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Ex-post Structured Product Returns: Index Methodology and Analysis

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Abstract

The academic and practitioner literature now includes numerous studies of the substantial issue date mispricing of structured products but there is no large scale study of the ex-post returns earned by US structured product investors. This paper augments the current literature by analyzing the ex-post returns of over 20,000 individual structured products issued by 13 brokerage firms since 2007. We construct our structured product index and sub-indices for reverse convertibles, single-observation reverse convertibles, tracking securities, and autocallable securities by valuing each structured product in our database each day.

The ex-post returns of US structured products are highly correlated with the returns of large capitalization equity markets in the aggregate but individual structured products generally underperform simple alternative allocations to stocks and bonds. The observed underperformance of structured products is consistent with the significant issue date underpricing documented in the literature.

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1 Introduction

Structured products are senior unsecured debt securities with payouts that depend on the value of one or more underlying assets. The underlying assets are can be individual stocks, baskets of stocks, stock indexes, interest rates, commodities, or other calculated values. Structured products can pay fixed coupon payments throughout their term or pay coupons contingent upon changes in the level of the underlying asset/rate although some products pay no coupons at all. Structured products have existed since the late 1980s, but issuance picked up in the mid 2000s. The issuance of new structured products declined during the financial crisis but has since rebounded and over $40.5 billion in structured products were issued in the US in 2013.[1]

Structured products can be classified into several common types according to their payout structures. For example, reverse convertibles (also known as reverse exchangeables) are coupon-paying structured products which convert to shares of the stock if the stock price declines below a specified barrier during the term of the notes. Reverse convertibles are the subject of much academic research. For example: Wilkens et al. (2003) found significant mispricing of reverse convertibles that could be duplicated using options traded on the Eurex Exchange. Szymanowska et al. (2009) studied reverse convertibles on the Amsterdam Stock Exchange between 1999 and 2002 and confirmed significant mispricing in a model-free analysis.

Issuers can completely hedge common structured products by using combinations of options. If banks can issue structured products at prices above the cost of hedging the structured product and issuing a zero coupon bond, then structured products can be used to obtain access to cheaper capital. We showed in (Deng et al., 2009) that Lehman Brothers issuance of structured products increased dramatically as its credit risk increased during 2007 and 2008.

Doebeli and Vanini (2010) and Gennaiolita et al. (2012) have argued that investors do not fully understand the risks embedded in structured products, and that this misunderstanding could wider market implications. Bethel and Ferrel (2007) discuss the policy issues related to structured products with a focus on investor protection concerns.

Several published papers have valued large samples of structured products and found average issue date values between 92 and 98 cents per dollar.[2] Henderson and Pearson (2010) argued that the complexity of structured products allows brokerage firms to sell investors mispriced market exposure and thus book an issue date profit. Bernard and Boyle (2011) drew similar conclusions for locally-capped structured products and estimated the average initial mispricing of these products at approximately 6.5%. This issue date mispricing can be interpreted as the present value of the extent to which the structured products expected future returns fall short of the returns required to compensate investors for the interest rate, credit and underlying market risks.

There currently is no large scale analysis of realized returns on US structured products to

[1] (Bloomberg Structured Notes Brief)

[2] SLCG's work includes valuations of absolute return barrier notes (Deng et al., 2011a), autocallables (Deng et al., 2011b), reverse convertibles Deng et al. (2012a), and dual-directionals (Deng et al., 2013).

supplement the large and growing literature of ex-ante analyses.[3] Such an analysis could help investors understand how the widely documented issue date mispricing of structured products affects their likely realized returns.

To study the ex-post returns of structured products in the aggregate, we construct five indexes that reference common types of structured products registered with the Securities and Exchange Commission from January 2007 to January 2014. We value our sample of outstanding products on each day and aggregate the results across issuers and underlying assets.

This work builds on SLCG's published research and is an extension of our structured product reports, which provide valuations and analysis of over 20,000 individual products.[4] We compare the returns of these indexes to several asset classes and find that across product types and market conditions, structured products underperform alternative allocations to stocks and bonds. The results of our index analysis should cause investors and their advisers to avoid retail structured products.

2 Index Methodology

In this section we describe our procedures for (a) collecting individual product data on our samples of each product type, (b) valuing each product on a daily basis, and (c) aggregating the calculated values into value-weighted indexes.

2.1 Sample of Products

The sample used for our paper consists of US dollar denominated structured products registered with the SEC.[5] We have developed software to automatically search the SEC website for 424B2 forms for several structured product issuers.[6] From these forms we obtain the name of the issuer; the name of the product; the pricing, issue, maturity, and final observation dates; the amount issued; the underlying security (or securities) and initial value(s); any coupon payment dates and amounts, if applicable; and any barrier, trigger or other product-specific parameters.

We then gather the tickers of all of the underlying securities referenced by the structured products in our sample and obtain prices/rates, dividend yields (if applicable), and option-implied

[3] Bergstresser (2008) studied the performance of a large sample of structured products, but based their analysis on pricing data. analysis differs from Bergstresser (2008) in that Bergstresser (2008) used price data to analyze returns while we use valuation models due to limited secondary market trading.

[4] Research reports available free of charge at `slcg.com/securities-structured-products.php`.

[5] Offering documents can be searched using the EDGAR system at `www.sec.gov/edgar.shtml` We use the subscription service EDGAR Pro to search for and download filings (`http://pro.edgar-online.com/`). Final structured product offering documents are filed as form 424B2.

[6] See Section 2.2.

volatilities.[7] We also obtain US Treasury rates, USD swap rates, and credit default swap (CDS) rates for each issuer for all available terms on each day.

We apply our index methodology to four product types: reverse convertibles, single-observation reverse convertibles, tracking securities, and autocallable securities. We define each of these types as:

- **Reverse convertibles** pay high periodic coupons regardless of the returns on the underlying asset. The notes return principal at maturity if the market value of the underlying asset on final observation date exceeds the initial market value, or if on every date during the life of the note the closing value of the linked asset is not less than the barrier level (e.g., 80% of the initial market value). Otherwise the note is converted into shares of the asset and the investor suffers 1-to-1 losses with declines in the asset price. Reverse convertibles typically have terms of three months to one year.[8]

- **Single-observation reverse convertibles** are a type of reverse convertible that pay the principal amount at maturity if the underlying asset price closed above the barrier level on the final valuation date regardless of the price history during the term of the notes. Otherwise the notes are converted into shares of the referenced asset and the investor suffers 1-to-1 losses with the asset.[9]

- **Tracking securities** are notes that do not pay coupons but whose payout at maturity depends on the value of the underlying security, usually market indexes.[10] These products often have leveraged upside, typically subject to a maximum return cap, and may include a buffer against losses within a range.[11] "Principal-protected notes" belong to this category since their returns are completely buffered.[12]

[7] We obtain several implied volatilities for each underlying, ranging from 6 month to 24 month volatilities. We then choose the volatility that best matches the term of each product.

