

Brokers vs. Retail Investors:

Conflicting Interests and Dominated Products

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Abstract

The prices and fees of seemingly identical financial products such as mutual funds often differ drastically. Does the fee/price dispersion imply that some consumers are over-paying for investments? Using a new dataset, this paper studies the market for lightly structured retail bonds, specifically equity reverse convertibles. It is common practice for banks to issue reverse convertibles with payouts that are unambiguously dominated by other available products. When available, consumers more often than not purchase the dominated products. I develop a model of retail financial distribution that rationalizes product issuance and the behavior of consumers. In the model, consumers search for investment opportunities with the aid of a broker. Brokers utilize the space of available products to price discriminate across consumers, selling high fee products to unsophisticated investors and low fee products to sophisticated investors. Lastly, I structurally estimate the model to analyze the impact of the proposed broker regulations of the Dodd-Frank Act. I find that holding brokers to a fiduciary standard over the period 2008-2012 would have increased investor returns by as much as 2.73% per annum.

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1 Introduction

It is well known that there is substantial price and fee heterogeneity in investment products. There are currently over 10,000 investment funds with expense ratios ranging from 0.05% to over 2.00%.¹ The existence of price dispersion is not unique to the mutual fund industry, such price dispersion is well documented in other financial products such as bonds and mortgages.² Does the heterogeneity in fees and prices of seemingly identical products imply that some consumers are making “bad” investments? Are investors either overpaying for investments or buying dominated products? If so, what is driving this behavior?

Using a new retail bond dataset, this paper develops an empirical and theoretical model to address the question if and why consumers buy investment products with dominated payouts. I construct a dataset covering lightly structured retail bonds, specifically equity reverse convertibles. In the dataset, I find evidence that consumers frequently buy dominated products. I define a product as being dominated if there exists another product which provides investors with a higher return in every state of the world. Over one in ten reverse convertible markets contains a reverse convertible with a payout that is unambiguously dominated by another reverse convertible. By simply buying the superior product, consumer risk adjusted returns would have increased by 1.60% on average. What’s more staggering is that when both a dominated and superior product were available consumers were 16% more likely to purchase the dominated product.

I argue that such behavior is rationalized by financial product distribution. The growing complexity and breadth of financial products elevates the importance of brokers and other intermediaries in retail financial markets. 56% of American households sought investment advice from a financial professional in 2010.³ Despite their prevalence, brokers may not be acting in the best interests of their clients. Brokers are not required to act as a fiduciary for their clients under current financial regulations, which means brokers are not required to act in their client’s best financial interests.⁴ For many investment products, brokers are compensated by suppliers with fees/commissions for selling a particular product. A broker may choose to subordinate her client’s interests for her own

¹Source: 2014 Investment Company Fact Book

²For examples see Hortaçsu and Syverson’s (2004) for the mutual fund industry, Gurun, Matvos and Seru (2013) for mortgages, and Green Hollifield and Shürhoff (2007) for bonds.

³Source: Survey of Consumer Finances

⁴Current regulations require that investment advisers but not brokers act as fiduciaries for their clients. See the SEC’s “Study on Investment Advisers and Broker-Dealers” (2011) for further details.

financial interests by directing her client to inferior products with high broker's fees. In the dataset, I find that brokers earned a 1.12% higher fee on average for selling the dominated reverse convertible over the superior reverse convertible. Brokers are incentivized to sell the dominated products.

Data has been the main challenge in addressing this research question. Directly comparing financial products is challenging as financial products differ on a plethora of both observable and unobservable characteristics. Furthermore, consumers may have heterogeneous preferences which make it difficult to make positive statements about one product being "better" than another. I construct a dataset of equity reverse convertibles issued in the US over the period 2008 through 2012. As will be discussed in detail in the proceeding section, a reverse convertible is a fixed rate bond where the final principal payment is linked to the performance of some pre-specified equity. The advantage of studying reverse convertible bonds over other financial products is threefold. First, reverse convertibles are completely characterized by a small number of dimensions, namely a fixed coupon and equity linked principal payment. Secondly, the Securities and Exchange Commission (SEC) requires all bond issuers to disclose the fees/commissions paid to brokers (broker's fees). Lastly and perhaps most importantly, it is common practice for banks to simultaneously issue reverse convertibles where the payout of one reverse convertible is unambiguously dominated by another.

Consider the following two nearly identical one year reverse convertibles issued by JPMorgan Chase on June 30th, 2008.⁵ One reverse convertible pays a fixed guaranteed coupon of 11.25% while the other reverse convertible pays a fixed guaranteed coupon of 9.00%.⁶ The final principal payment of both reverse convertibles is identical and linked to the share price of Microsoft Inc. If the share price of Microsoft Inc. remains above \$22.68 over the life of the reverse convertible, investors receive their full 100% principal payment at maturity. If the share price of Microsoft Inc. ever closes below \$22.68, the bond principal is converted into equity where bond holders receive 35.27 shares of Microsoft Inc. for every \$1,000 invested rather than the full principal amount.⁷ If the bond principal is converted into equity, investors may receive less than the full principal amount invested at maturity. Figure 1 displays hypothetical return to investors of the two products based on the

⁵CUSIPS: 48123LAM6 and 48123LBR4

⁶Guarantee is based on the creditworthiness of the issuer.

⁷The principal payment on both reverse convertibles is capped at par regardless of whether or not the principal is converted into equity.

underlying price of Microsoft Inc. shares. Notice that the return of the 11.25% reverse convertible clearly dominates that of the 9.00%. In every state of the world, investors would be better off holding the 11.25% reverse convertible than the 9.00% reverse convertible. However, in practice consumers purchased only \$50k of the 11.25% reverse convertible while purchasing \$1.5mm of the 9.00% reverse convertible. Consumers purchased more than 30x as much of the dominated product even though both products were available to consumers. This example of a bank simultaneously issuing a dominated/superior product is not unique, I observe over one hundred dominated/superior reverse convertibles in the dataset.

