# PERFORMANCE OF AUTO-CALLABLE REVERSE CONVERTIBLES, INFORMATION DISCLOSURE PRESCRIBED BY REGULATION S-K CHANGE IN 2013 UNDER U.S. SECURITY ACT: AN EMPIRICAL STUDY

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## ABSTRACT

This thesis studies the effect of the estimated value disclosure imposed in 2013 on the realized return of the auto-callable reverse convertibles (ACRCs) in the U.S. retail market. The sample of this study consists of about 3,700 issues of ACRCs during the period from 2011 to 2015, which is collected from the Edgar database of the U.S. Security and Exchange Committee (www.sec.gov).

The comparison between product realized return and the return of underlying assets reveals that the ACRCs are underperformed by 5% on average, while further analysis shows that the return difference was broadened after the disclosure regulation. It is found that the statistical attributes of the underlying assets are critical to the product performance while they are hidden by the issuer of ACRCs. The disclosure regulation is presumed to enhance information disclosure and to further protect the investors, but the deteriorated performance of ACRCs indicates a failure of the regulation. To protect the anonymity and confidentiality, the identity of the issuer of ACRCs in our sample is removed without compromising the validity of our research. The original data is available upon request.

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# Table of Contents

## List of Tables

## List of Figures



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# 1 Introduction

Structured products, as a combination of future and spot market, are unsecured financial instruments. These products usually consist of components of interest rate products, derivatives and underlying assets (Deng et al., 2014), and are traded on organized exchanges or over-the-counter (Stoimenov and Wilkens, 2005). Throughout their maturity which can range from a few months to several years, these products can pay a fixed or contingent coupon to the investors and, depending on the performance of the underlying assets, the payment at maturity to the investors can be significantly less than the principal.

The market of structured products has experienced a continuous upsurge throughout the last few decades. The total sales of structured notes around the globe reach US$40.3 billion in the first quarter of 2017. Among these sales, the SEC-registered equity-linked notes issued in the U.S. accounted for about 25% (US$11.2 billion), which had climbed by 10% since last quarter of 2016 (Bloomberg Brief, April 2017). In the U.S. market, research suggests that the issuers of the structured products introduce some exotic features (complexity) to the products in order to exploit the retail investors (Carlin, 2009; Célérier and Vallée, 2013). An example of complex structured products is the auto-callable reverse convertible (ACRC), which is a particular type of unsecured debt security.

The payoffs of ACRCs are determined by the performance of the underlying assets. The investors will receive contingent coupons if the observed price of the underlying asset does not hit the trigger level, which is usually a percentage of its initial price. Also, the auto-callable feature of the product entitles the bank to call the products when the underlying assets perform well which is against the interest of the banks. If the product is called, the principal and coupon at the term will be paid to the investors, but no further coupons will be received. As for the reverse convertilibity, at maturity, if the final observed price hit below the trigger, the banks can convert the products into the underlying stocks and pay the investors a cash value of the stocks at their final price. The investors thus only receive a portion of their principal.

The historical studies of structured products usually criticize their price distortion. With the exception of Wasserfallen and Schenk (1996), other studies identified a significant gap between the theoretical fair value of the products and their selling price (e.g. Chen and Sears (1990), Burth, Kraus and Wholwend (2001), Baule, Entrop and Wilkens (2008), Henderson and Pearson (2011), Jorgensen, Norholm and Skovand (2012)). The pricing bias of these products indicates that the development of structured products has deviated from their original purposes, such as reducing agency conflict (Ross, 1989), overcoming market frictions (McConnell and Schwartz, 1992), and diminishing the impact of tax and regulation (Tufano and Poetzscher, 1996).

To regulate the sale of structured products and provide further protection to the investors, in 2013, the U.S. Securities and Exchange Commission (SEC) extended the requirement of information disclosure prescribed by Regulation S-K Items 201, 501 and 505. The estimated value of the structured products is required to be included in the Prospectus and other offering documents. This regulatory change is considered to be a direct response to the critiques of the price distortion of structured products. However, no research has been done explicitly focusing on this regulatory effort.

The primary objective of this research is to solve the puzzle of ACRCs' underperformance and the failure of estimated value disclosure regulation. This study sheds the empirical light on the return of ACRCs issued by *The Bank* in the period from 2011 to 2015. This study adopts the approach of Deng et. al (2015) to analyze the ACRCs from the realized return perspective. The realized return is analyzed based on the payoff structure of ACRCs and the statistical attributes of the underlying assets.

