the proceeding section, I focus on a stationary equilibrium in which the distribution of offered products is constant over time.¹⁷ I abstract away from the broker/consumer matching process by assuming that conditional on type, brokers and consumers are ex-ante identical and are randomly assigned. Consumers search for products by randomly searching across brokers, brokers intermediate the search process and select the product that maximizes the brokers expected profits.

Let $V_S(u_j, v_i)$ denote the value function of a Searcher with search cost v_i that is offered a product yielding utility u_j . A consumer offered product j can either purchase the product or pay a search cost and continue searching. Formally the consumer's problem is¹⁸

$$V_S(u_j, v_i) = \max \left\{ u_j, -v_i + \sum_{k=1}^n \rho_{k,S} V_S(u_k, v_i) \right\}$$

Purchasing the product j yields utility flow u_j while the expected utility of searching is $-v_i + \sum_{k=1}^n \rho_{k,S} V_S(u_k, v_i)$. Here $\rho_{j,S}$ reflects the probability a Searcher observes product j . The sets of offering probabilities $\rho_{1,S}, \rho_{2,S}, \dots, \rho_{n,S}$ are endogenously determined based on incentives of brokers. Collectively the probabilities $\rho_{1,S}, \rho_{2,S}, \dots, \rho_{n,S}$ form the distribution $H_S(\cdot)$.

Under this framework, consumers optimally search by adopting a reservation utility.¹⁹ A Searching consumer with search cost v_i searches until he is shown an investment product that exceeds his reservation utility $u^r(v_i)$. Consumers will optimally continue searching as long as the consumer's expected benefit of search is greater than his search cost. Suppose a consumer is offered product j

¹⁷Alternatively one can think of the market as clearing instantaneously.

¹⁸The equivalent formulation with a continuous product space is given by

$$V(u_j, v_i, T) = \max \left\{ u_j, -v_i + \int_{\underline{u}}^{\bar{u}} V(u', v_i, T) dH_t(u') \right\}$$

where $[\underline{u}, \bar{u}]$ is the support of available products.

¹⁹See McCall 1970, Rogerson et al. 2005, and Hortaçsu and Syverson (2004) for a further discussion of search problems and a proof of the optimal strategy.

yielding utility u_j , the consumers expected benefit of search is given by $\sum_{k=j+1}^n \rho_{k,S}(u_k - u_j)$ which is equal to the probability the consumer sees a better product than u_j weighted by the gain in terms of utils.²⁰ The optimal strategy is then²¹

$$\begin{aligned} \text{Continue Searching: } \underbrace{v_i}_{\text{Cost}} &\leq \underbrace{\sum_{k=j+1}^n \rho_{k,S}(u_k - u_j)}_{\text{Expected Benefit}} \\ \text{Purchase: } v_i &\geq \sum_{k=j+1}^n \rho_{k,S}(u_k - u_j) \end{aligned} \quad (4)$$

The reservation utility is equal to the utility generated by product j , $u^r(v_i) = u_j$, such that $\sum_{k=j+1}^n \rho_{k,S}(u_k - u_j) \leq v_i \leq \sum_{k=j}^n \rho_{k,S}(u_k - u_{j-1})$. A consumer purchases the product if it exceeds his reservation utility, $u^r(v_i)$, otherwise he continues searching. An individual's optimal reservation utility, $u^r(v_i)$ is a weakly decreasing function of his search cost v_i . A consumer with zero search costs searches until he finds the product yielding the highest utility u_n while a consumer with infinite search costs (i.e. Non-Searchers) simply selects the first product offered. Let $G(\cdot)$ denote the stationary distribution of reservation utilities among Searchers in equilibrium.

In contrast, Non-Searching consumers simply select the first product offered to them by brokers. Non-Searchers can equivalently be thought of as consumers with infinite search costs. The probability a Non-Searcher observes a particular product j is denoted $\rho_{j,NS}$ and is endogenously determined based on broker profit maximization. The set of probabilities $\rho_{1,NS}, \rho_{2,NS}, \dots, \rho_{n,NS}$ from the distribution of products offered $H_{NS}(\cdot)$. Since brokers observe a consumer's type, the distribution of product offered $H_S(\cdot)$ and $H_{NS}(\cdot)$ will likely vary across types in equilibrium. In other words brokers may be more inclined to show Non-Searchers high fee inferior products while showing Searchers low fee superior products.

A couple of underlying assumptions in the model are worth noting. In the model framework, consumers know the distribution of product offerings $H_S(\cdot)$ and $H_{NS}(\cdot)$ (or equivalently $\rho_{j,S}$ and

²⁰This formulation assumes consumers can recall and purchase products observed in prior periods; however, in practice consumers will never find it optimal to do so.

²¹The equivalent optimal reservation strategy in the formulation with a continuous product space is given by

$$v_i = \int_{u^r}^{\bar{u}} (u' - u^r) dH_S(u')$$

where $[\underline{u}, \bar{u}]$ is the support of available products.

$\rho_{j,NS} \forall j$) but are unable to purchase a product without the aid of the broker. Although not applicable to all financial markets, this framework seems reasonable in the setting of reverse convertible bonds. Reverse convertible bonds have short marketing periods (typically less than one month) and are SEC registered products which makes them costly to market directly to end consumers. Consequently, issuers do not market these products directly to consumers. The prevalence of dominated products indicates that search is a key component of the consumer's problem. Investor suitability regulations (FINRA Rule 2111) require that reverse convertible investors meet a certain level of financial sophistication, risk tolerance etc.. Hence, even though reverse convertible investors may not know the exact distribution of product offerings, they may still have realistic expectations over the distribution of product offerings based on previous experience and the prices of more transparent assets.

5.3 Broker Behavior

Brokers act as a liaison between the end consumers and the financial product issuers. Brokers observe the full scope of available products. Each period brokers offer each consumer an individual specific financial product tailored to the consumers level of sophistication/type. If the consumer purchases the product, the product issuer pays the corresponding broker a product specific fee. Fees f_j for a given product j are fixed but are heterogeneous across products.

Each issuer creates a suite of financial products available to and observed by all of the brokers. Let $\mathcal{J} = \{u_1, u_2, \dots, u_n\}$ denote the product space available to brokers. For each of her clients, the broker selects the product that maximizes her expected profits

$$\max_{j \in \mathcal{J}} E[\pi_{i,j}] \tag{5}$$

Offering product j to client i , yields an expected profit equal to the probability client i purchases product j multiplied by the returns from selling product minus the cost of offering the product. Brokers observe the preferences and types of their clients but do not observe each client's specific search cost. Recall that a Searcher purchases a product if and only if it exceeds his reservation utility while Non-Searchers always purchase the product offered. The probability product j exceeds a Searcher's reservation utility and thus the probability a consumer purchases the product is given

by $G(u_j)$. The distribution of reservation utilities $G(\cdot)$ are endogenously determined based on the consumers optimal search strategy (12). The expected profit of offering product j to a Searching consumer i is then

$$\mathbb{E}[\pi_{i,j,S}] = f_j G(u_j) + \psi_j + \eta_{S,i,j} \quad (6)$$

where $f_j G(u_j)$ is the broker's expected revenue, ψ_j is the product specific marketing cost incurred by the broker, and $\eta_{i,j}$ is a product/consumer specific marketing cost incurred by the broker. The cost term $\eta_{i,j}$ is unobserved (by the econometrician) and is assumed to be distributed T1EV. The expected profit of showing product j is increasing in the fees associated with the product and the utility generated by the product. The better the product, the higher the probability it will exceed a consumers reservation utility. Since Non-Searchers always purchase the product offered, the expected profit of offering product j to a Non-Searching consumer i is

$$\mathbb{E}[\pi_{i,j,NS}] = f_j + \psi_j + \eta_{NS,i,j} \quad (7)$$

where f_j is expected revenue and ψ_j $\eta_{i,j}$ are product and product/consumer specific market costs. The cost term $\eta_{i,j}$ introduces broker/investor specific heterogeneity into the broker's profit function. Note that if $\eta_{i,j} = 0 \forall i, j$, brokers would always show the same product to Searchers and the same product to Non-Searchers. One can interpret $\eta_{i,j}$ cost of accessing and/or marketing a product to a particular client. Alternatively, η could be interpreted as broker error in assessing value of a product and the consumers type (Searcher/Non-Searcher). The term ψ_j introduces another element of conflict of interest between a broker and consumers. For example, a broker may inherently prefer to sell a UBS reverse convertible because of a preexisting relationship or an affiliation between the broker and UBS (i.e. the broker works for UBS Advisers)

A key assumption in the model framework is that brokers only show a client one product at a time and that each particular broker and client interact at most one time. These assumptions rule out any learning between brokers and clients. For tractability reasons, these assumptions simplify the broker's profit maximization problem to a static problem while the consumer's search problem remains dynamic. In practice these assumptions may be reasonable when applied to the reverse convertible setting. It seems unlikely that a broker would simultaneously show a superior and

dominated product to a client. Similarly, a broker may be hesitant to show a client a superior product in a proceeding period after first showing them a dominated product or vice versa.