FIGURE 1: DOMINATED REVERSE CONVERTIBLE EXAMPLE

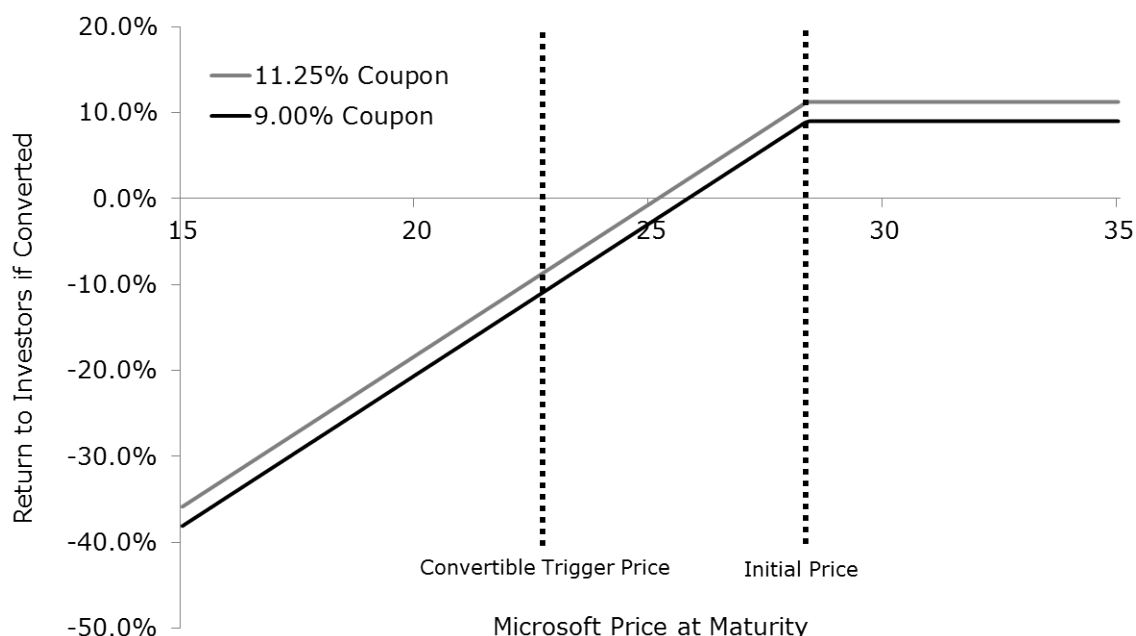


Figure 1 Notes: The figure displays the return to investors for two one year reverse convertible bonds linked to the price of Microsoft Inc. that were issued by JPMorgan Chase on June 30th, 2008 (CUSIPS 48123LAM6 and 48123LBR4). The reverse convertibles pay monthly coupons of 9.00% and 11.25% respectively. If the price of Microsoft Inc. closes above the convertible trigger price of \$22.68 every day over the life of the bond, investors will receive 100% of the principal at maturity earning a return of 9.00% and 11.25% respectively. If the share price of Microsoft Inc. ever closes below the convertible trigger price 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/Initial Price) rather than 100% of the principal amount invested. The principal is then said to have been “converted”. The above figure displays the final return to investors provided the principal has been converted. Investors may lose some or all of their principal investment. Note that the 11.25% reverse convertible always yields a 2.25% higher return than the 9.00% reverse convertible in every state of the world.

The prevalence of dominated products suggests that consumers purchasing the dominated product are not aware of the superior product. Hence, a consumer's investment decision problem is fundamentally a search problem. Previous research such as Sirri and Tufano (1998) and Hortaçsu and Syverson (2004) highlight the importance of search in a consumer's investment decision process. Search helps explain why consumers buy dominated products but does not fully explain why consumers more often than not purchase the dominated product. Such behavior can be rationalized by how financial products are distributed through financial intermediaries such as brokers and other financial advisors. Brokers are incentivized to sell consumers the dominated products. In the preceding dominated product example, brokers received a commission of 3.09% for selling the dominated 9.00% reverse convertible while only received 2.15% for selling the 11.25% reverse convertible. More generally, the empirical evidence reaffirms the conflict of interest problem. Figure 2 summarizes the average return, fees and issue size of dominated/superior reverse convertibles. On average, the return on the dominated reverse convertible is 1.60% lower than the superior reverse convertible. However, brokers earned a 1.10% higher commission for selling the dominated reverse convertible. I argue that the reason consumers purchase more dominated reverse convertibles is that brokers earn higher commissions on those products.

FIGURE 2: DOMINATED VS SUPERIOR PRODUCTS

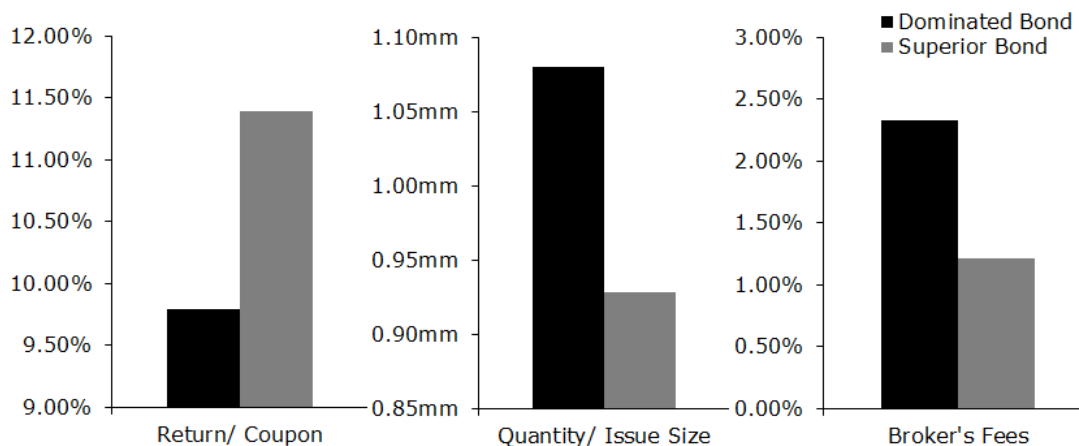


Figure 2 Notes: The figure displays the average characteristics of all of the dominated and superior reverse convertible dataset. The dataset covers all US issued, SEC registered, one year reverse convertible bonds. A reverse convertible is defined as dominated if there exists a reverse convertible with the same issuer, issue date, price, underlying equity, and principal payment structure with a higher fixed rate coupon.

I develop a model of retail financial distribution to rationalize consumer behavior and product issuance that is consistent with these empirical facts. In the model consumers sequentially search for investment products with the aid of 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, the distribution of products observed by consumers is endogenously determined based on broker profit maximization. Consumers ultimately decide whether or not to purchase the offered product or continue searching. Consumers differ in their level of financial sophistication (measured as search costs). Brokers utilize the full product space to price discriminate across consumers based on their level of financial sophistication. In terms of the economics of the model, I essentially introduce two frictions that are consistent with the empirical data. First, consumers must engage in costly search for products which explains why consumers might purchase dominated products. Secondly, there is a conflict of interest problem between brokers and consumers, making it potentially harder for consumers to find superior products relative to dominated products. This helps explain why consumers are actually more likely to purchase dominated products.

Using the reverse convertible dataset, I structurally estimate the model of consumer financial distribution. The structural estimation results provide insight into the underlying fundamentals of the market in terms of consumer search costs and the broker profit function. I then use the structural estimates to analyze the proposed broker regulations under the Dodd-Frank Act.

As part of the Dodd-Frank Act, 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, thus eliminating the conflict of interest problem in retail finance. I retroactively analyze the effect of such a policy on the reverse convertible market from two perspectives. First, I calculate the welfare gains of consumers if consumers had always purchased the "best" product available. I define the "best" product from two perspectives: a risk neutral fair value perspective and in terms of utility (as per the structural estimates). This serves as a back of the envelope calculation for assessing the welfare impacts of holding brokers to a fiduciary duty and is essentially a "model free" accounting calculation. Secondly, I calculate the welfare effects of a policy where regulators impose fiduciary duty by fixing fees across products.

This paper relates to several strands of literature regarding price dispersion in retail finance

and the potential conflict of interest problem between brokers and retail investors. 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) discuss price dispersion and competition in the mutual fund industry. Similarly, researchers have documented the potential conflict of interest problem arising in consumer finance (Livingston and O’Neal 1996; Mahoney 2004; Bolton et al. 2007, Bergsteresser et al. 2009). This paper builds on the preceding work by studying a new financial market (reverse convertibles) in which makes it easier to identify the conflict of interest problem and document price dispersion and dominated products. The previous research suggests that underlying economic frictions in the market for reverse convertibles, search and conflict of interest, apply to a much broader set of financial markets.