[8] See the reverse convertible note linked to Apple, Inc. (CUSIP: 617446Z44) issued by Morgan Stanley on December 12, 2007 at `www.sec.gov/Archives/edgar/data/895421/000095010307002969/dp07869_424b2-ps447.htm`.

[9] See the single-observation reverse convertible note linked to Ford Motor Company (CUSIP: 06740H526) issued by Barclays on January 21, 2010 under the brand name "Yield Optimization Notes with Contingent Protection" at `www.sec.gov/Archives/edgar/data/312070/000119312510008836/d424b2.htm`.

[10] Some tracking securities pay a small amount of interest compared to the rate paid in reverse convertible and single-observation reverse convertibles. Those coupon-paying tracking securities are not frequently issued, hence we exclude those products for the index.

[11] See the tracking security linked to the S&P 500 Index (CUSIP: 902661719) issued by UBS on January 26, 2010 with the brand name "Return Optimization Securities with Partial Protection" at `www.sec.gov/Archives/edgar/data/1114446/000139340110000060/c172345_690437-424b2.htm`.

[12] See the principal-protected note issued by JP Morgan under the brand name "Equity Index-Linked Notes" (CUSIP: 48125XKS4) on March 30, 2011 at `www.sec.gov/Archives/edgar/data/19617/000119312511080977/d424b2.htm`.

- **Autocallables** have maturity payoffs that are similar to single-observation reverse convertible notes. Autocallables also include observation dates on which the notes can be called prior to maturity if the underlying security closes below or above a trigger level (depending on the type of autocallable). Autocallable securities pay coupons and typically have a term longer than either type of reverse convertible discussed above. If the note is called, principal and unpaid coupons are paid to the investor (limiting further coupon payments).[13]

2.2 Data Description

To construct the structured product indexes, we value all outstanding structured products in SLCG's database on each trading day. Table 1 includes summary statistics of the product parameters used in those products.

Table 1: Summary Statistics of Structured Products in Our Sample. (N/A = Not Applicable).

	Reverse Convertibles	SO Reverse Convertibles	Tracking Securities	Autocallable Securities
Count	11,504	3,165	2,570	2,882
Average Term (years)	0.49	0.92	1.84	1.26
Average Size (MM)	\$1.275	\$2.139	\$4.717	\$0.994
Aggregated Size (MM)	\$14,669	\$6,768	\$12,122	\$2,866
Average Coupon (per annum)	14.0%	10.1%	N/A	13.3%
Average Barrier	73.9%	72.8%	N/A	71.2%
Average Cap	N/A	N/A	20.1%	N/A
Average Buffer	N/A	N/A	11.1%	N/A
Number of Issuers	11	9	12	7

Figure 1 includes a time line of products in SLCG's database issued in the years 2007-2013. Although issuance of traditional reverse convertibles decreased significantly since 2008, they are a majority of our sample. Since 2011, the issuance of closely related single-observation reverse convertibles and autocallable securities has increased significantly.

[13] See the "Trigger Phoenix Autocallable Optimization Securities" linked to the common stock of Alpha Natural Resources, Inc. (CUSIP: 90267G772) issued by UBS on April 20, 2011 at `www.sec.gov/Archives/edgar/data/1114446/000139340111000211/c218923_690629-424b2.htm`.

Figure 1: Structured Product Sample by Year Issued

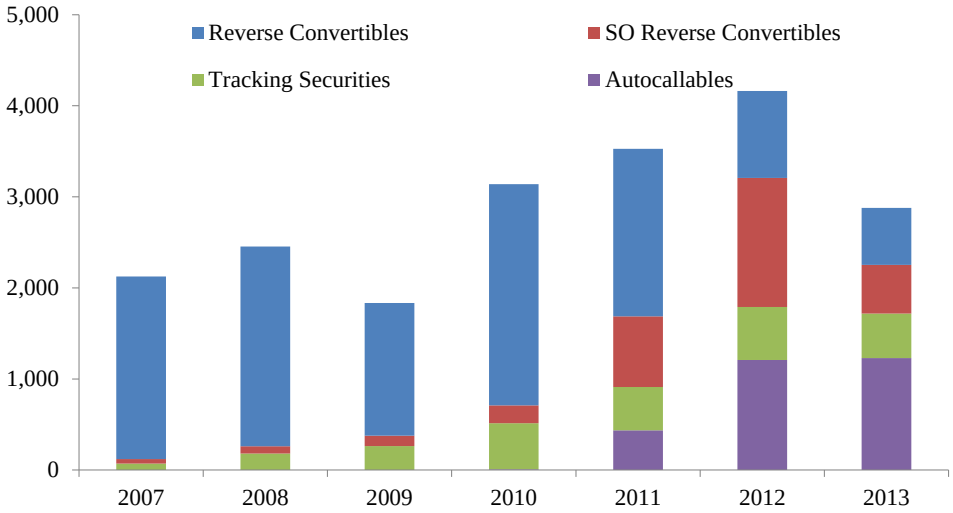
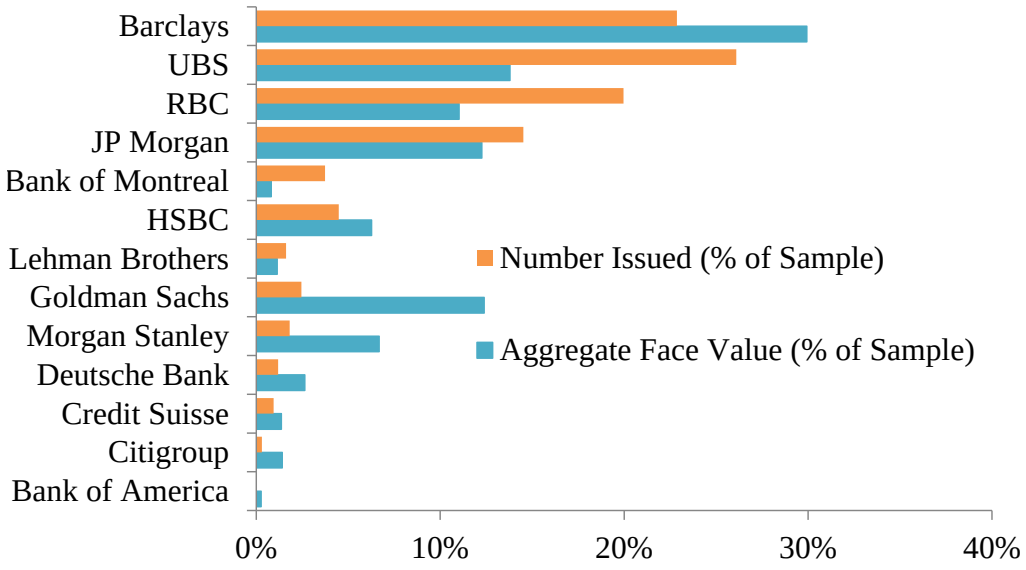


Figure 2 illustrates the distribution of products in our sample by issuer. Barclays, UBS, Royal Bank of Canada and JP Morgan issued the great majority of the products in our sample. Although Goldman Sachs issued a relatively small number of products (2% of our sample), the aggregate face value of the Goldman notes is nearly 12% of our sample.