The probability that a broker selects product j to offer to a client of type T (Searcher or Non-Searcher), denoted ρ_{jT} , is given by

$$\rho_{j,T} = \Pr(E[\pi_{i,j,T}] > E[\pi_{i,k,T}] | \forall k \in \mathcal{J}_{-j})$$

Given the distributional assumption of the cost shock $\eta_{i,j}$, the probability that a broker selects product j follows the multinomial logit distribution

$$\rho_{j,S} = \frac{\exp(f_j G(u_j) + \psi_j)}{\sum_{k=1}^n \exp(f_k G(u_k) + \psi_k)} \quad (8)$$

$$\rho_{j,NS} = \frac{\exp(f_j + \psi_j)}{\sum_{k=1}^n \exp(f_k + \psi_k)} \quad (9)$$

The offering probabilities $\rho_{j,S}$ and $\rho_{j,NS}$ generate the distributions of available products $H_S(\cdot)$ and $H_{NS}(\cdot)$ observed by Searchers and Non-Searchers. Note that the distribution of reservation utilities $G(\cdot)$ and the distribution of product offerings $H_S(\cdot)$ and $H_{NS}(\cdot)$ are endogenously and simultaneously determined in equilibrium according to optimal consumer and broker behavior described in equations (4) and (5).

The probability a broker shows a particular product to a Non-Searcher is simply a function of the broker fees. The probability a broker shows a particular product is increasing the fees

$$\frac{\partial \rho_{j,NS}}{\partial f_j} = \rho_{j,NS}(1 - \rho_{j,NS}) > 0$$

Because of the unobserved cost shock, $\eta_{i,j}$, it is not always the case that the broker shows the highest fee product to a Non-Searcher. Rather, brokers, face consumer/specific marketing costs or make errors in assessing the value of the product and type of consumer such that probability a Non-Searcher sees a particular product is not degenerate.

The probability that a broker shows a particular product to a Searcher is a function of the product's fees as well as the probability that the client purchases the product. All else equal, the probability that a broker selects a particular product to show a client is increasing in the product's

fees

$$\frac{\partial \rho_{j,S}}{\partial f_j} = G(u_j) \rho_{j,S} (1 - \rho_{j,S}) > 0$$

Brokers only earn the fee if the consumer purchases the product. The better the product offered, the more likely Searching consumers are to purchase the product. For this reason, the probability a broker selects a particular product to show a Searcher, all else equal, is increasing in the utility generated by the product

$$\frac{\partial \rho_j}{\partial u_j} = f_j g(u_j) \rho_{j,T} (1 - \rho_{j,T}) > 0$$

where $g(\cdot)$ is the density corresponding to the distribution $G(\cdot)$. In this sense, the incentives of brokers and consumers are not totally misaligned. If the fees, f , and costs, η , were fixed across products, brokers would be incentivized to always offer products that generate the highest utility. However, the reduced form results from Section 4.2 suggest that fees and product utility are negatively correlated. Overall, Searchers are more likely to observe products with higher fees and that generate higher utility.

5.4 Product Issuers

Issuers create financial products characterized by coupon, risk and broker's fees. For each product sold, each issuer l earns a constant markup $\mu_l(c, e, d, f)$ that is a function of the product characteristics. The markup potentially varies across issuers to reflect differences in productivity. The markup is decreasing in coupon and fee ($\frac{\partial \mu_l}{\partial c} < 0$, $\frac{\partial \mu_l}{\partial f} < 0$) but is increasing in the corresponding equity and CDS components ($\frac{\partial \mu_l}{\partial e} > 0$, $\frac{\partial \mu_l}{\partial d} > 0$). Issuing a product yields an expected profit equal to the product of the probability a broker selects the product, the probability a client buys the product, the issuer's markup, and the mass of consumers, N , minus the cost of issuing the product ξ_{lj} ,

$$\Pi_{lj} = N [\omega_s \rho_{j,S} G(u_j) + (1 - \omega_s) \rho_{j,NS}] \mu_{lj} - \xi_{lj}$$

The term $N \omega_s \rho_{j,S} G(u_j)$ reflects demand from Searching consumers. It reflects the number of Searchers $N \omega_s$, multiplied by the probability a Searcher observes product ($\rho_{j,S}$) and the probability a searcher would purchase the product $G(u_j)$. The term $N(1 - \omega_s) \rho_{j,NS}$ reflects demand from Non-Searchers.

In the model issuers play a differentiated product Nash Bertrand game where issuers compete on fees. The corresponding first order condition for a single product issuer is²²

$$\underbrace{N (\omega_S \rho_{j,S} (1 - \rho_{j,S}) G(u_j)^2 + (1 - \omega_S) \rho_{j,NS}) \mu_j}_{\text{Marginal Benefit}} = N \underbrace{\left[\omega_S \rho_{j,S} G(u_j) + (1 - \omega_S) \rho_{j,NS} \right]}_{\text{Marginal Cost}} \quad (10)$$

The term on the LHS reflects the marginal benefit of increasing the fee offered to brokers and attracting more consumers. The RHS reflects the marginal cost of increasing the brokerage fee which reflects the decrease in markup $\left(\frac{\partial \mu}{\partial f} = -1\right)$ multiplied by demand.

5.5 Equilibrium

I study a stationary pure strategy Bayes Nash equilibrium. In equilibrium consumers optimally search by employing the reservation strategy described by equation (4). Furthermore, consumer beliefs over the distribution of indirect utilities offered to Searchers and Non-Searchers, $H_S(\cdot)$ and $H_{NS}(\cdot)$, reflect the true distribution of product offerings generated from broker profit maximization. In equilibrium brokers maximize profits according to equations (6), and (7) where their beliefs over the distribution of reservation utilities reflect the true distributions generated by equation (4), $G(\cdot)$. Product issuers play a Nash Bertrand fee setting game and maximize profits according to equation (10). The distribution of products observed by consumers, $H_S(\cdot)$ and $H_{NS}(\cdot)$, and the distribution of reservation utilities, $G(\cdot)$, are endogenously and simultaneously determined in equilibrium.

The distribution of search costs and consumer types in the population, market parameters and characteristics of available products are all assumed to be constant over time. Or alternatively, the market is assumed to clear instantaneously. The equilibrium is therefore stationary. Consequently, the distribution of product offerings and reservation utilities are constant over time.

6 Model Estimation

The search model described in Section 5 lends itself to structural estimation. Using the reverse convertible data set, I structurally estimate the search model. The model and estimation procedure most closely resembles that of Hortaçsu and Syverson (2004) and Hong and Shum (2006). The key parameters of interest are consumer preferences, the broker's profit functions, and the distribution

²²The corresponding first order condition for a multi-product issuer is $\left(\begin{array}{l} \rho_{j,S}(1 - \rho_{j,S})G(u_j)^2 + (1 - \omega_S)\rho_{j,NS} \\ - \sum_{k \in K} [\omega_S \rho_{kS} \rho_{jS} G(u_j) G(u_k) + (1 - \omega_S) \rho_{kS} \rho_{jS}] \mu_k \end{array} \right) \mu_j = \omega_S \rho_{j,S} G(u_j) + (1 - \omega_S) \rho_{j,NS}$

of reservation utilities, consumer types and search costs.