The remainder of the paper is laid out as follows. Section 2 describes the reverse convertible dataset and some fundamental features of the reverse convertible dataset. In Section 3, I analyze the reverse convertible dataset and establish some key empirical facts regarding the conflict of interest in consumer finance. In Section 4, I develop a search model of financial distribution. Section 5 describes the structural estimation of the model. In Section 6 I leverage the structural estimates to analyze the proposed Dodd-Frank Act broker regulations. Lastly, Section 7 concludes the paper.

2 Data

The empirical analysis focuses on the market for lightly structured retail bonds, specifically equity reverse convertibles. 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 is linked to the share price of a pre-specified equity. Reverse convertibles provide investors with an opportunity to enhance the yield on a standard three month to two year fixed rate bond by taking some additional equity risk. Reverse convertibles pay a fixed, guaranteed, relatively high⁸ interest rate over the life of the bond. Although the interest payments are guaranteed, the principal amount returned at maturity is not guaranteed. The final principal payment depends on the performance of a pre-specified underlying equity. At maturity, investors receive 100% of their principal provided that the underlying equity remains above the

⁸The 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.

pre-specified convertible trigger price. If the equity falls below the convertible trigger price during the life of the note, investors receive a fixed number of equity shares rather than the full principal amount. The value of the shares may be worth substantially less than the initial principal amount invested.

Consider the following reverse convertible example that was discussed briefly in the introduction.⁹ JPMorgan Chase offers a one year reverse convertible bond linked to shares of Microsoft Inc. The bond pays a fixed guaranteed monthly coupon of 11.25%. The final principal payment depends on the performance of the share price of Microsoft Inc. The initial price of Microsoft Inc. shares on the bond settlement date is \$28.35 while the convertible trigger price is 80% of the initial stock price, or \$22.68. If the share price of Microsoft Inc. remains above the convertible trigger price over the life of the bond, investors receive their full 100% principal payment at maturity and investors will have earned 11.25% on their initial investment. However, if the share price of Microsoft Inc. ever closes below the convertible trigger price, the final bond principal payment is converted into equity. If the principal payment is converted into equity, investors will receive at maturity 35.27¹⁰ shares of Microsoft Inc. for every \$1,000 invested rather than the full principal amount. The principal payment cannot exceed \$1,000 for every \$1,000 invested, regardless of the price of Microsoft Inc. at maturity. Figure 1 illustrates the hypothetical bond return based on share price of Microsoft Inc. at maturity provided that the principal payment was converted into equity. Note that investors may lose some or all of their investment if the principal payment is converted into equity.

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.

In practice, there are two different common types of reverse convertibles: 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

⁹CUSIP: 48123LBR4

¹⁰The conversion rate is equal to \$1000 divided by the initial share price of Microsoft Inc.

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. Investors effectively sell more optionality to the issuer when purchasing continuous observation reverse convertibles in comparison with single observation reverse convertibles. Figure A-1 in the appendix walks through an example of a single observation reverse convertible that was issued by UBS.

2.1 Why Study 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.¹¹ 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. To protect retail consumers, the SEC requires disclosure of the details of each reverse convertible issued, including broker’s fees and other transaction costs. Though relatively simple, reverse convertibles are often synonymous with structured products which are often criticized for their opaqueness and high costs.¹² 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.

¹¹Source: Bloomberg

¹²See Stoimenov and Wilkens (2005) and Szymanowska et al. (2009) for further details.

2.2 Reverse Convertible Market Structure and Distribution

The reverse convertible market consists of three players. Product issuers, namely banks, create and issue reverse convertibles. A reverse convertible consists of a coupon, issuer, equity risk/option, and a broker's fee. The characteristics of reverse convertibles, including the broker's fee, are fixed in advance prior to the sale of the product.

Figure 3 illustrates the reverse convertible distribution process. Issuers create reverse convertibles and then sell them to brokers at a price of 100% minus the fixed broker's fee. For each product sold, issuers earn a markup $\mu(c, r, f)$ that is decreasing in the product coupon (c) and broker's fee (f) but is increasing in the risk of the product (r). Brokers then sell reverse convertibles to the end consumer at a fixed price of par (100%).¹³ For each product sold, brokers earn the broker's fee f . A crucial component of the distribution process is that conditional on the risk and return of the product, consumer utility and demand is unaffected by the broker's fee.

FIGURE 3: REVERSE CONVERTIBLE DISTRIBUTION

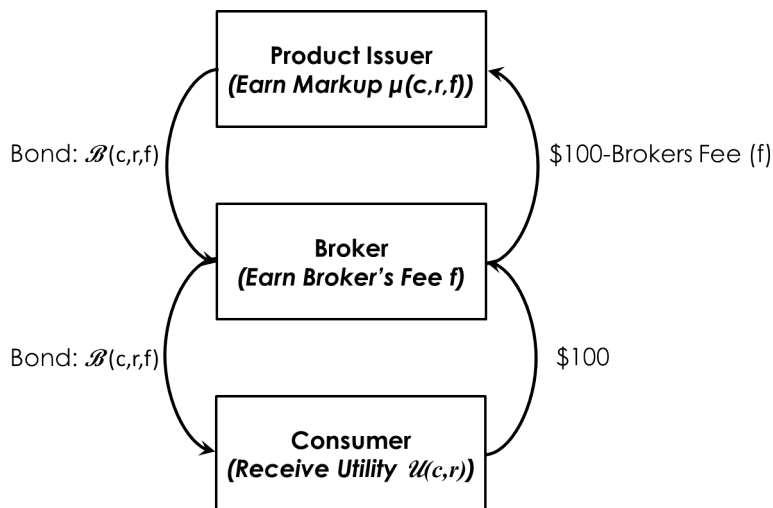


Figure 3 Notes: The figure displays the market structure/ distribution process of the reverse convertible market. Issuers earn a markup $\mu(c, r, f)$ on each reverse convertible sold. Brokers purchase the bonds from product issuers at a price of par minus the broker's fee. Brokers then sell the bonds to consumers at a price of par, earning the broker's fee f .

Reverse convertibles are typically announced by issuers at the beginning of each month. Over the

¹³The 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.

course of the month, issuers market available reverse convertibles to brokers who then solicit orders from end consumers. At the end of the month all of the orders are accumulated and the reverse convertible is issued. 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. Rather, issuers choose to sell reverse convertibles to brokers who market them to end consumers directly.

2.3 Data and Summary Statistics

The empirical analysis uses a new reverse convertible dataset. The dataset 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 424b filings found on the SEC EDGARS website. The dataset 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 dataset. The mean and median issuance size in the sample was \$1.64 million and \$665 thousand respectively. To ensure that the dataset is limited to retail consumers, the largest 1% issuances (exceeding \$17.51 million) are dropped from the dataset. On average, reverse convertibles paid a coupon of 10.50% per annum. The option premium measures the value of the put options embedded in each reverse convertible expressed as a percentage of notional invested.¹⁴ The one year credit default swap (CDS) spread reflects the default risk for senior unsecured debt which corresponds to the underlying issuer credit risk embedded in each reverse convertible. To put this number in perspective, a 3.00% CDS spread implies that the risk neutral probability of default is 4.80%.¹⁵

¹⁴Option 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.

¹⁵The risk neutral probability of default is calculated under the assumption that hazard rate into default is constant across time and using a discount rate of 3%. See Hull (2012) for further details.

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.

Although any firm could issue a reverse convertible as easily as any other sort of debt instrument, 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.