Figure 2: Structured Product Sample by Issuer



2.3 Valuation

We value each product based on the product specific information we have gathered and market data on volatilities, dividend yields, interest rates, etc., for each underlying security on each valuation date reflecting then-current market conditions. We value each product over its entire term (the period between its issue date and its final maturity date). We include the effects of credit risk on the value of each note by augmenting the discount rate used for present value calculations with the credit default swap rate of the issuer.[14] We provide a more detailed description of our valuation methodology in (Deng et al., 2012b).

Our approach to valuing a structured product depends on the structured product type.[15] Simple closed-form solutions exist for reverse convertibles, single-observation reverse convertibles and tracking securities which allow for relatively quick and computationally efficient valuations. Autocallables, however, are less amenable to closed-form solutions and require Monte Carlo simulations.

2.3.1 Reverse Convertibles

Reverse convertible notes can be valued as a combination of a zero coupon bond from the issuer, a short, down-and-in, at-the-money put option on the underlying asset, and a series of coupon payments. Investors purchasing reverse convertibles effectively sell put options to the issuer and post the notes issue price as collateral to secure satisfaction of the investors obligations under the option contracts. The issuer pays investors a coupon that is higher than the issuer pays on its straight debt as compensation for the put options and interest on the investors' posted collateral.

Following (Hernández et al., 2007) and (Deng et al., 2012a), we write the value of the reverse convertibles as

$$V = PV_{\text{Zero Coupon Bond}} + PV_{\text{Coupons}} - PV_{\text{Down-in-put Option}}.$$

2.3.2 SO Reverse Convertibles

Likewise, the value of a single-observation reverse convertible can be written as a zero coupon bond, a series of coupon payments and a short European put option

$$V = PV_{\text{Zero Coupon Bond}} + PV_{\text{Coupons}} - PV_{\text{European Put Option}}.$$

Both of these expressions are based on the intuition that the payoffs from a structured product can be replicated by a combination of option contracts.

[14] To include the effect of the Lehman Brothers Bankruptcy, we changed the market value of all outstanding Lehman Brothers structured products to zero following the filing of bankruptcy on September 15, 2008. The market value of these products remains zero through expiration. Valuing the Lehman structured products at \$0.10 per dollar after the bankruptcy does not materially change any of our results.

[15] (Deng et al., 2012b)

2.3.3 Tracking Securities

Principal-protected notes are the simplest to value, because their payoffs can be replicated by just (1) a zero-coupon bond issued by the bank, and (2) a European call option on the underlying security. The value of a principal-protected note is therefore:

$$V = PV_{\text{Zero Coupon Bond}} + PV_{\text{European Call Option}}.$$

Buffered and capped tracking securities can be replicated by a combination of options that includes a zero coupon bond, a short put that is out-of-the-money by the buffer amount (if any), long at-the-money call options for any leveraged upside L, and short out-of-the-money call options if returns are capped. This replication leads to the following expression:

$$\begin{aligned} V &= PV_{\text{Zero Coupon Bond}} - PV_{\text{OTM European Put Option}} \\ &+ L\left(PV_{\text{ATM European Call Option}} - PV_{\text{OTM European Call Option}}\right). \end{aligned}$$

2.3.4 Autocallables

Valuing autocallable structured products using the option decomposition method is complex because their periodic coupon payments are path-dependent and do not have predefined maturity dates. Instead, we adopt a Monte Carlo simulation-based method, which uses market data to simulate many possible paths of the underlying asset and value the resulting payoffs of the note for each path.[16] Those payoffs are then discounted to present value using a discount factor that reflects both the current risk-free interest rate and the credit risk of the issuer (as reflected in its credit default swap rate).

2.4 Index Construction

The fair value of each structured product is calculated using market data, including stock price, implied volatility, the issuers CDS rate, and market interest rates at the end of each business day. The fair value includes the present value of all future cash flows from the product, including scheduled or contingent coupon payments, but excludes any coupons paid before and on day t. The fair value of each structured note at time t ($V_{t,i}$) equals its market value if there was a liquid secondary market. The total return of the structured product $R_{t,i}$ is calculated based on the fair values at day t and $(t-1)$. If no coupons are paid on date t, the total return is

$$R_{t,i} = V_{t,i}/V_{t-1,i} - 1. \tag{1}$$

[16] Our approach follows closely the methods described in (Glasserman, 2003). We here use 10,000 simulations for each valuation.

When t corresponds to a coupon payment date, the fair value $V_{t,i}$ excludes this expected coupon. By the end of the day, the investor holds both the structured notes, and the coupon payment $C_{t,i}$. Now the total return becomes

$$R_{t,i} = (V_{t,i} + C_{t,i})/V_{t-1,i} - 1. \tag{2}$$

Some products pay high coupons $C_{t,i}$ – see Table 1 – when compared to comparable straight debt. Since these structured products pay large coupons, it is important to include the effect of these coupon payments on the index. Following the methodology used for the construction of the S&P 500 Municipal Bond Index, the coupons received from the structured products are not reinvested in the index. We also do not consider any interest generated on those coupons.[17] On the other hand, when we calculate the weights $\omega_{t,i}$ of any structured product index component, the coupons paid become part of the denominator. In this case, we denote the total return of the index IR_t as

$$IR_t = \sum_{i=1}^{n} R_{t,i}\omega_{t,i}, \tag{3}$$

where

$$\omega_{t,i} = \frac{V_{t-1,i}}{\sum_{j=1}^{n}\left[V_{t-1,j} + \sum_{\tau \le t-1} C_{\tau,j}\right]}.$$

The weight each structured product contributes to the index is determined by the products calculated market value on the previous business day. After maturity, the structured products are removed from the calculation of index total return. We set the starting value of each index to be 100 on the index initial valuation date, which varies by product type.[18] The number and market size of products of any given type varies from day to day, as well as the number of valuations that are included in the index calculation.[19]

Bergstresser (2008) took a similar approach to constructing a "structured product portfolio" based on products issued before October 2008. That study had a majority of European products in its sample (particularly those linked to the Deutsche Borse AG German Stock Index), and used market bid prices rather than calculated fair values to determine returns, despite the illiquidity of most structured products.