The model is estimated using the reverse convertible market share level data described in Section 3. Each month and underlying equity defines a reverse convertible market and corresponding market share. For example, all one year reverse convertibles linked to Apple Inc. issued in December 2012 constitute a market. In total there are 498 markets with 1513 different reverse convertibles.²³

The model is estimated via maximum likelihood. The probability a consumer purchases product j is equal to the probability the broker shows the product to a consumer multiplied by the probability that the product's utility exceeds the consumer's reservation utility. The probability a consumer observes and purchases a bond depends on his consumer type which is observed by brokers but not the econometrician. Thus the probability that consumer i purchases product j is given by

$$\begin{aligned} \Pr(D_{ij} = 1) &= \omega_S \rho_{j,S} G(u_j) + (1 - \omega_H) \rho_{j,NS} \\ &= \omega_S \frac{\exp(\theta_S (f_j G(u_j) + \psi_j))}{\sum_{k=1}^n \exp(\theta_S (f_k G(u_k) + \psi_j))} G(u_j) + (1 - \omega_S) \frac{\exp(\theta_{NS} (f_k + \psi_j))}{\sum_{k=1}^n \exp(\theta_{NS} (f_k + \psi_k))} \end{aligned}$$

where $D_{i,j}$ is a dummy variable indicating that individual i purchased product j . Here the term ω_S reflects the probability a consumer is a Searcher, the term $\rho_{j,S}$ or $\frac{\exp(\theta_S (f_j G(u_j) + \psi_j))}{\sum_{k=1}^n \exp(\theta_S (f_k G(u_k) + \psi_j))}$ reflects the probability that a Searcher is shown product j , and $G(u_j)$ reflects the probability that product j exceeds a Searcher's reservation utility. I introduce the parameters θ_S and θ_{NS} as scaling parameter that scale the variance of the unobserved cost shocks η_S . The parameters to be estimated in the model are the scaling parameters (θ_S, θ_{NS}) , the utility parameters corresponding to eq. (3), product specific marketing costs ψ_j , the distribution of reservation utilities $G(\cdot)$ among Searchers, and the distribution of consumer types ω_S . The distribution of consumer types (high and low) are estimated using a discrete mixing distribution similar to Heckman and Singer (1984).

I estimate the model using market share data. Hence, the dependent variable is the market share for each product which ranges from zero to one.²⁴ Note that from the market share data, I only observe bond purchases and do not observe individuals who were shown bonds but elected not to purchase them. A common problem related to demand estimation in the industrial organization

²³Note that the original sample consists of 3,066 reverse convertibles. Markets consisting of only one reverse convertible are not used in the model estimation procedure.

²⁴As a robustness check shown in the appendix I also re-estimate the model where each observation is weighted by the market size.

literature is how to define and quantify the outside good/alternative which in this setting is not purchasing a reverse convertible. I circumvent the outside good issue by simply estimating the observed conditional probabilities. I estimate the model via maximum likelihood where I condition on the probability that a consumer purchased a reverse convertible from that particular market. The corresponding likelihood used to estimate the model is given by

$$\Pr \left(D_{i,j} = 1 \mid \sum_{l=1}^n D_{i,l} = 1 \right) = \frac{\omega_S \rho_{j,S} G(u_j) + (1 - \omega_S) \rho_{j,NS}}{\sum_{l=1}^n [\omega_S \rho_{l,S} G(u_l) + (1 - \omega_S) \rho_{l,NS}]} \quad (11)$$

Estimating the conditional likelihood solves the outside good problem in this setting.

To facilitate estimation, I assume that consumers employ the same set of reservation strategies across all markets. In other words, $G(\cdot)$ is assumed to be constant across all markets. This assumption is equivalent to assuming that the distribution of search costs, consumer types and consumer beliefs over $H_S(\cdot)$ and $H_{NS}(\cdot)$ are constant across markets. For example, this implies that consumers searching for Apple linked reverse convertibles and Microsoft linked reverse convertibles hold the same beliefs over the distribution of available reverse convertibles. This assumption provides additional statistical power to estimate $G(\cdot)$, otherwise it would have to be separately estimated for each market. Although this assumption restricts consumer beliefs, it may not be unreasonable to think consumers searching for Apple or Microsoft linked reverse convertibles employ the same search strategy. As a robustness check, in the Appendix relax this assumption by re-estimating the model using only Apple linked reverse convertibles and find similar results.²⁵

The model is parametrized as follows. The utility function is specified as a linear function of coupon, option premium and the CDS spread according to equation (3). I parametrize the broker's cost of showing a particular product ψ_j using product issuer fixed effects for the five largest issuers: ABN Amro, Barclays, JPMorgan, RBC and UBS. For example, brokers it may be less costly for brokers to sell products issued by JPMorgan Chase or brokers may simply prefer to sell JPMorgan chase products because of a preexisting relationship. The SEC has recently investigated brokers for steering clients to particular product issuers because of preexisting relationships.²⁶

Estimation of the model requires no additional assumptions regarding the parametric form of

²⁵See Table A-1 and Figure A-2.

²⁶THE SEC and CFTC are currently investigating whether JPMorgan brokers have been improperly steering consumers into proprietary products or third party products in which the bank has a preexisting relationship (<http://www.wsj.com/articles/j-p-morgan-in-talks-to-settle-case-over-steering-investment-products-1435181444>).

$G(\cdot)$. Following Barseghyan et al (2013), I flexibly estimate the distribution functions $G(\cdot)$ using a third order polynomial approximation to $\log G(\cdot)$.²⁷ I estimate polynomial approximations to $\log G(\cdot)$ rather than $G(\cdot)$ to ensure that the estimated distribution $\widehat{G}(\cdot)$ is strictly positive. However, I do not restrict the estimated distribution functions to be weakly increasing.²⁸ The variation in the data helps identify the curvature of the reservation utility functions $G(\cdot)$. However, the scale of $G(\cdot)$ is not separately identified from θ_S in the above likelihood. The scale of $G(\cdot)$ is pinned down by the fact that all consumers purchase the best product which yields utility \bar{u} . In other words, no consumer continues searching if observes the best available product. Hence, $G(\bar{u}) = 1$.

The underlying data and model separately identifies the consumer utility and broker parameters as well as the observed distribution of reservation utilities. The utility formulation of the model allows for two normalizations. Due to its arbitrary scale and level, I normalize consumer preferences for coupon equal to one and the constant²⁹ to zero. Under this normalization, the utility parameters can be interpreted in terms of monetary value or percentage return.

Although each parameter of the model is jointly identified through the data, I provide a brief stylized discussion of the intuition behind the identification of the key parameters of the model. The preference parameters γ^{Opts} and γ^{CDS} measure how consumers trade off option premium and issuer credit risk (CDS) relative to coupon. Identification of preferences is best illustrated through the proceeding thought experiment. Suppose we observe a product with fees f , coupon c , and equity option premium e that has market share s . Now suppose we decrease the coupon from c to c' , $c' < c$. The question we are interested in is how much would the option premium have to decrease by from e to e' to keep the market share of the product unchanged at s . The compensating change in option premium identifies how consumers trade off option premium for coupon.

Intuitively, identification of the distribution of reservation utilities $G(\cdot)$ follows closely to that of the preference parameters. The conceptual experiment we would like to be able to run is to freely vary the coupon of a product and see how the corresponding product's market share changes,

²⁷Note that $G_H(\cdot)$ and $G_L(\cdot)$ are estimated using a smooth polynomial function while $H_H(\cdot)$ and $H_L(\cdot)$ are likely non-smooth in practice. Given that the distribution of available products is discrete $H_L(\cdot)$ and $H_H(\cdot)$, then the distribution of reservation utilities $G_H(\cdot)$ and $G_L(\cdot)$ will also be discrete according to the search model described in Section 5.

²⁸In the appendix, I estimate $G(\cdot)$ using a B-spline where I force $G(\cdot)$ to be positive and weakly increasing and find quantitatively similar results. See Figure A-3 for further details.

²⁹I included brand fixed effects for the five largest issuers: ABN Amro, Barclays, JPMorgan, RBC and UBS. The constant represents the brand effect for all other issuers.

keeping all other products and product characteristics constant. Such variation allows us to trace out the curvature of the distribution of reservation utilities. The scale of $G(\cdot)$ is pinned down by the fact that all consumers purchase the best product which yields utility \bar{u} , i.e. $G(\bar{u}) = 1$.