3 Empirical Analysis

The existence of dominated products leads to the question how do consumers value these products? In this section I estimate several reduced form demand specifications for reverse convertibles. As part of the analysis, I examine the role of financial intermediaries and the potential conflict of interest between brokers and consumers. Using the reverse convertible dataset, I examine the following two questions. First, all else equal, are consumers more likely to purchase reverse convertibles with higher fees? Secondly, all else equal, are reverse convertibles with higher fees of lower quality in terms of risk (equity option and credit risk) and return (coupon)?

3.1 Issuance Size vs. Product Characteristics

Theoretically consumers should value reverse convertibles solely on their risk and return. A reverse convertible is comprised of a coupon, issuer credit risk, a short equity put option and a

broker's fee. One would expect demand to be increasing in coupon while decreasing in credit and equity risk. Since product issuers rather than brokers pay the broker's fee, consumer utility should not depend on the broker's fee. I estimate the following linear demand system.

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

I also include issuer, month and equity fixed effects and control for the type of reverse convertible issued (single vs. continuous observation).

A common concern when estimating any regression much less a demand system is the potential endogeneity of the right hand side variables. One advantage of studying reverse convertibles is that in a risk neutral framework, the fee, coupon, CDS and option premium should capture all of the relevant characteristics of a reverse convertible. Thus any unobserved error term is likely to be idiosyncratic and uncorrelated with product characteristics. One might also be concerned with the potential marketing/advertising of these products. SEC regulations require that any special marketing materials be filed with the SEC. Given the cost of marketing these products and the relatively short offering periods, no special marketing materials were filed for any of the reverse convertibles in the sample. Each convertible was marketed to consumers with the prospectus which formally lays out the details of the security.

As a robustness check, I estimate a corresponding demand specification where I restrict the dataset to the set of dominated/superior products. I estimate the regression of quantity issued on broker's fees, coupon and a month by risk fixed effect

$$Size_j = \beta Fee_j + \alpha Coupon_j + Fixed_Effects \quad (2)$$

This formulation should quell further concerns about the potential endogeneity of fees and coupon. The month by risk fixed effect should capture all other product characteristics. Within the month by risk fixed effect the products are the exact same outside of the fee and coupon.

Table 2 displays the regression estimates corresponding to equations (1) and (2). Columns (1)-(4) include the results for the full dataset while columns (5) and (6) display the regression results corresponding to when the dataset is restricted to the dominated/superior products. The relevant

coefficients not only have the expected sign but are also statistically significant from zero. As expected, the product issue size is positively correlated with return and negatively correlated with equity and 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 risk (option premium) is correlated with a \$61,800 decrease in issue size while 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 that consumers trade off coupon and option premium roughly one for one but appear relatively averse to credit risk. One potential explanation for this is that the dataset 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.

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 and 2). Each specification includes issuer, underlying equity and month fixed effects. Continuous observation is an indicator variable indicating that 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 parenthesis. *, **, and *** indicate significance at the 10%, 5%, and 1% respectively.*

The regression results indicate that demand is increasing in return and decreasing in risk 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 dataset 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 towards broker's fees. One might be concerned that this relationship is driven by some omitted product characteristic that is positively correlated with fees and size. However, I am able to control for all product characteristics;

this is especially true when I restrict the dataset to the set of dominated/superior products. These results suggest that brokers must be more inclined to sell high fee products.

3.2 Fees vs. Product Characteristics

The estimation results from the Table 1 suggest that all else equal, consumers are more likely to purchase products with a higher broker's fee. Since consumers are theoretically unaffected by the broker's fee, these results suggest that brokers are directing consumers to higher fee products. This raises concerns over the conflict of interest between brokers and consumers, especially if products with higher fees have lower returns and higher risk. I examine this relationship further by estimating the following specification where I regress the broker's fee on the set of product characteristics

$$Fee_j = \beta_1 Coupon_j + \beta_2 Option_Premium_j + \beta_3 CDS_j + Fixed_Effects \quad (3)$$

I also include issuer, month and equity fixed effects as well as 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 dataset to dominated/superior products and regress broker's fees on the product coupon and include a month by risk fixed effect

$$Fee_j = \beta_1 Coupon_j + Fixed_Effects \quad (4)$$

This again should help limit any concerns over the endogeneity of coupon and product fees.

Table 3 displays the estimation results corresponding to equations (3) and (4). The columns differ in terms of which co-variates are controlled for, whether or not the regression results are weighted by the square root of the issuance size, and the dataset used. The results indicate that fees are negatively correlated with product return and positively correlated with product risk. The estimated coupon coefficients in all six specifications are negative and significant at the one percent level. The estimates indicate that 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 (equity risk) is correlated with a 0.07% increase in product fees. The estimates from column (4) imply that 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 dataset is 2.20%.

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. 3 and 4). 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 that 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 parenthesis. *, **, and *** indicate significance at the 10%, 5%, and 1% respectively.*

Overall, the results from the empirical analysis confirm the existing concerns in the literature that there is a conflict of interest between brokers and 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 be riskier and have lower coupons. In this sense, brokers are incentivized to sell consumers inferior products.

4 Model

The prevalence of dominated financial products raises the question: why do consumers buy dom-

inated products and why do issuers and brokers create and sell dominated products? 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 behavior and product issuance. The model is then structurally estimated and used to analyze the welfare implications of the proposed broker regulations under the Dodd-Frank Act.

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 the distribution of products available to consumers is an endogenous function of broker profit maximization and that brokers price discriminate across consumers.

4.1 Model Overview

The model involves three types of market participants: end 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. Financial issuers create reverse convertibles and then sell them through brokers to end consumers. Reverse convertibles are characterized by their payoff c (coupon), risk characteristics r (interest, credit, equity risk, etc.) and broker's fee/commission f . All bonds are all sold at some fixed par price of 100%. Thus the triplet (c, r, f) defines a financial product.

The mechanics of the model works as follows. 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 selects exactly one reverse convertible to show her consumer client. 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 $\mathcal{U}(c_j, r_j)$ 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.

4.2 Consumer Behavior

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) and uncompensated risk r_j generates consumer utility $u_j = \mathcal{U}(c_j, r_j)$. Utility is increasing in return and decreasing in risk such that $\mathcal{U}_c > 0$ and $\mathcal{U}_r < 0$.¹⁶ The utility function is specified as a linear function of return/coupon, equity risk and issuer credit risk. Equity risk is measured as the value of the equity put options embedded in each reverse convertible while credit risk is measured using the corresponding one year CDS spread.

$$u_j = \alpha c_j + \gamma^{Opt} Option_Premium_j + \gamma^{CDS} CDS_j \quad (5)$$

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 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.

Secondly, 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

¹⁶The risk term r represents uncompensated risk. Consequently, utility is decreasing in risk regardless of the risk preferences of the consumer.

consumer specific error term. Consequently, consumers possess a clear rank ordering over the product space.