[17] Indices (2013)

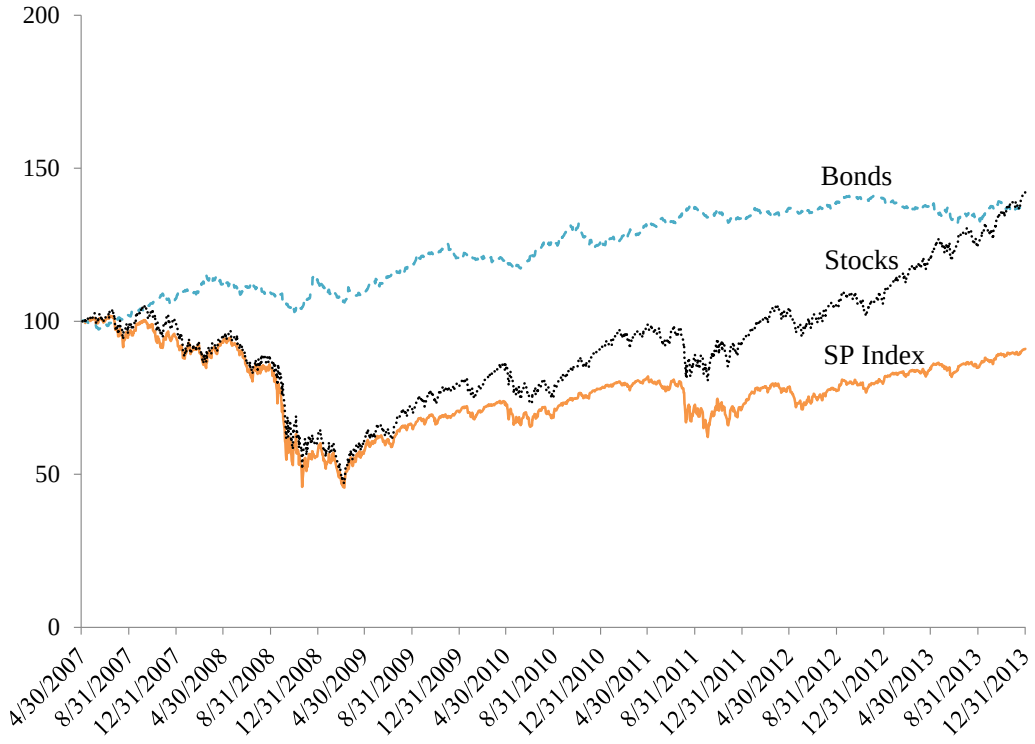
[18] All structured product indexes except for the autocallable securities subindex start on May 4, 2007. SLCG collected data of structured products issued in and after 2007. The autocallable securities subindex, based mainly on "autocallable phoenix" products issued by UBS, and other financial institutions, starts on December 9, 2010. The first of this type was issued in December 2010 by UBS according to our database.

[19] The average number of products valued per day in our sample is 1,907. The minimum number since May 4, 2007 is 395 and the maximum number is 3,239.

3 Analysis

We plot the structured product index values over time in Figure 3. We also overlay the S&P 500 Total Return Index and the Barclays Aggregate Bond Total Return Index values for comparison.[20]

Figure 3: SLCG Aggregate Structured Product Index
(Dotted-Line is the scaled S&P 500 Total Return Index, Dashed-Line is the scaled Barclays Aggregate Bond Total Return Index)

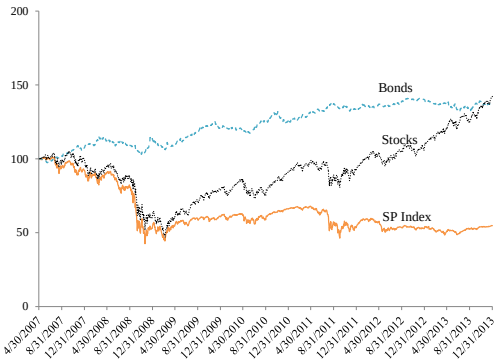


Changes in the structured product index levels are highly correlated with changes in the S&P 500 Total Return Index. During the market downturn 2008, structured product values tracked the S&P 500 closely. Since early 2009, the returns to structured products have been positive but substantially less than the returns to large capitalization stocks.

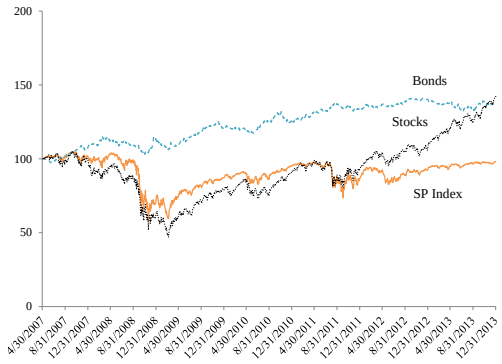
We have also calculated sub-indexes for several types of structured products. Figure 4 illustrates each of these subindexes. The autocallable security sub-index does not begin until 2011 because our sample contains very few autocallable securities prior to 2011. For comparison, we have included both the S&P 500 Total Return Index and the Barclays Aggregate Bond Total Return Index in each of the figures.

[20] The tickers for these indexes are SPXT Index and LEGATRUU Index, respectively.

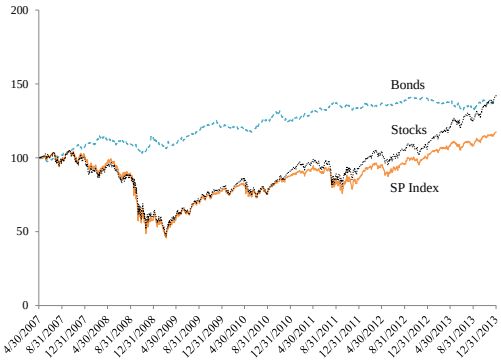
Figure 4: Aggregate Structured Product Subindexes
(Dotted-Line is the scaled S&P 500 Total Return Index, Dashed-Line is the scaled Barclays Aggregate Bond Total Return Index)



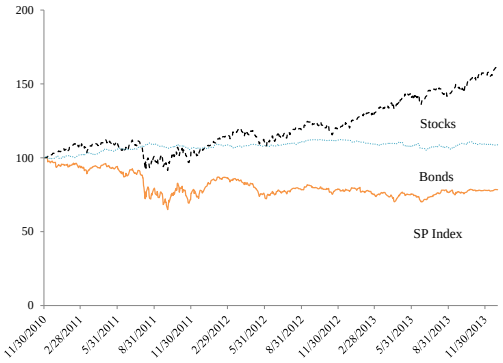
(a) Reverse Convertibles



(b) SO Reverse Convertibles



(c) Tracking Securities



(d) Autocallables

3.1 Returns and Volatility

In Table 2, we summarize the mean and standard deviation of the monthly excess return distribution for each of the structured product indexes and for the stock and bond indexes. The mean return is the annualized monthly excess return and the standard deviation is the annualized standard deviation of monthly returns. The Sharpe ratio is calculated as the ratio of the mean excess return to the standard deviation of excess returns. The structured product indexes exhibited lower mean excess returns than the bond and stock indexes, with similar standard deviations as the S&P 500. The resulting Sharpe Ratios are all lower than the Sharpe Ratio for both the stock or bond indexes.