The variation in consumer types is identified by variation in the distribution of product offerings across markets. Specifically, the variation in substitution patterns across markets identifies consumer types. Consider a market consisting of one clearly superior, high utility, low fee bond and one dominated, low utility, high fee bond. Now suppose an additional inferior bond is introduced into the market. We can identify the proportion of Searchers and Non-Searches based on how the market share of the superior bond changes when an additional inferior bond is introduced into the market. If the market share of the superior bond falls dramatically, that suggests those investors who initially purchased the superior reverse convertible were “lucky” Non-Searchers. If the market share of the superior bond does not change much, that suggests that those investors who initially purchased the reverse convertible were primarily Searchers. Although the preceding example is a bit stylized, variation in substitution patterns across markets is the key feature of the data that identifies consumer types.

7 Estimation Results and Analysis

7.1 Estimation Results

The maximum likelihood estimates are reported in Table 4. I first estimate the model under the assumption that all consumers are Searchers and then estimate the model allowing for the two types of consumers: Searchers and Non-Searchers. Columns (1) and (3) display the estimates for the one consumer type model while columns (2) and (4) report the estimates corresponding to the heterogeneous two consumer type model. As expected, the results indicate that consumer utility is decreasing in equity option premium and issuer credit risk (CDS). In all specifications, I estimate a negative and statistically significant relationship utility and the two measures of risk. The results from column (1) indicate that consumers are indifferent between a 1.00% point increase in coupon and a 0.655% point decrease in option premium. Similarly, consumers are willing to trade off a 1.00% point change in coupon for a 4.33% point decrease in the corresponding CDS spread. Recall that under a risk neutral framework consumers should be willing to trade off option premium and

CDS spread roughly one-for-one with coupon. Just as with the reduced form results from Section 4, it appears that consumers are particularly sensitive to issuer credit risk.

In the two consumer type model, I also estimate the distribution of consumer types ω_S . The estimates in column (2) suggest that 74.38% of the population is comprised of Searchers while the remaining 25.62% of the population is comprised of Non-Searchers. We can reject the null hypothesis that $\omega_S = 0$ and $\omega_S = 1$ at the 10% significance level against the alternative hypothesis $\omega_S > 0$ and $\omega_S < 1$. These results suggest that brokers have the ability to price discriminate across consumer types.

7.2 Search Costs

The structural model provides additional quantitative insight into the underlying forces driving the market for reverse convertibles. The empirical evidence suggests that costly search prevents consumers from finding the superior reverse convertibles in the market. Using the model estimates, I am able to recover the distribution of search costs by inverting eq. (4) as detailed in the appendix. Recovering the distribution of search costs provides us with an opportunity to determine whether or not the estimates are reasonable and/or economically meaningful.

Figure 6 displays the estimated distribution of search costs for the two consumer type models.³⁰ The estimated search costs from the two agent model suggest that roughly 50% of the population has search costs below 150bps. In other words over 50% of Searchers behave as if the cost (in terms of time value) of soliciting an additional offer from a broker is less than \$150 for a \$10,000 investment. The estimates suggest that relatively small search costs can support the observed dispersion in returns.

7.3 Broker Behavior

The consumer search problem is compounded by the fact that brokers are not incentivized to show consumers the best available products. The structural estimates help illustrate the incentives of brokers and assess the degree of price discrimination occurring in the reverse convertible market.

Consider the hypothetical market comprised of two nearly identical reverse convertibles where the payout of one dominates the payout of the other. One of the reverse convertibles, the superior reverse convertible, pays a coupon of 12% and a broker's fee of 1.00%. The other reverse convertible,

³⁰Appendix Figure A-2 displays the estimated distribution for the one agent model.

the dominated reverse convertible, pays a coupon of 8% and a broker's fee of 5.00%. We can use the parameter estimates to determine the probability consumers of each type observe each product. Table 5 displays the probability consumers observe each product. Searchers observe both the superior and dominated products with roughly equal probability. However, brokers are 2.125x more likely to show a Non-Searcher the dominated product relative to the superior product. These results help explain why not only consumers buy dominated products but why consumers may actually purchase more of dominated products.

The model also allows brokers to have preferences for showing particular types of products. For example, a broker may be affiliated with JPMorgan Chase and prefer to show JPMorgan bonds. The SEC is currently investigating several bulge bracket brokerage firms for exhibiting favoritism towards certain financial products and issuers. The empirical model includes a set of fixed effects, ψ , for the five largest issuers. Figure 7 displays the distribution estimated fixed effects. The fixed effects can be interpreted as follows. On average, brokers prefer to show Barclays Capital issued bonds over ABN Amro bonds. A broker is indifferent between showing a Non-Searching Client an ABN Amro reverse convertible that pays a brokerage fee of 1% versus a Barclays Capital reverse convertible that pays a brokerage fee of 4%.

7.4 Issuer Markups

I use the structural estimates to calculate the implied markups earned on each reverse convertible. Using the product issuer's optimality condition (10), I calculate the implied markup for each reverse convertible bond issued.

A unique feature of the data is that I am able to compute the implied markups using the structural model as well as the actual markup using financial derivatives data. Given that a reverse convertible bond is comprised of financial derivatives with readily available cost/price data, it is straightforward to compute the actual true ³¹ markup for each reverse convertible. Figure 8 displays the distribution of actual and implied markups. Figure 9 displays a scatter plot of implied markups versus the actual markup. In general, the actual and implied markups are comparable. The actual and implied markups are positively and significantly correlated (0.35).

³¹I calculate the markup $\mu \approx CDS + Option\ Premium + 1YCMS - c - f$. The Issuer receives the value of the bond funding which (ignoring discounting) is $CDS + 1YCMS$ and the equity option. The issuer then pays out the coupon and broker's fee.

8 Policy Analysis: Fiduciary Duty

Two economic forces/frictions appear to drive the existence and prevalence of dominated products. First, consumers must not be aware of or able to purchase the superior product. I model and argue that the consumer's problem is fundamentally a search problem. Second, the consumers search problem is confounded by the fact that the incentives of brokers do not align with the incentives of consumers. As consumers search for new investment products, they are more likely to see high fee products. Brokers may also be inclined to sell products where they have a preexisting relationship and/or affiliation with the issuer. These conflicts of interest burden consumers with excess search. The structural estimation results provide a way of quantifying the forces driving consumer behavior in an economically meaningful way. Both economic forces/frictions impact the distribution and total level of consumer and producer surplus.

Across the globe regulators are moving towards addressing the asymmetry between broker and consumer incentives. Australia, the United Kingdom, India, Norway, Finland, Denmark and the Netherlands all recently placed bans on commissions in the financial service industry.³² With the Dodd-Frank Act, US regulators are moving in a similar direction. As part of the Dodd-Frank Act, US regulators may soon require brokers to act as fiduciaries for their clients which would obligate brokers to act in the best financial interests of their clients.

I use the preceding structural estimates to analyze how holding brokers to a fiduciary duty would impact the distribution and total level of surplus. In the baseline model framework, brokers select the product that maximizes the broker's expected profit rather than the product that maximizes the utility of consumers. The probability a broker shows product j to a consumer is given by

$$\rho_{j,S} = \frac{\exp(f_j G(u_j) + \psi_j)}{\sum_{k=1}^n \exp(f_k G(u_k) + \psi_j)}, \quad \rho_{j,NS} = \frac{\exp(f_j + \psi_j)}{\sum_{k=1}^n \exp(f_k + \psi_j)}$$

I change the broker's incentive structure by imposing that

$$\tilde{\rho}_{j,T} = \begin{cases} 1 & \text{if } u_j > u_l \forall l \in \mathcal{J}_{-j} \\ 0 & \text{otherwise} \end{cases}$$

³²See King & Wood Mallesons publication "Australia is Not Alone in Banning Commissions in Financial Services." <http://www.mallesons.com/publications/marketAlerts/2012/regulator-october-2012/Pages/Australia-is-not-alone-in-banning-commissions-in-financial-services.aspx>

Brokers must show the product with the highest utility regardless of the fee charged or the brokers relationship with the issuer (ψ_j). Thus in a given market (defined in terms of the underlying equity and month), brokers must show the best available product in that market. For example, if a consumer is searching for a reverse convertible linked to Apple, the broker must show the client the best available Apple linked product in that month. Note that even though consumers are always shown the best product in a given market, a consumer may still elect to continue searching over/time across other markets. It is possible that the best product in a given market does not exceed the consumers reservation utility strategy.³³

In equilibrium, changing the brokers' incentive structure not only impacts the optimal behavior of brokers but also consumers and product issuers. I first complete a partial equilibrium analysis to show how the proposed fiduciary duty policy would impact the behavior of brokers and consumers while keeping the product space fixed. I then allow then allow product issuers to optimally respond to the policy.