Costly search prevents consumers from always simply purchasing the product yielding the highest utility. Each period, consumers must pay a search cost v_i in order to observe a new product offer from a broker. Search costs reflect the time and effort of interacting with a broker as well as the forgone opportunity cost of delaying investment. Search costs for a given consumer are constant over time but are heterogeneous across consumers. Consumers are classified into two types based on their search costs: low search cost/sophisticated investors and high search cost/unsophisticated investors. The fraction of high search cost/unsophisticated investors in the population is denoted π_H . Search costs among sophisticated/low cost consumers are distributed $v_i \sim F_L(\cdot)$ while search costs among unsophisticated/high cost consumers are distributed $v_i \sim F_H(\cdot)$. Without any loss in generality, consumer types are defined such that the average search cost of sophisticated investors is lower than the average search cost of unsophisticated investors $E_L[v] < E_H[v]$.¹⁷ Brokers observe a consumer's type and preferences but not his exact search cost. 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 sophisticated and unsophisticated investors.

The consumer's problem is analogous to that of an unemployed worker in McCall (1970). 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 $H_L(\cdot)$ or the stationary distribution $H_H(\cdot)$ depending on whether the consumer is a sophisticated or unsophisticated investor. The distribution $H_L(\cdot)$ reflects a consumer's belief about the distribution of the indirect utilities of financial products offered to low cost type consumers by brokers. Similarly, $H_H(\cdot)$ represents the distribution of indirect utilities of financial products offered to high cost type consumers by brokers. Consumer beliefs about $H_L(\cdot)$ and $H_H(\cdot)$ are correct and completely rational in equilibrium.

¹⁷For ex positional ease, I refer to the low cost consumer type as sophisticated investors and high cost consumer types as unsophisticated investors. Consumer types are defined by the corresponding distribution of search costs. By definition, low cost consumers have a lower expected search cost than high cost consumers. Note this may have little to do with the financial sophistication of the investor. Consumer type literally depends on his distribution of search costs not on his level of financial sophistication.

As discussed in the proceeding section, I focus on stationary equilibrium in which the distribution of offered products is constant over time.¹⁸ 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.

Let $V(u_j, v_i, T)$ denote the value function of a consumer with search cost v_i of type T (either low, L , or high, H) that is offered a product yielding utility u_j . Formally the consumer's problem is

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

where I have assumed no discounting and $[\underline{u}, \bar{u}]$ represents the support of the product offerings. Purchasing the product yields utility flow u_j while the expected utility of searching is $-v_i + \int_{\underline{u}}^{\bar{u}} V(u', v_i, T) dH_t(u')$.

Under this framework, consumers optimally search by adopting a reservation utility (McCall 1970).¹⁹ A consumer with search cost v_i of type T optimally searches until he is shown an investment product that exceeds his reservation utility $u_T^r(v_i)$. The optimal reservation utility strategy is characterized by

$$v_i = \int_{u^r}^{\bar{u}} (u' - u^r) dH_T(u') \quad (6)$$

An individual's optimal reservation utility, $u_T^r(v_i)$ is a decreasing function of his search cost v_i . A consumer with zero search costs searches until he finds the product yielding the highest utility (\bar{u}) while a consumer with infinite search costs simply selects the first product offered. Since brokers observe a consumers type, the distribution of product offered $H_L(\cdot)$ and $H_H(\cdot)$ will likely vary across types in equilibrium. Consequently the optimal reservation strategy of an individual with search cost v_i will also depend on the agent's type T . The analysis focuses on stationary equilibrium such that the distribution of consumer types and search costs among agent types is at a steady state in the searching population. Let $G_L(\cdot)$ and $G_H(\cdot)$ denote the stationary distribution of reservation utilities among low and high cost consumer types.

A couple of underlying assumptions in the model are worth noting. In the model framework, consumers know the distribution of product offerings $H_L(\cdot)$ and $H_H(\cdot)$ but are unable to purchase

¹⁸Alternatively one can think of the market as clearing instantaneously.

¹⁹See McCall 1970 or Rogerson et al. 2005 for a further discussion of search problems.

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 discussed earlier, indicates that search is a key component of the consumer’s problem. However, 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.

4.3 Broker Behavior

Brokers act as a liaison between the end consumers and the financial product issuers. Brokers observe the full scope of available products and service their customer base by offering each customer an individual specific financial product. If the customer 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} denote the product space available to brokers. For each of her clients, the broker selects the product that maximizes her expected profits

$$\max_{j \in \mathcal{J}} E[\pi_{i,j}] \tag{7}$$

Offering product j to client i , yields an expected profit equal to the probability the client i purchases product j multiplied by the returns from selling product. Brokers observe the preferences and types of their clients but do not observe each client’s specific search cost. The expected profit of offering product j to client i of type T is then

$$E[\pi_{i,j,T}] = f_j G_T(u_j) + \eta_{i,j} \tag{8}$$

The term $f_j G_T(u_j)$ is the broker's expected revenue 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.

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. Due to the prevalence of dominated products within a market, 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 either a superior product in a preceding period after first showing them either a dominated product or vice versa.

The probability that a broker selects product j to offer to client of type T , denoted $\rho_{j,T}$, 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

$$\rho_{j,T} = \frac{\exp(f_j G_T(u_j))}{\sum_{k \in \mathcal{J}} \exp(f_k G_T(u_k))} \quad (9)$$

The offering probabilities $\rho_{j,T}$ for the various set of products generate the distribution of available products $H_L(\cdot)$ and $H_H(\cdot)$ observed by the two types of consumers.

The probability that a broker shows a particular product to a client 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 fees

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

Brokers are more likely to be able to sell products that generate higher utility. All else equal, the probability a broker selects a particular product to show a client is increasing in the utility generated

by the product

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

where $g_T(\cdot)$ is the density corresponding to the distribution $G_T(\cdot)$. Consequently, consumers are more likely to observe products with higher fees and higher utility.

4.4 Equilibrium

I study stationary pure strategy Bayes Nash equilibrium. In equilibrium consumers optimally search by employing the reservation strategy described by equation (6). Furthermore, consumer beliefs over the distribution of indirect utilities offered for high and low types reflect the true distribution of product offerings generated from broker profit maximization. In equilibrium brokers maximize profits according to equations (7) and (8) where their beliefs over the distribution of reservation utilities reflect the true distributions generated by (6).

The distribution of search costs and agents 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.

5 Model Estimation

The search model described in Section 4 lends itself to structural estimation. Using the reverse convertible dataset, 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 of reservation utilities, consumer types and search costs. Structurally estimating the model provides insight into how the reverse convertible market works. For example, how often are consumers shown dominated products? I then use the model to assess the welfare implications of the proposed broker regulations in the Dodd-Frank Act.

5.1 Data, Identification and Estimation

The model is estimated using reverse convertible market share level data described in Section 2. 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 423 markets with 1227 different reverse convertibles.

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 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

$$\Pr(D_{ij} = 1) = \pi_H \frac{\exp(\theta G_H(u_j))}{\sum_{k \in \mathcal{J}} \exp(\theta G_H(u_k))} G_H(u_j) + (1 - \pi_H) \frac{\exp(\theta G_L(u_j))}{\sum_{k \in \mathcal{J}} \exp(\theta G_L(u_k))} G_L(u_j)$$

where $D_{i,j}$ is a dummy variable indicating that individual i purchased product j . Here the term π_H reflects the probability a consumer is a high type, the term $\frac{\exp(\theta G_H(u_j))}{\sum_{k \in \mathcal{J}} \exp(\theta G_H(u_k))}$ reflects the probability that a high type consumer is shown product j , and $G_H(u_j)$ reflects the probability that product j exceeds a high consumer type's reservation utility. The dependent variable is the market share for each product which ranges from zero to one.²⁰ Note that from our market share data we only observe bond purchases and do not observe individuals who were shown bonds but elected not to purchase them. Consequently, I estimate the model via maximum likelihood where I condition on the probability that a consumer purchased a bond from the market.