Table 2: Excess Return Distribution Moments of SLCG Structured Product Indexes and Major Stock and Bond Market Indexes.

	Mean Return	Standard Deviation	Sharpe Ratio
Reverse Convertibles Index	-8.0%	19.5%	-0.41
SO Reverse Convertibles Index	0.2%	16.8%	0.01
Tracking Securities Index	3.4%	18.6%	0.18
Autocallable Securities Index	-4.4%	17.7%	-0.25
Aggregate SP Index	-0.5%	18.4%	-0.03
Barclays Aggregate Bond TR Index	4.5%	6.2%	0.72
S&P Total Return Index	6.1%	18.7%	0.33

In Table 3, we list regression coefficients from a linear regression of the structured product index excess returns with both the excess returns of the S&P 500 Total Return Index and the excess returns on the Barclays Aggregate Bond Total Return Index. The regression model is

$$r_i^{\mathrm{SP}} = \alpha + \beta_{\mathrm{B}} r_i^{\mathrm{B}} + \beta_{\mathrm{S}} r_i^{\mathrm{S}}$$

where r^{S} are the excess returns to the stock index and r^{B} are the excess returns of the bond index.

Table 3: Regression of Structured Product Indexes' Excess Returns on Major Stock Market Indexes' Excess Returns
(* = 95% confidence level)

	Observation Period	α	β_B	β_S
Reverse Convertibles	6/1/2007 – 12/31/2013	-0.01*	0.23	0.91*
SO Reverse Convertibles	6/1/2007 – 12/31/2013	0.00	0.25	0.79*
Tracking Securities	6/1/2007 – 12/31/2013	0.00	0.25*	0.93*
Autocallable Securities	1/1/2011 – 12/31/2013	-0.02*	0.96*	1.10*
Aggregate SP	6/1/2007 – 12/31/2013	-0.01*	0.23	0.91*

The excess returns of the structured product indexes exhibit a stronger linear relationship with the S&P 500 than to the bond index. These regressions are similar to those carried out in Bergstresser (2008) for their sample of European structured products.

In Table 4, we compute the six-month holding period return for each structured product index. For each six-month holding period, we compute the number of times the alternative allocation to

stocks and bonds outperformed the particular structured product index as a percent of the total number of six-month holding periods.

Table 4: Percentage of Six-Month Holding Periods in which Bond/Stock Allocations Outperform Structured Product Indexes.

	Number of Holding Periods	100% Stocks/ 0% Bonds	80% Stocks/ 20% Bonds	0% Stocks/ 100% Bonds
Reverse Convertibles Index	1,550	83.4%	89.9%	65.4%
SO Reverse Convertibles Index	1,550	65.5%	73.2%	49.5%
Tracking Securities Index	1,550	60.6%	59.3%	42.3%
Autocallable Securities Index	650	99.8%	96.8%	65.7%
Aggregate SP Index	1,550	78.2%	81.7%	47.5%

Table 4 shows that for the great majority of six-month holding periods, a portfolio of stocks or bonds produced higher returns than a portfolio of structured products. This ex-post comparison answers the fundamental question: how do structured products fare, in the aggregate, against broad market indexes and alternative allocations to bonds and stocks? The answer is: quite poorly. 81.7% of the time, investors would be better off owning a diversified portfolio 80% invested in stocks and 20% invested in bonds than they would be as a result of investing in the structured products we have studied.

3.2 Correlations with Other Indexes

We have also calculated the correlation matrix between the excess returns on our structured products since each structured product index inception date and the excess returns to the S&P 500 Total Return Index and Barclays Aggregate Bond Total Return Index. Our results are presented in Table 5 below.[21]

[21] Correlations are calculated based on monthly excess returns over the 1-month US Treasury rates.

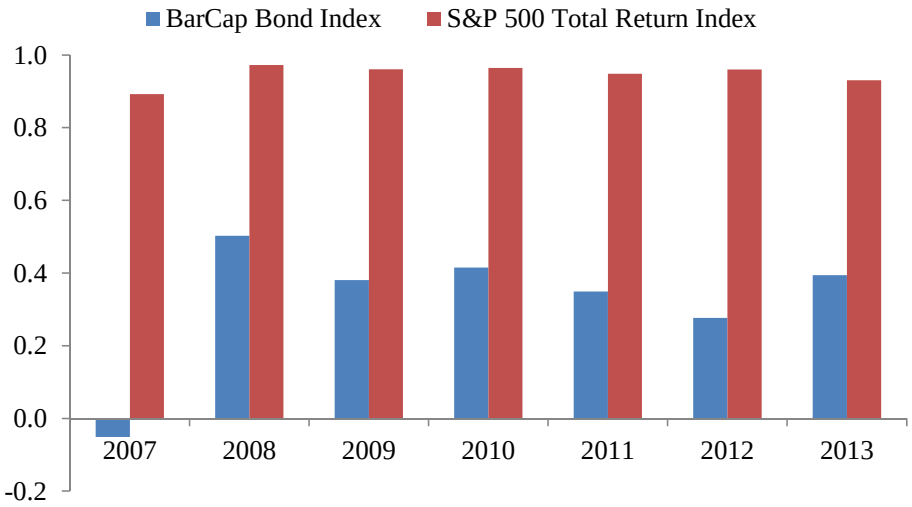
Table 5: Correlation Matrix of Structured Product Indexes with Bond and Stock Markets.