Table 7 displays the average change in search expenditures and consumer risk-adjusted returns under the new fiduciary duty policy keeping the product space fixed. On average, search expenditures among Searchers declines by 0.10 percentage points (pp). The decline in search expenditures represent real increases in total economic surplus. Consumers capture most of the increase in surplus as consumer risk adjusted returns by 1.00pp on average. The average risk free adjusted rate over the period studied was 0.60%. Consequently these represent relatively large gains in risk-adjusted returns.

The results displayed in Table 7 keep the product space fixed. If the FDIC were to hold brokers to a fiduciary duty, this would undoubtedly change the behavior of product issuers. If brokers were legally obligated to offer the product with the highest utility in a given market, then consumers would only purchase the best available product in that market. I consider the following policy where I allow consumers, brokers and product issuers to endogenously respond to the policy change.

- FDIC holds brokers to a fiduciary duty as described above
- FDIC fixes the fee paid to brokers to 2.30% (weighted average previously earned by brokers)
- Issuers play a Nash Bertrand coupon setting game

³³As discussed in the preceding section, I assume for the empirical analysis that all consumers adopt the same reservation utility strategy across all of the observed markets.

I allow issuers to change the coupon offered on each reverse convertible in response to the policy change. Because brokers do not have any discretion in which products they can offer, this changes the issuers' game from a differentiated Nash Bertrand game to an undifferentiated product Nash Bertrand game. Because consumers will only observe and purchase the best available products at a given time, issuers will compete away any economic profits.

Table 8 displays the average change in search expenditures and consumer risk-adjusted returns under the new policy keeping the product space fixed. On average, search expenditures among searching consumers decline by 0.45pp. Given the market size for this type of structured product, this represents an annual increase in welfare of on the order of \$225mm. Consumers capture the lion's share of the increase in surplus as risk adjusted returns increase by 3.51pp on average.

9 Conclusion

Economists and regulators have long been interested in the observed price dispersion in financial products. Does such price dispersion imply consumers are overpaying for investments? Using a new data set I find evidence that consumers frequently purchase products with dominated payoff structures. What's even more alarming is that when both a superior and dominated product are available, consumers are more likely to end up with the latter.

Previous research has pointed to consumer search as the mechanism supporting price heterogeneity and potentially dominated financial products. Consumer search helps explain why consumers buy dominated products, but a standard search model cannot explain why consumers are more likely to purchase the dominated product over the superior product. I argue that consumers are more likely to purchase dominated products because the product fee structure incentivized brokers to sell dominated products; hence, the incentives of brokers differ from the incentives of consumers. The empirical evidence verifies the incentive asymmetry. All else equal, consumers are more likely to buy products with higher fees. And similarly, all else equal, products with higher fees have lower payoffs.

The finding that consumers frequently overpay for investments and the finding that the incentives of brokers do not align with consumers are likely not unique to the reverse convertible industry. This paper focuses on reverse convertibles because some features of the reverse convertible market

make identifying dominated products and the incentives of brokers easier. I find little reason to believe that search and broker incentives do not play important roles in other financial markets. A vast literature discusses price heterogeneity in financial markets, which suggests consumers might be overpaying for investments in other product markets (Hortaçsu and Syverson 2004, Gurun et al. 2013, and Green et al. 2007). Similarly, previous work, such as Livingston and O'Neal (1996), Mahoney (2004), Bergsteresser et al. (2009) and Christoffersen et al. (2013) details the potential conflict of interest arising in the mutual fund industry. The presence of dominated products and the broker/consumer incentive asymmetry prevalent in the market for reverse convertibles is more likely to be closer to the rule rather than the exception in financial markets.

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FIGURE 2: REVERSE CONVERTIBLE DISTRIBUTION

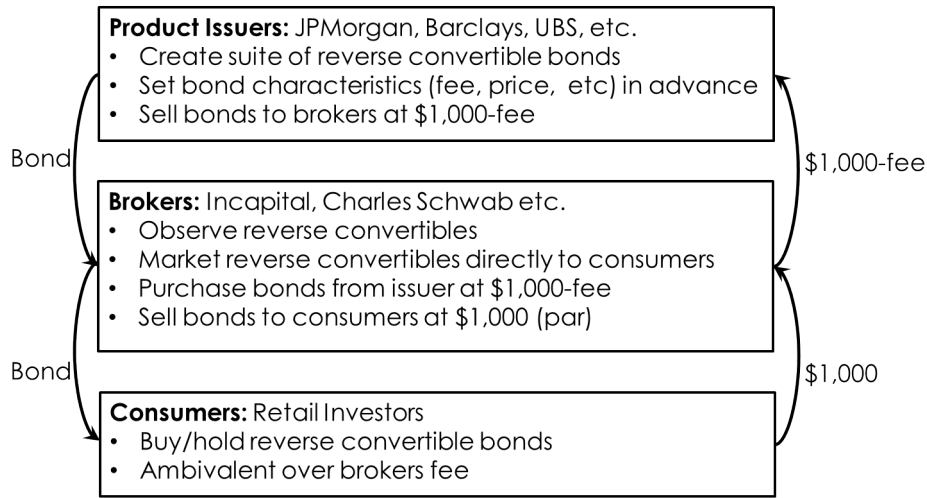


Figure 2 Notes: The figure displays the market structure/ distribution process of the reverse convertible market.

FIGURE 3: DISPERSION IN RISK ADJUSTED RETURNS

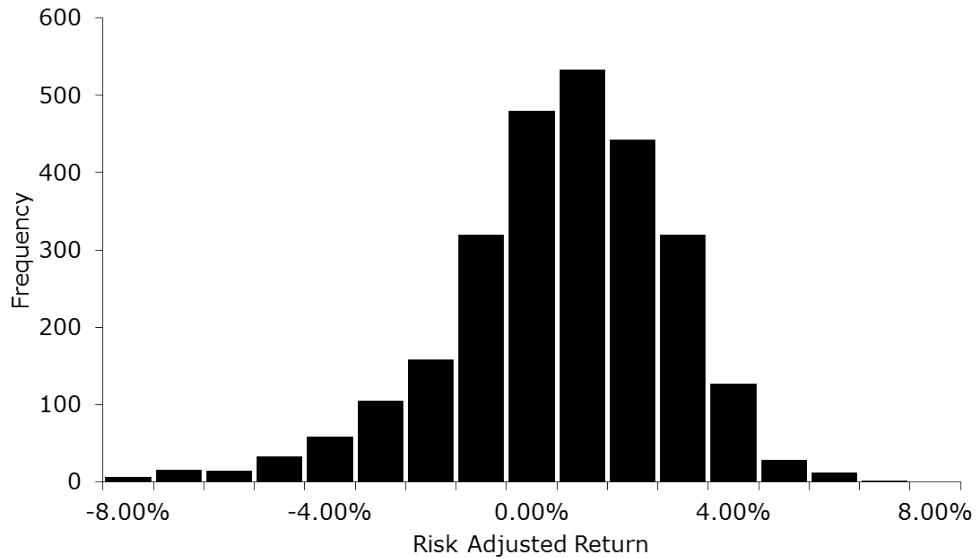


Figure 3 Notes: The figure displays dispersion in reverse convertible risk-adjusted returns. I calculate the risk adjusted return of each reverse convertible as the present value of coupon payments (assuming monthly coupons discounted using the one year swap rate) minus the implied option premium, the issuer CDS spread and the one year risk free rate (as measured using the one year swap rate). I normalized risk-adjusted returns such that the average return is zero.