To facilitate estimation, I assume that consumers employ the same set of reservation strategies across all markets conditional on consumer type. In other words, $G_H(\cdot)$ and $G_L(\cdot)$ are 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 $H_H(\cdot)$ and $H_L(\cdot)$ are constant across markets. This assumption provides additional statistical power to estimate $G_L(\cdot)$ and $G_H(\cdot)$, otherwise they would have to be separately estimated for each market. Equivalent assumptions are ubiquitous empirical literature. The utility function is specified as a linear function of coupon, option premium and the CDS spread according to equation (5). I also include issuer fixed effects for the five largest issuers: ABN Amro, Barclays, JPMorgan, RBC and UBS.

The underlying data and model separately identifies the consumer utility and broker parameters as well as non-parametrically identifies the observed distribution of reservation utilities. The utility

²⁰As a robustness check shown in the appendix I also re-estimate the model where each observation is weighted by the market size.

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 constant to zero. Under this normalization, the utility parameters can be interpreted in terms of monetary value or percentage return. Estimation of the model requires no additional assumptions regarding the parametric form of $G_L(\cdot)$ or $G_H(\cdot)$. Following Barseghyan et al (2013) I flexibly estimate the distribution functions $G_L(\cdot)$ and $G_H(\cdot)$ using a third order polynomial approximation to $\log G_L(\cdot)$ and $\log G_H(\cdot)$. I estimate polynomial approximations to $\log G_L(\cdot)$ and $\log G_H(\cdot)$ rather than $G_L(\cdot)$ and $G_H(\cdot)$ to ensure that the estimated distributions $\widehat{G}_L(\cdot)$ and $\widehat{G}_H(\cdot)$ are strictly positive. However, I do not restrict the estimated distribution functions to be weakly increasing.

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

Intuitively, identification of the distribution of reservation utilities $G_L(\cdot)$ and $G_H(\cdot)$ 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, 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 $G_L(\cdot)$ and $G_H(\cdot)$ is pinned down by the fact that all consumers purchase the best product. Hence, $G_L(\bar{u}) = G_H(\bar{u}) = 1$.

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 bond and one dominated bond in terms of utility. Now suppose an additional inferior bond is introduced into the market. We can identify the proportion of low cost/sophisticated types 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” unsophisticated/high cost investors. 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 sophisticated/ low cost investors.

5.2 Estimation Results

The maximum likelihood estimates are reported in Table 4. Column (1) displays the estimates for the one consumer type model while column (2) reports 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 (CDS) risk. In both specifications I estimate a negative and statistically significant relationship utility and the two measures of risk. The results from column (2) indicate that consumers are indifferent between a 1.00% point increase in coupon and a 0.67% point decrease in option premium. Similarly, consumers are willing to trade off a 1.00% point change in coupon for a 5.55% point decrease in the corresponding CDS spread. Recall that under a risk neutral framework consumers should be willing to trade off risk (option premium and CDS spread) roughly one-for-one with coupon. Just as with the reduced form results from Section 3, it appears that consumers are particularly sensitive to issuer credit risk.

In the heterogeneous agent model, I also estimate the distribution of consumer types π_H . I estimate that 98.94% of the population is comprised of high cost/unsophisticated investors while the remaining 1.06% of the population is comprised of low cost/sophisticated investors. The differentiating factor between the two types is how search costs are distributed across types.

TABLE 4: STRUCTURAL ESTIMATION RESULTS

Variables	(1)	(2)
Coupon (α)	1	1
Option Premium (γ^{Delta})	-0.66**	-0.67***
	(0.26)	(0.013)
CDS Spread (γ^{CDS})	-6.59***	-5.55***
	(2.35)	(0.40)
Scaling Parameter (θ)	39.67	45.72
	(24.35)	(29.23)
π_H		98.94%**
		(0.49%)
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.*

The other parameter of interest is distribution of search costs across the two types of consumers. I am able to recover the distribution of search costs as follows. First, from the estimation procedure I estimate the distribution of reservation utilities for both types of consumers, $\widehat{G}_L(\cdot)$ and $\widehat{G}_H(\cdot)$. Given the distribution of reservation utilities and the corresponding utility and profit parameters, I am able to determine the probability that a broker shows each product j to a client. Hence, I determine $\rho_{j,T}$ for each product and consumer type according to equation (9). Given the set of ρ 's for each product and consumer type, I then calculate the density of indirect utilities for observed product offerings for each consumer type $h_L(\cdot)$ and $h_H(\cdot)$, via kernel density estimation.²¹ Lastly, I am able to calculate the distribution of search costs for each consumer type by inverting equation

²¹Here $h_L(\cdot)$ and $h_H(\cdot)$ are the densities corresponding to the distribution functions $H_L(\cdot)$ and $H_H(\cdot)$. 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.

(6).

Figures 4 and 5 display the estimated distribution of search costs for the single agent and two agent models. The estimated search costs from the one agent model displayed in Figure 4 suggest that roughly 50% of the population has search costs below 25bps. In other words, it costs the majority of consumers less than 0.25% to receive an offer from a broker. Figure 5 displays the results for the two agent model. The results indicate that virtually all low cost (sophisticated) investors have essentially zero search costs. Recall that sophisticated consumers make up 1.06% of the population. The result suggests that roughly one percent of the population is comprised of market mavens, who essentially search until they find the best product. The other 98.94% of the population still have relatively low search costs. The results displayed in Figure 5 indicate that roughly 60% of the unsophisticated consumers have search costs below 10 basis points per offer. Estimates from both models seem intuitively plausible and are in-line with existing estimates in the literature such as those from Hortaçsu and Syverson (2004).

FIGURE 4: SEARCH COSTS

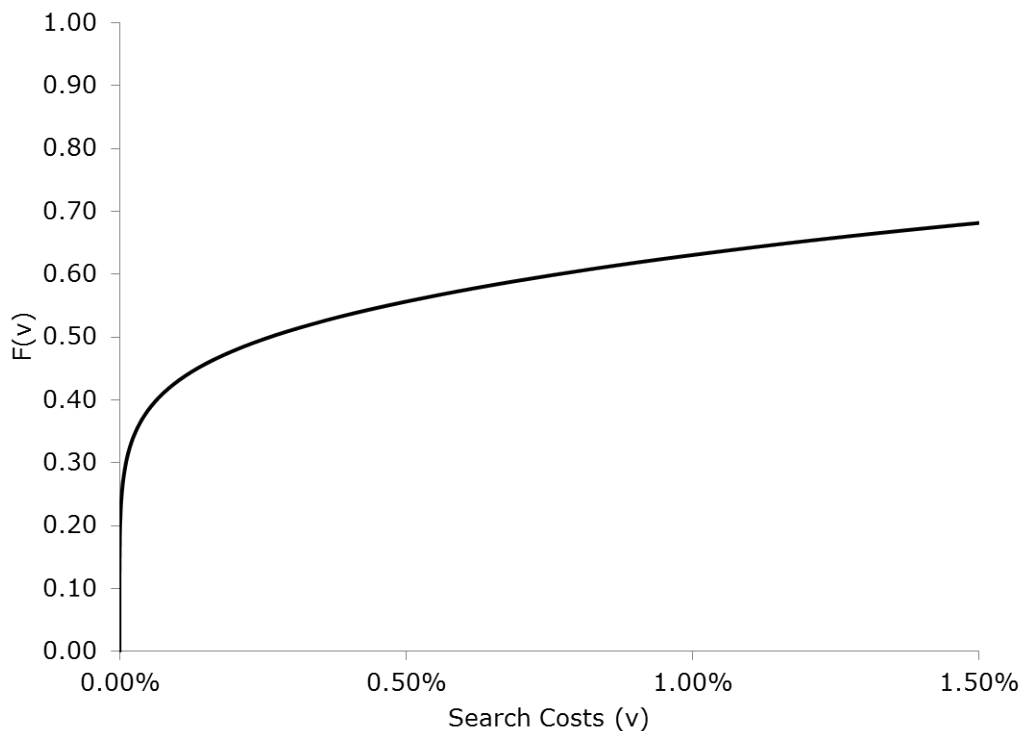


Figure 4 Notes: Figure 4 displays the estimated distribution of search costs corresponding to the single consumer type model. The results imply that roughly 50% of consumers have search costs below 25bps per offer.