	Reverse Convertible	SO Reverse Convertible	Tracking Securities	Autocallable	Aggregate SP Index	Barclays Bond TR Index	S&P 500 TR Index
Reverse Convertibles Index		97.1%	93.8%	97.9%	97.6%	39.2%	90.2%
SO Reverse Convertibles Index	97.1%		94.1%	95.7%	97.3%	41.2%	91.3%
Tracking Securities Index	93.8%	94.1%		91.2%	98.7%	42.6%	96.8%
Autocallable Securities Index	98.0%	95.7%	91.4%		95.6%	33.3%	83.1%
Aggregate SP Index	97.6%	97.3%	98.7%	95.5%		41.7%	95.7%
Barclays Bond Total Return Index	39.2%	41.2%	42.6%	34.2%	41.7%		36.5%
S&P 500 Total Return Index	90.2%	91.3%	96.8%	82.4%	95.7%	36.5%	

The structured product index changes are highly correlated with changes in the S&P 500 Total Return Index, and weakly positively correlated with changes in the Barclays Aggregate Bond Total Return Index. In Figure 5, we plot the correlations of monthly returns to the S&P 500 Total Return Index and the Barclays Aggregate Bond Total Return Index with the aggregate structured product index for each year from 2007 to 2014.[22]

[22] 2007 includes 10 months of index returns.

Figure 5: Correlations with the SLCG Aggregate Structured Product Index Over Time (May 2007−January 2014)



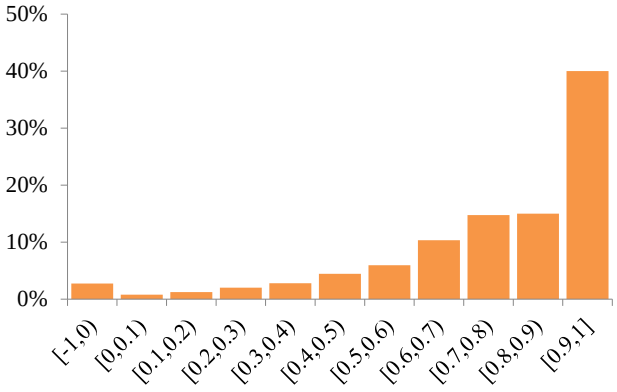
3.3 Comparison to Returns on Underlying Securities

Reverse convertibles, single-observation reverse convertibles, and some autocallable structured products are typically linked to individual equities, rather than an index such as the S&P 500, and have short maturities. The investors in these structured products receive a higher coupon in part due to a higher implied volatility of the underlying assets. On the other hand, tracking securities are typically linked to a basket of equities, or a market index, and usually have a long maturity of 5-10 years.

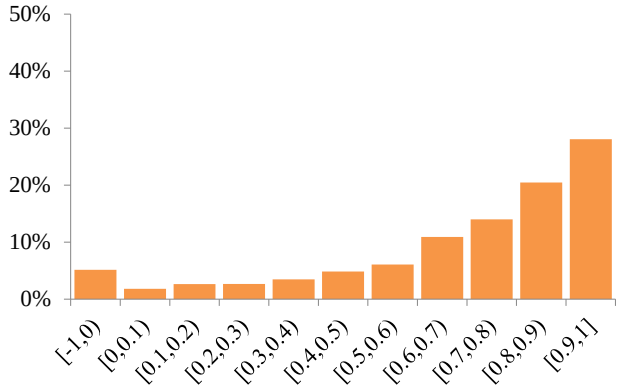
In Figure 6 we plot the distribution of correlations of each structured products value to the value/level of the underlying asset. The maturity payoffs of reverse convertibles (Figure 6(a)), single-observation reverse convertibles (Figure 6(b)) and autocallables (Figure 6(d)) are limited by their face value. Investors in those notes do not participate in the appreciation of the underlying equities at maturity; when the market value of the underlying asset increases over the initial value, the fair value of these structured products does not increase on a one-to-one basis. However, when the underlying asset value decreases below its barrier, the notes fair value also decreases, usually on a one-to-one basis.

The majority of the correlations in Figure 6 are quite positive with much of each distribution above a correlation of 0.8. The correlation in tracking securities is typically higher (see Figure 6(c)) than the correlations of the other three types.

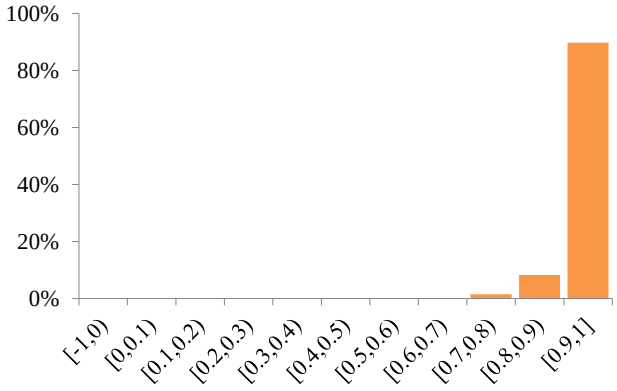
Figure 6: Correlation between Structured Products and Their Underlying Assets



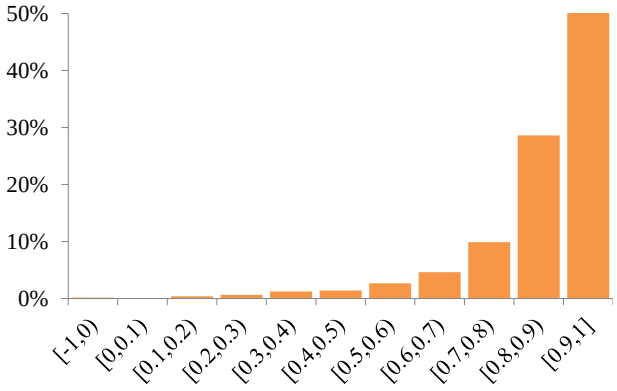
(a) Reverse Convertibles



(b) SO Reverse Convertibles



(c) Tracking Securities



(d) Autocallables

3.4 Comparison of Structured Product Returns and Index Returns

In Table 6, we summarize the average holding period return for each structured product index component. This table also summarizes the average over-performance of alternative allocations to stocks and bonds when compared to holding each type of structured product. We computed the annualized holding period return for each structured product and then calculated the annualized holding period return for the alternative allocations to stocks and bonds over the same period from trade date to the maturity date (or the call date for autocallables that have been called). We then compute the difference (stock and bond portfolio return minus the structured product index component return) and average by product type. Table 6 parenthetically reports the percentage of times the alternative allocation to stocks and bonds outperformed an investment in the structured product index component.

Portfolios that primarily hold stocks generally outperform every structured product index com-

ponent: their average returns are higher, and are, on average, three times more likely to have a higher return than lower return than the individual structured products. The 100% bond portfolio comparison shows mixed results. The bond portfolio underperforms the tracking security index and the probability of the bond portfolio outperforming the SO reverse convertible and the tracking securities indexes are also less than 50%.