FIGURE 5: BROKER'S FEES

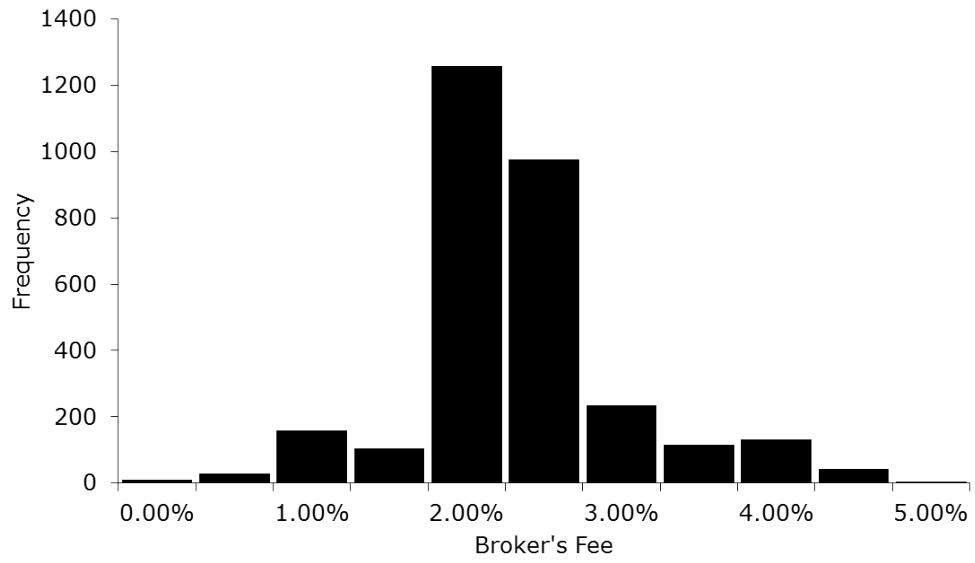


Figure 6 Notes: The figure displays the distribution of fees paid by issuers to brokers.

FIGURE 6: SEARCH COSTS

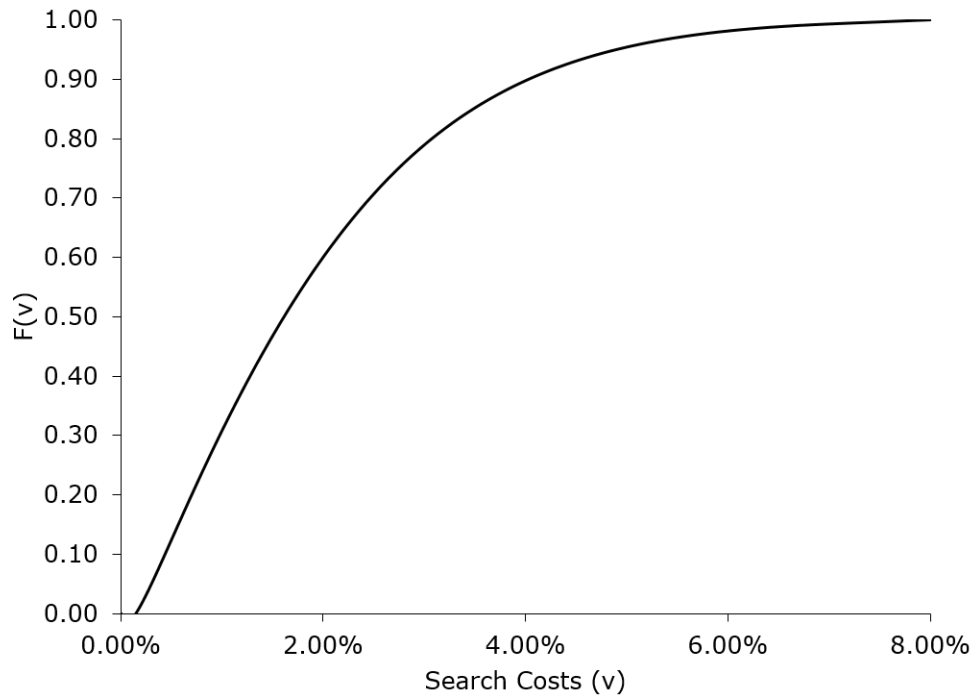


Figure Notes: Figure 6 displays the estimated distribution of search costs corresponding to the estimates in column (2) of Table 4.

FIGURE 7: ISSUER FIXED EFFECTS

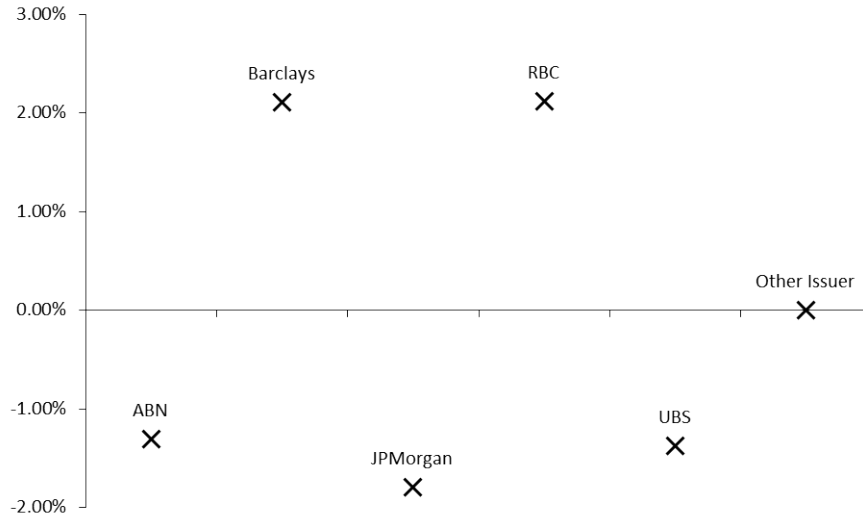


Figure Notes: Figure 7 displays the issuer fixed effects corresponding to the estimates in column (2) of Table 4. The estimates suggest that, all else equal, brokers are indifferent between showing a Barclays reverse convertible that pays a broker's fee of 4% and an ABN Amro reverse convertible that pays a fee of 1% to Non-Searching client.

FIGURE 8: ACTUAL VS. MODEL IMPLIED PROFIT MARGIN/MARKUP (μ)

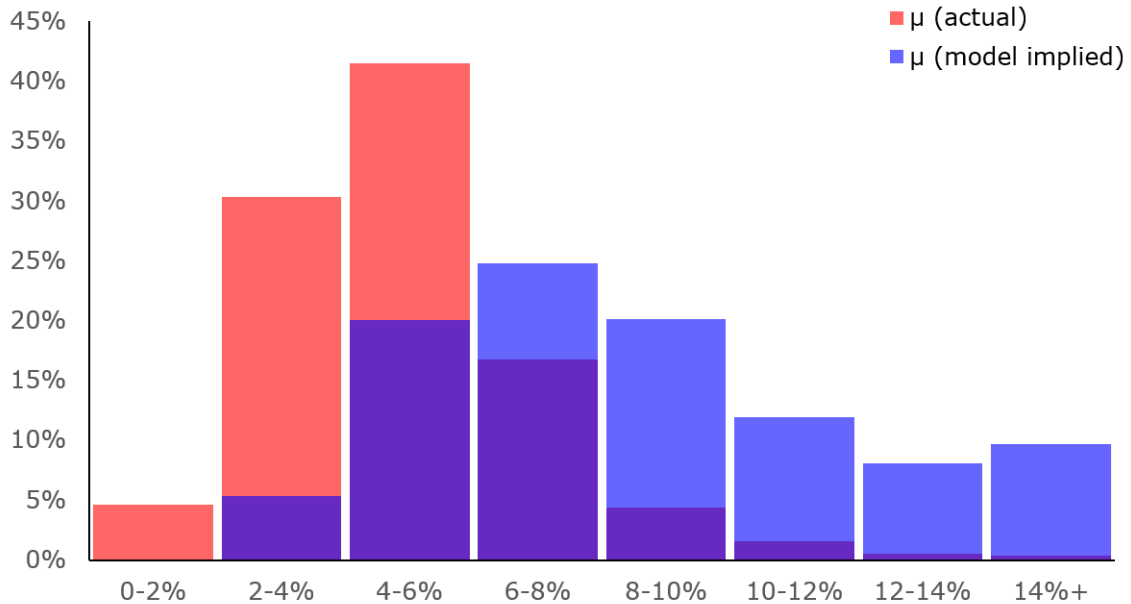


Figure Notes: Figure 9 displays the distributions of implied and actual markups for each reverse convertible in the data set. The implied markups are calculated using the issuers' optimality conditions (eq. 10) and the structural estimates displayed in column (2) of Table 4. The actual markups are computed using bond and financial derivatives data.