FIGURE 5: SEARCH COSTS (HETEROGENEOUS AGENTS)

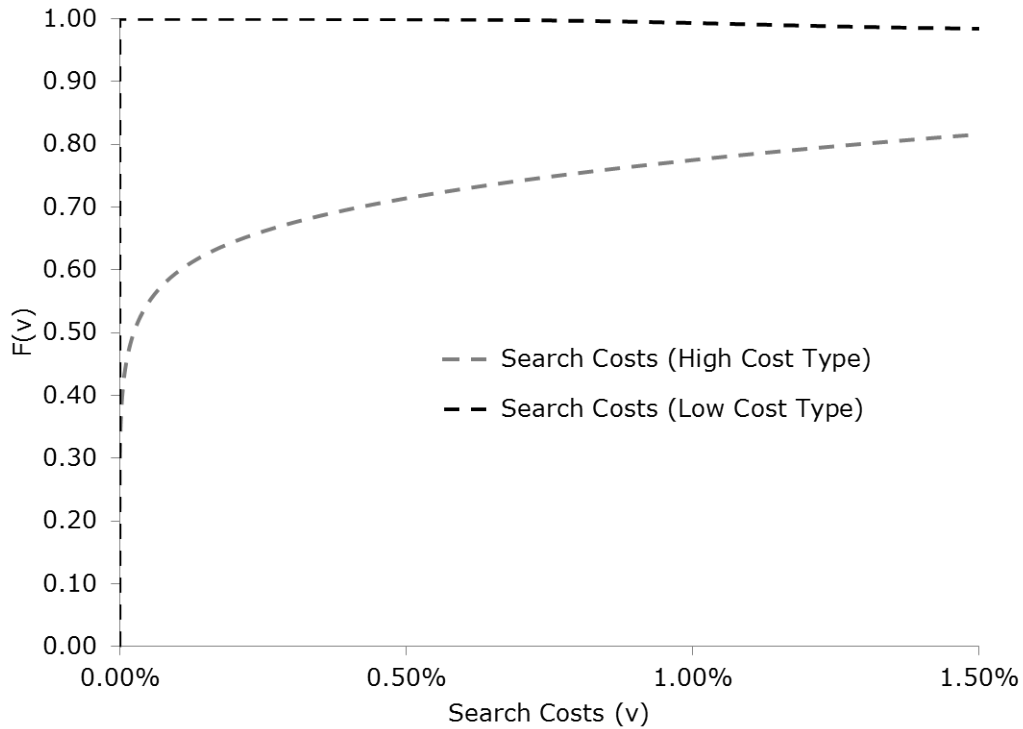


Figure 5 Notes: Figure 5 displays the estimated distribution of search costs corresponding to the heterogeneous two consumer type model. The total population is comprised of 98.94% of high cost consumers and 1.06% low cost consumers. The results suggest that virtually all low cost consumers have zero search costs while roughly 60% of high cost consumers have search costs below 10bps per offer.

The parameter estimates help assess the degree of price discrimination occurring in the reverse convertible market. Consider the hypothetical market comprised of two reverse convertibles with identical risk characteristics. 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, the dominated reverse convertible, pays a coupon of 10% and a broker's fee of 3.00%. 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. Brokers show low cost type consumers both products with roughly equal probability. However, brokers are more than twice as likely to show a high cost consumer the dominated product relative to the superior product. This helps explain not only why consumers buy dominated products but why consumers are actually more likely to purchase dominated products.

TABLE 5: IMPLIED SEARCH PROBABILITIES

	Bond 1	Bond 2
Fee	1.00%	3.00%
Coupon	12.00%	10.00%
Prob. Observed by Low Cost Type	0.50	0.50
Prob. Observed by High Cost Type	0.33	0.67

6 Policy Analysis: Fiduciary Duty

Two economic 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. Secondly, the consumers search problem is confounded by the conflict of interest problem between consumers and brokers. As consumers search for new investment products, they are more likely to see high fee products. Hence the conflict of interest problem burdens consumers with excess search. As part of the Dodd-Frank Act, regulators are moving towards addressing the conflict of interest problem. 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.

Building on the structural estimation results from the preceding section, I analyze the proposed broker regulations. One difficulty in assessing the broker regulations is determining how regulators will impose fiduciary duty. I examine the policy from two different angles. First, I calculate the change in consumer returns had consumers always purchased the “best” product available in a market where “best” is defined in terms of both utility and fair market value. Secondly, I examine the effect of a policy where regulators impose fiduciary duty by fixing fees across all products. Fixing fees across products eliminates the conflict of interest problem between consumers and brokers. I then use the structural estimates from the preceding section to determine the expected change in consumer welfare.

6.1 Highest Fair Value / Highest Utility

One way to assess the potential change in consumer welfare of the fiduciary duty policy is to ask how much better off would consumers have been if they always purchased the “best” reverse

convertible available? I calculate the average change in consumer risk adjusted returns had consumers always purchased the “best” product available in each market²² where “best” is first defined in terms of fair market value and then in terms of utility. I calculate the fair market value of each product as the present value of coupon payments minus the option premium and CDS spread. In some sense this provides us with a “model free” estimate of the potential consumer welfare gains as the calculation is a simple accounting exercise and does not rely on the model or model estimates. Conversely, I use the estimated preferences parameters from the heterogeneous agent model (column 2 in Table 4) to determine the “best” product in terms of utility.

Table 6 displays the average change in consumer risk adjusted returns had consumers always purchased the “best” available product in market. On average consumer risk adjusted returns would have increased by 1.10% had consumers always purchased the “best” product in terms of fair market value. Similarly, when “best” is defined in terms of estimated utility preferences, consumer returns would have increased by 2.73% on average under such a policy. To put these number in perspective, the average risk free rate over the period studied (2008-2012) was 0.594%. Under both measures, the results indicate that holding brokers to a fiduciary duty could generate enormous welfare gains for consumers.