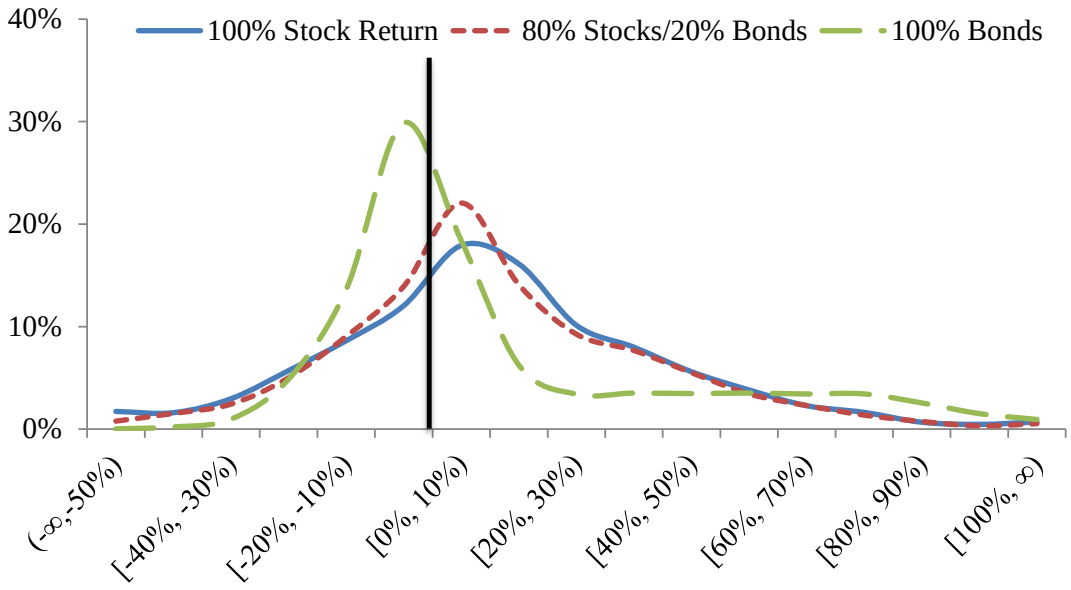
Table 6: Percentage of Holding Periods in which Bond/Stock Allocations Outperform Structured Product Index Components and Average Overperformance by Alternative Bond/Stock Allocations.

		Average Portfolio Overperformance (Frequency)		
	Average Holding Period Return	100% Stocks/ 0% Bonds	80% Stocks/ 20% Bonds	0% Stocks/ 100% Bonds
Reverse Convertibles Index	-8.8%	10.1% (62.6%)	10.7% (63.3%)	15.3% (52.9%)
SO Reverse Convertibles Index	1.3%	13.2% (76.5%)	11.0% (74.8%)	3.0% (25.8%)
Tracking Securities Index	6.1%	5.3% (71.2%)	4.2% (67.3%)	-0.6% (36.8%)
Autocallable Securities Index	-1.0%	30.0% (90.2%)	24.2% (90.4%)	4.7% (73.0%)

This ex-post analysis of structured product returns shows that a simple portfolio of stocks and bonds are better investments than structured products.

In Figure 7, we show the frequency distribution for the difference between stock/bond portfolio and structured product annualized returns aggregated across product type.

Figure 7: Probability Distribution for the Relative Performance of Stock and Bond Portfolios to Structured Product Index Components in the Aggregate.



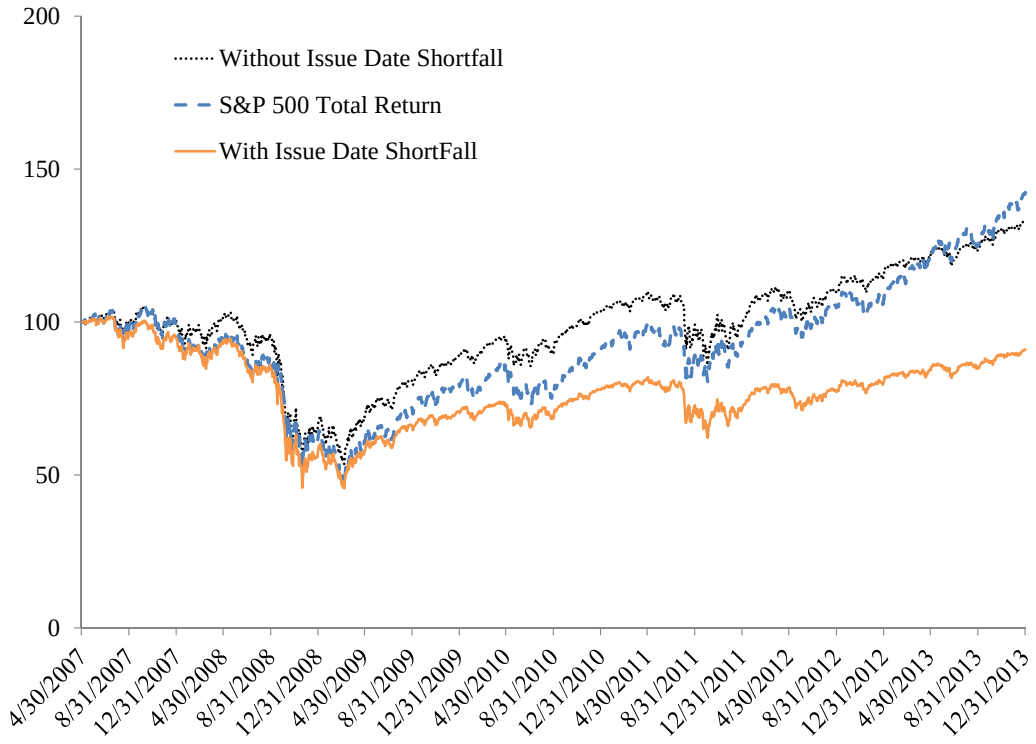
The fact that the majority of the weight for each distribution in Figure 7 is in the positive range indicates that structured products generally underperform stock and bond portfolios.

4 Effect of Issue Date Shortfall

We, and others, have previously argued that the issue date mispricing makes structured products poor investments. We have isolated the effect of issue date shortfall in our index by assuming that investors are compensated with (face value)/(issue date value) amount of each structured product and then computing returns based upon this value. This scaling essentially removes the issue date shortfall, but does not effect any of the returns on the days following the issue date.