FIGURE 9: ACTUAL VS. MODEL IMPLIED PROFIT MARGIN/MARKUP (μ)

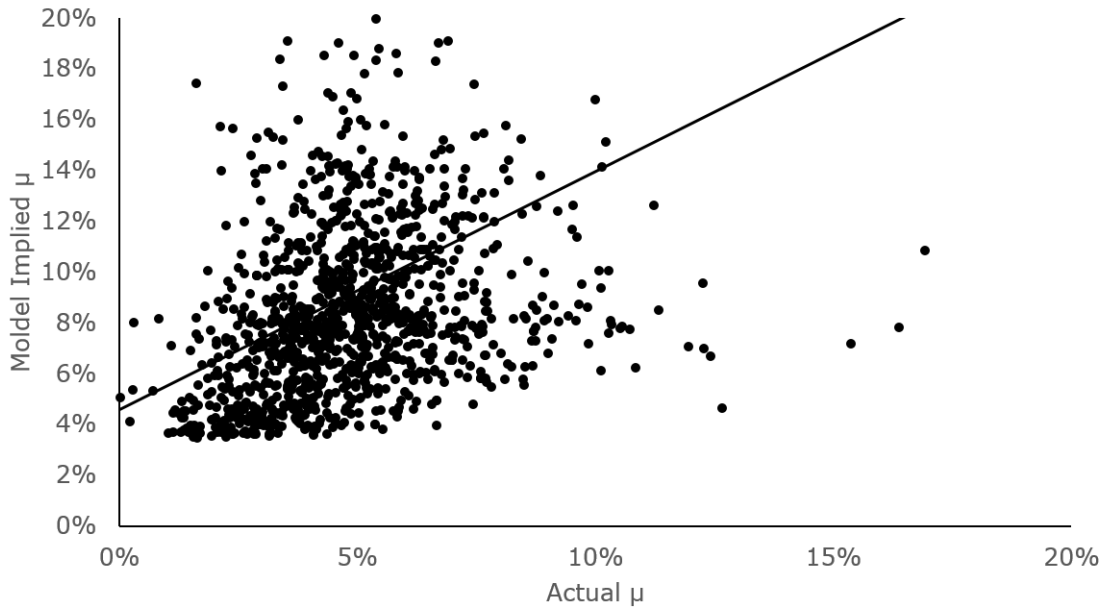


Figure Notes: Figure 9 plots the implied and actual markups for each reverse convertible in the data set. The implied markups are calculated using the issuers' optimality conditions (eq. 10) and the structural estimates displayed in column (2) of Table 4. The actual markups are computed using bond and financial derivatives data. The two series are positively and significantly correlated (0.35).

TABLE 1: SUMMARY STATISTICS

Variable	Obs	Mean	Std.Dev.	Min	Max
Size (mm)	3066	1.64	2.62	0.00	17.51
Coupon	3066	10.50%	2.84%	3.24%	27.00%
Option Premium	3066	16.10%	3.90%	2.55%	42.90%
Fee	3066	2.24%	0.70%	0.00	6.75%
CDS Spread	2680	0.78%	0.60%	0.04%	9.20%

Table 1 Notes: Table 1 reflects US SEC registered one year equity reverse convertible issuance data over the period 2008-2012.

TABLE 2: ISSUE SIZE VS. PRODUCT CHARACTERISTICS

Dependent Variable	Size	ln(Size)	Size	ln(Size)	Size	ln(Size)
Broker's Fee	44.72*** (8.26)	28.48*** (4.70)	43.34*** (8.84)	28.95*** (5.01)	14.23* (7.91)	50.02*** (17.37)
Coupon	12.88*** (3.08)	12.57*** (1.61)	11.08*** (3.49)	10.20*** (1.77)	-4.31 (5.55)	6.10 (15.21)
Option Premium	-7.64*** (2.17)	-7.51*** (1.25)	-6.18** (2.49)	-5.69*** (1.35)		
CDS Spread			-43.14* (23.39)	-47.57*** (14.34)		
Continuous Obs.	-3.66*** (0.34)	-2.16*** (0.15)	-4.01*** (0.45)	-2.08*** (0.18)		
Dominated Products					X	X
Observations	3,066	3,066	2,680	2,680	143	143
R-squared	0.484	0.657	0.475	0.667	0.716	0.726

*Table 2 Notes: Table 2 displays the results from the regressions of quantity issued and broker's fees on the specified variables (eq. 1). Each specification includes issuer, underlying equity, and month fixed effects. Continuous observation is an indicator variable indicating the reverse convertible is a continuous rather than a single observation reverse convertible. Coupons and fees are measured such that 0.10 corresponds to a 10% coupon/fee. Quantity issued is measured in millions. Huber-White robust standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.*

TABLE 3: BROKER'S FEES VS PRODUCT CHARACTERISTICS

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Coupon	-0.10*** (0.01)	-0.11*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)	-0.53*** (0.09)	-0.68*** (0.07)
Option Premium	0.07*** (0.01)	0.08*** (0.01)	0.07*** (0.01)	0.07*** (0.01)		
CDS Spread			0.06 (0.04)	0.08* (0.05)		
Continuous Obs.	0.01*** (0.00)	0.00*** (0.00)	0.01*** (0.00)	0.00*** (0.00)		
Weighted		X		X		X
Dominated Products					X	X
Observations	3,066	3,066	2,680	2,680	143	143
R-squared	0.600	0.613	0.614	0.620	0.707	0.833

*Table 3 Notes: Table 3 displays the results from the regressions of broker's fees on the specified variables (eq. 2). Each specification includes issuer, underlying equity, and month fixed effects. The weighted specifications are weighted by the square root of the issuance size. Continuous observation is an indicator variable indicating the reverse convertible is a continuous rather than a single observation reverse convertible. Coupons and fees are measured such that 0.10 corresponds to a 10% coupon/fee. Huber-White robust standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.*

TABLE 4: STRUCTURAL ESTIMATION RESULTS

Variables	(1)	(2)
Coupon (α)	1	1
Option Premium (γ^{Delta})	-0.655*** (0.09)	-0.626*** (0.07)
CDS Spread (γ^{CDS})	-4.33*** (0.83)	-6.76*** (1.36)
Scaling Parameter (θ_1)	28.00* (17.00)	31.19** (12.71)
Scaling Parameter (θ_2)		18.75** (7.10)
ω_S		74.38%*** (18.66%)
Heterogeneous Agents		X
Observations	1,227	1,227
Number of Markets	423	423

*Table 4 Notes: Table 4 displays the maximum likelihood estimation results for the fully specified model. Standard errors are calculated using the observed Fisher Information Matrix. *, **, *** indicate significance at the 10%, 5% and 1% level.*

TABLE 5: IMPLIED SEARCH PROBABILITIES

	Reverse Convertible 1	Reverse Convertible 2
Fee	1.00%	5.00%
Coupon	12.00%	8.00%
Prob. Observed by Searcher	0.53	0.47
Prob. Observed by Non-Searcher	0.32	0.68

Table 5 Notes: Table 5 displays the probability a broker shows a particular product to a Searcher and Non-Searcher in a two product market. Other than the coupon and associated brokers fee, Reverse Convertible 1 and Reverse Convertible 2 are assumed to be identical such that the payout of Reverse Convertible 1 dominates the payout of Reverse Convertible 2. Table 5 is computed using the parameter estimates from Column (2) in Table 4.

TABLE 7: ECONOMIC IMPACT OF BROKER INCENTIVES

	One Agent Model	Two Agent Model		
	Searcher	Searcher	Non-Searcher	Average
Avg. Change in Search Expenditure	0.10%	0.10%	0.00%	0.08%
Avg. Change in Expected Return	0.88%	0.95%	1.20%	1.01%

Table 7 Notes: Table 7 displays the hypothetical gains to total and consumer surplus if brokers were forced to always show the best product available in a market to a consumer keeping the product space fixed. Table 7 is computed using the parameter estimates from Column (2) in Table 4.

TABLE 8: ECONOMIC IMPACT OF BROKER INCENTIVES

	One Agent Model	Two Agent Model		
	Searcher	Searcher	Non-Searcher	Average
Avg. Change in Search Expenditure	0.39%	0.45%	0.00%	0.34%
Avg. Change in Expected Return	3.28%	3.29%	4.18%	3.51%

Table 8 Notes: Table 8 displays the hypothetical gains to total and consumer surplus if brokers were forced to always show the best product available in a market to a consumer. The results display the full analysis where brokers, consumers and issuers are allowed to respond to the policy change. Table 8 is computed using the parameter estimates from Column (2) in Table 4.