TABLE 6: WELFARE EFFECTS OF FIDUCIARY DUTY

Policy	Avg. Change in Return
Fair Value	1.12%
Highest Utility	2.73%

6.2 Fixed Fee Policy

The results from the empirical and theoretical section suggest that brokers select products to show consumers based on the product specific broker’s fee and the quality of the product. One way to force brokers to select products solely on product quality would be to fix fees across all products. I consider the scenario where regulators hold brokers to a fiduciary duty by fixing fees across all products at some fee f^* . Fixing broker’s fees is analogous to imposing fiduciary responsibility respective of the unobserved marketing costs $\eta_{i,j}$. Under the fixed fee policy, brokers still market

²²I use the market definition from Section 5. An underlying equity and month constitutes a product market.

the bond yielding the highest expected profit to client i

$$\max_{j \in \mathcal{J}} E[\pi_{i,j,T}] = \max_{j \in \mathcal{J}} [f^* G_T(u_j) + \eta_{i,j}]$$

where f^* is fixed across all products. Brokers trade off the weighted probability the consumer purchases the bond $f^* G_T(u_j)$ with the cost of marketing the product to the client $\eta_{i,j}$. Fixing fees helps align the incentives of brokers with their client's preferences. As detailed in Section 3, fees are negatively correlated with product quality in terms of reverse convertible's risk and return. By fixing fees, regulators eliminate the incentive for brokers to market high fee inferior products.

I calculate the expected change in consumer welfare under the fixed fee policy as follows. First, I fix fees across all products at some fixed rate while keeping all other product characteristics the same. I then calculate the new implied distribution of product offerings $H_L(\cdot)$ and $H_H(\cdot)$ from the broker's profit maximization problem under the assumption that consumer reservation strategies remained unchanged. Then, given the new distribution of product offerings, I recalculate the optimal reservation utility strategy for each consumer type. A consumer's reservation utility represents his expected utility from searching for a product. Consequently, using the change in reservation utilities under the new fixed fee policy, I am able to calculate each consumer's expected change in utility under the policy. It's worth noting that this is a partial equilibrium analysis as I treat the product space and product characteristics as fixed (other than fees) and do not allow brokers to update their beliefs about the distribution of reservation utilities.

Table 7 displays the average expected change in consumer welfare (measured as risk adjusted return) for both types of consumers under the new policy. Sophisticated/low cost consumers only benefit very marginally from the fixed fee policy (less than 0.001%). Since sophisticated consumers essentially have zero search costs, they always purchase the reverse convertibles generating the highest utility, regardless of the policy. The average return of unsophisticated investors would increase by 0.13% if regulators were to fix fees at 3% and by 0.40% if regulators were to fix fees at 6%. Note that as the fixed fee goes up, brokers will put more weight on the quality of a product relative to the cost when selecting products to show each client. Consequently, the greater the fixed fee, the more aligned broker and consumer incentives are. Again, given that the risk free rate over the period was 0.594%, the fiduciary duty policy generates a relatively large gain for consumers.

TABLE 7: WELFARE EFFECTS OF FIDUCIARY DUTY

Policy	Avg. Change in Return by Consumer Type	
	High Cost Consumers	Low Cost Consumers
3.00% Fee	0.13%	0.00%
6.00% Fee	0.40%	0.00%

7 Conclusion

Economists and regulators have been long interested in the observed price dispersion in financial products. Does such price dispersion imply that consumer are making “bad” investments? Using a new data set I find evidence that consumer’s 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 it does not explain why consumers are actually 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 incentivizes brokers to sell dominated products; hence, there is a conflict of interest. The empirical evidence verifies the conflict of interest problem. All else equal, consumers are more likely to buy products with higher fees. And similarly, all else equal, products with higher fees are of lower quality in terms of risk and return.

The findings that consumers frequently overpay for/make bad investments and the conflict of interest problem are likely not unique to the reverse convertible industry. This paper focuses on reverse convertibles because some features of the reverse convertible market make it easier to identify dominated products and the conflict of interest problem. However, there is little reason to believe that search and conflict of interest do not play important roles in other financial markets. A vast literature discusses price/fee 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) and Bergsteresser et al. (2009) details the potential conflict of interest arising in the mutual fund industry. The presence of dominated products and the conflict of interest problem

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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Appendix

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

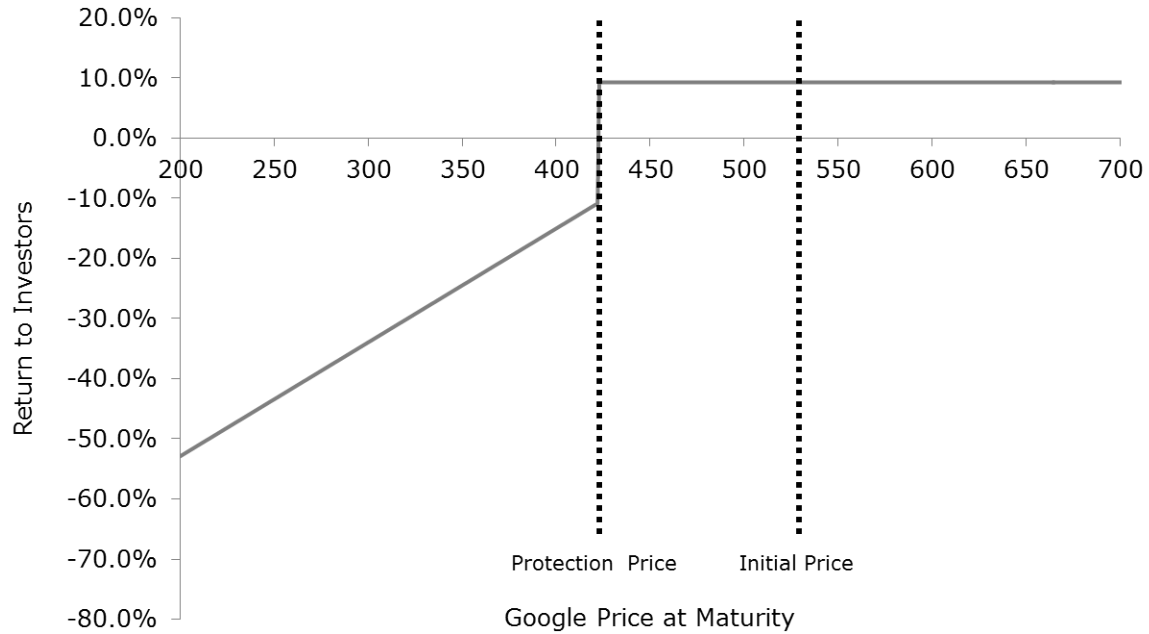


Figure A-1 Notes: The figure displays the return to investors for a one year reverse convertible bond linked to the price of Google Inc. that was issued by UBS (CUSIP 90268F112). The reverse convertible pays a monthly coupon of 9.25%. If at maturity the price of Google closes above the protection price (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 Goolge Inc. at maturity.

TABLE A-1: STRUCTURAL ESTIMATION RESULTS

Variables	(1)	(2)
Coupon (α)	1	1
Option Premium (γ^{Delta})	-0.83*** (0.07)	-1.17*** (0.0135)
CDS Spread (γ^{CDS})	-4.55*** (0.96)	-4.05*** (0.17)
Scaling Parameter(θ)	49.27*** (15.22)	36.49*** (13.45)
π_H		1.56%*** (0.25%)
Heterogeneous Agents		X
Observations	1,227	1,227
Number of Markets	423	423

*Table A-1 Notes: Table A-1 displays the maximum likelihood estimation results for the fully specified model. Each observation is weighted by the market size. Standard errors are calculated using the observed Fisher Information Matrix. *, **, *** indicate significance at the 10%, 5% and 1% level.*