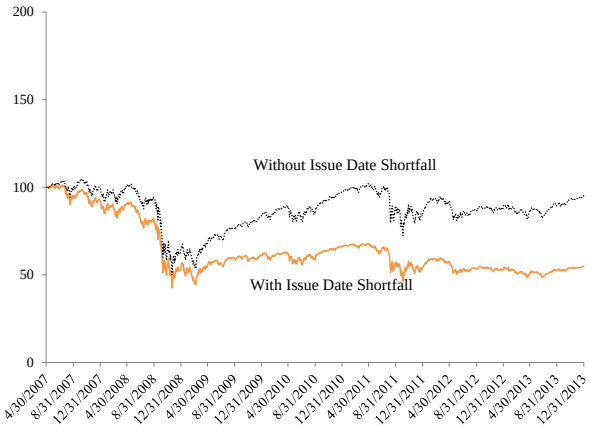
In Figure 8, we reproduce Figure 3 and plot the comparison of the aggregate structured product index with and without this issue date shortfall. The issue date shortfall has a dramatic impact on the structured product index. Without the issue date shortfall, the structured product index closely resembles the S&P 500 in Figure 3. At the end of this six year period, and starting from normalized 100 starting levels, the level of the structured product index is 133.29, compared with 142.37 for the S&P 500 total return index.

Figure 8: Comparison between the Aggregate Structured Product Index Constructed with and without Issue Date Shortfall.

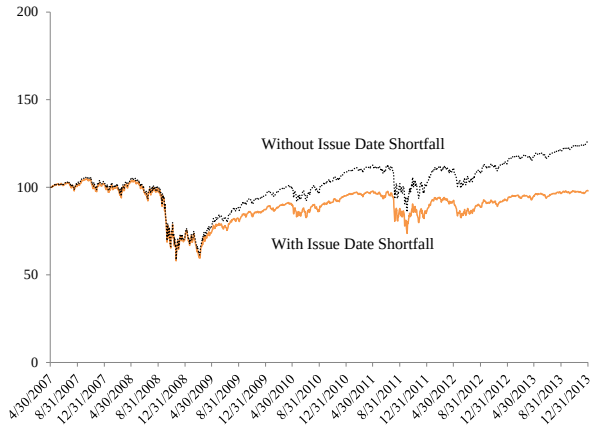


In Figure 9, we plot the structured product index subindexes of Figure 4 with and without this issue date shortfall. The issue date shortfall also impacts the subindexes very significantly.

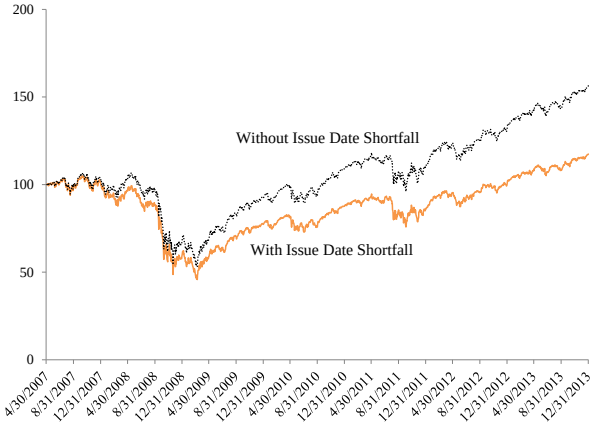
Figure 9: Comparison between Structured Product Subindexes Constructed with and without Issue Date Shortfall.



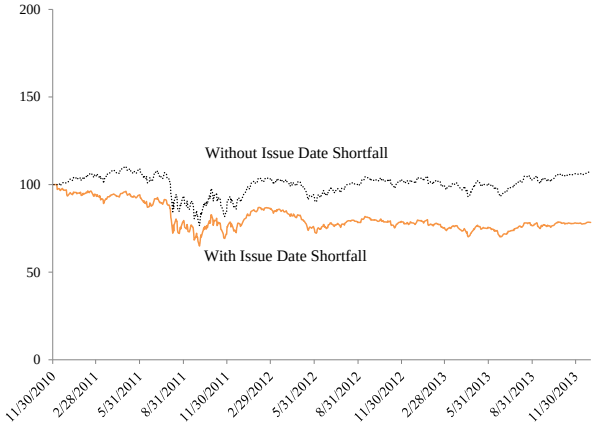
(a) Reverse Convertibles



(b) SO Reverse Convertibles



(c) Tracking Securities



(d) Autocallables

To quantify the impact of the issue date shortfall on ex-post structured product index returns, we have computed the annualized returns and Sharpe Ratio based on monthly returns with and without the issue date shortfall. See Table 7.[23]

[23] Annualized returns are calculated based on the total return of the index since inception, while the Sharpe Ratios are based on excess returns over the 1-month US Treasury rates.

Table 7: Return Characteristics of SLCG Structured Product Indexes and Major Stock and Bond Market Indexes.

	With Shortfall		Without Shortfall	
	Annualized Return	Sharpe Ratio	Annualized Return	Sharpe Ratio
Reverse Convertibles Index	-8.9%	-0.41	-1.1%	0.01
SO Reverse Convertibles Index	-0.6%	0.01	3.3%	0.24
Autocallable Securities Index	-6.4%	-0.25	1.1%	0.42
Tracking Securities Index	2.3%	0.18	6.8%	0.19
Aggregate SP Index	-1.6%	-0.03	4.1%	0.28
Barclays Aggregate Bond TR Index			4.5%	0.72
S&P 500 Total Return Index			6.1%	0.33

Both the annualized return and the Sharpe Ratio for the index without issue date shortfall increases significantly for each index. The effect is strongest for the reverse convertible and autocallable indexes, which have higher annualized returns by approximately 8% without the issue date shortfall. Although the issue date shortfall has a significant effect on annualized returns, it turns out that the correlation between each index and the benchmark indexes – the S&P 500 Total Return Index and the Barclays Aggregate Bond Total Return Index – do not change appreciably.

5 Discussion

The existing academic and practitioner literature does not contain a study of the ex-post returns of US structured products. This paper fills that gap by analyzing the ex-post returns of almost 20,000 structured products issued between May 2007 to January 2014. Our analysis aids investors understanding of the mispricing of structured products, and reveal how the market exposure offered by structured products relates to the performance of other common investments.

We find that structured products generally underperform alternative allocations to stocks and bonds both at the aggregate level and at the product level. We find that investments in broad stock portfolios earn higher returns than 67% of structured products in our database.

Our analysis shows that the aggregate value of structured products has been highly correlated with broad stock indexes, and less correlated with broad bond indexes. This is also true for each individual product type we analyzed. The results of our ex-post analysis suggest that structured products do not represent a unique asset class. Since their aggregate exposure roughly amounts to an equity allocation, aggregate structured product allocations do not expand the efficient frontier for the product types considered here.

Our results strongly suggest that retail investors should avoid retail structured products. Because of high initial embedded fees, investors have earned ex post returns that are highly correlated with, but lower than, returns on simple combinations of liquid stocks and bonds.

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