Appendix

A-1: Recovering Search Costs

I recover the search cost distributions as follows. First, from the estimation procedure I estimate the distribution of reservation utilities for Searchers, $\widehat{G}(\cdot)$. One of the empirical assumptions is that consumers use the same search strategies across markets; hence, $G(\cdot)$ is constant across markets. Consistent with that assumption, I assume that each consumer's belief over the distribution of indirect utilities offered reflect the empirical density of utilities offered, $\widehat{h}_S(\cdot)$. To calculate $\widehat{h}_S(\cdot)$, I first calculate the probability that a broker shows each product j to a client. Given the distribution of reservation utilities and corresponding profit parameters, I calculate $\rho_{j,S}$ for each product according to equation (8). Given the set of ρ s for each product, I then calculate the density of indirect utilities for observed product offerings for each consumer type $h_S(\cdot)$ via kernel density estimation giving each observed market equal weight.³⁴ Lastly, I calculate the distribution of search costs by inverting the equation

$$v_i = \int_{u^r}^{\bar{u}} (u' - u^r) dH_S(u') \quad (12)$$

Note that equation (12) is continuous product space equivalent to optimal reservation utility in the discrete formulation characterized by equation (4). Here I use the continuous product space formulation since consumer beliefs reflect the empirical density of offered products. To help rule out outliers I winzorize the distribution of product utilities at the 5% level.

³⁴Here $h_S(\cdot)$ and $h_{NS}(\cdot)$ are the densities corresponding to the distribution functions $H_S(\cdot)$ and $H_{NS}(\cdot)$. I estimate the density of the indirect utility of product offerings for each type of consumer using a Gaussian kernel and giving equal weight to each market. I use select the kernel bandwidth according to Silverman's Rule of Thumb.

FIGURE A-1: REVERSE CONVERTIBLE EXAMPLE (SINGLE OBSERVATION)

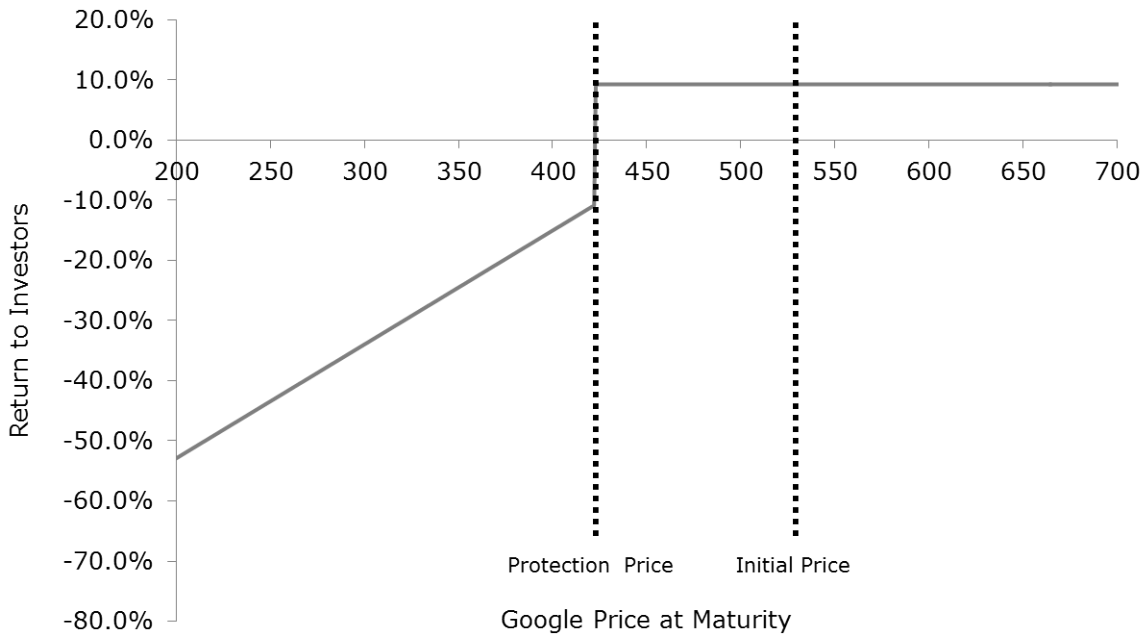


Figure A-1 Notes: The figure displays the return to investors for a one year reverse convertible bond linked to the price of Google Inc. that was issued by UBS (CUSIP 90268F112). The reverse convertible pays a monthly coupon of 9.25%. If at maturity the price of Google closes above the protection price (convertible trigger price) of \$422.63 (80% of the initial price), investors will receive 100% of the principal at maturity earning a return of 9.25%. If the share price of Google Inc. closes below \$422.63, the issuer will pay the bondholder 1.89 shares of Google Inc. per \$1,000 invested ($\$1,000/\text{Initial Price}$) rather than 100% of the principal amount invested. The above figure displays the final return to investors based on the price of Google Inc. at maturity.

FIGURE A-2: SEARCH COSTS

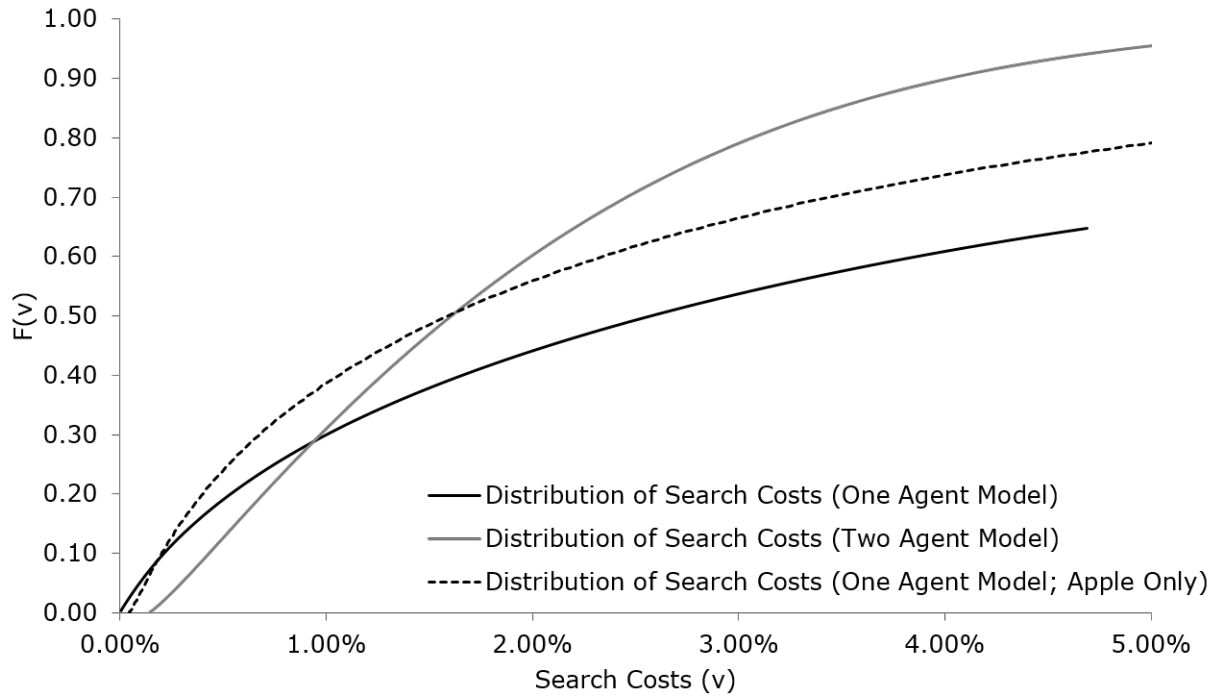


Figure Notes: Figure A-2 displays the estimated distribution of search costs. The baseline specifications correspond to the estimates in columns (1) and (2) of Table 4.

TABLE A-1: STRUCTURAL ESTIMATION RESULTS

Variables	(1)	(2)
Coupon (α)	1	1
Option Premium (γ^{Delta})	-0.673*** (0.10)	-1.64*** (0.25)
Scaling Parameter (θ_1)	72.35* (39.14)	49.11 (41.48)
Data Set	All Convertibles	Apple Linked
Observations	1513	189
Number of Markets	498	36

*Table A-1 Notes: Table A-1 displays the structural estimation results using the full data set and restricting the data set to Apple linked reverse convertibles. Standard errors are calculated using the observed Fisher Information Matrix. *, **, *** indicate significance at the 10%, 5% and 1% level.*