Our empirical results identify the information shrouded in the sales of ACRCs. The realized return of ACRCs in our sample is found to be, on average, 4% less than that of the underlying assets before the regulatory change, and the gap broadened by about 2% after the change. Our analysis of ACRCs shows a significant relationship between the product return and the ex-post statistical attributes of underlying assets: *The Bank* selects underlying assets with skewed and more platykurtic returns that increases the probability of the product being called and converted. Further, the disclosed estimated value is found to be missing critical information and reflect inaccurate product performance. For example, the disclosed estimated value shows no significant relationship with the probability of the products being called, and a positive relationship with the probability of conversion which suggests an ACRC with a greater chance to be converted are more valuable.

This study contributes to academia by explaining the underperformance of ACRCs, identifying the information shrouding in the sales of the products and revealing the shrouding mechanism. Our findings also provide practical insights for regulating the sale of structured products and for predicting the performance of structured notes to investors.

The remaining sections are organized as follows: in Section 2, we discuss the development trend of ACRCs and their payoff structure. In Section 3, we review the literatures of financial innovation and structured products. From Sections 4 to 7, we construct our hypotheses, describe the data and procedures of analysis, report the empirical results and discuss our findings. We conclude this study with a brief summary and possible future research directions.

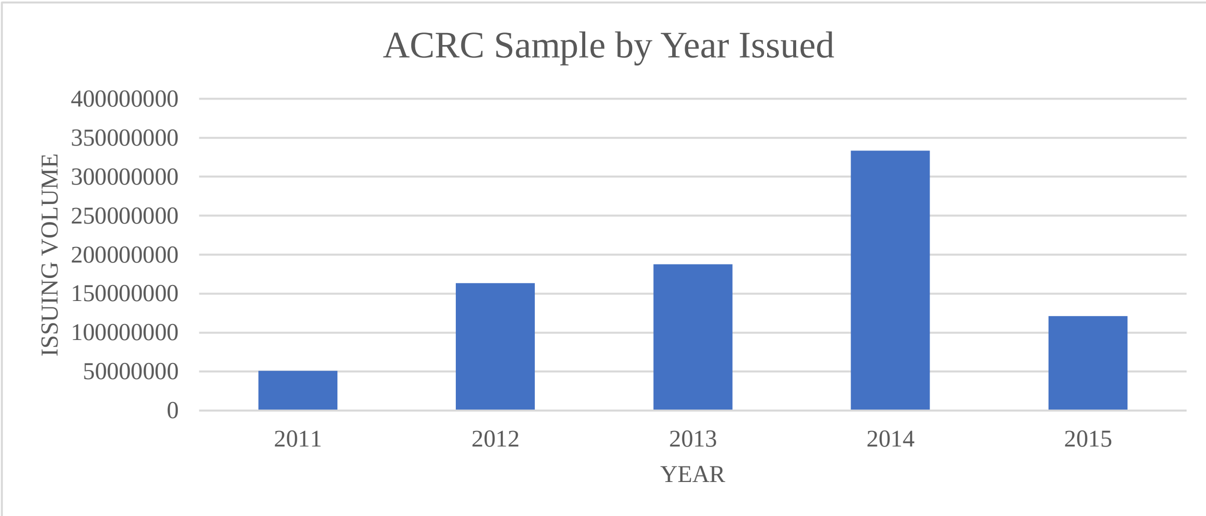


*Figure 1.1 Issuing volume of ACRCs over years*

# 2 Empirical backgrounds

## 2.1 Auto-callable Reverse Convertibles (ACRCs)

Figure 1.1 illustrates the total issuing volume of ACRCs included in our sample. The issuance of ACRCs experienced a continuous surge since 2011, with a significant escalation in 2014 that the total issuance of ACRCs in 2014 was about US$ 350 million. As our sample only contains ACRCs that matured before the end of 2016, and the majority term is 12 months, the issuing volume in 2015 does not capture the total yearly issuance. This increase in issuing volume of ACRCs indicates that the popularity of ACRCs is increasing over time, which could be evidence of its profitability to the issuers. The trend is consistent with the findings of Célérier and Vallée (2013) that the issuers have developed more complicated products in the market for structured notes.

This study adopts a definition of Reverse Convertible similar to Deng et. al (2014). Reverse convertibles are the structured financial products that pay contingent coupons based on the performance of the underlying assets. The product structure is similar to the combination of a long fixed coupon bond, a short put option and a short call option. The short put option enables the issuers to convert the product into the underlying assets at the maturity if the final observed price was below the pre-determined trigger level, while the short call option provides the auto-callable feature to the products. If the notes are converted into the underlying assets, the investors only receive the cash value of the underlying assets at the final observed price on the maturity date, which could be significantly lower than the principal. This additional risk embedded in the products is compensated for the coupon rate which is higher than traditional bonds.

Also, the auto-callable feature of ACRCs gives the issuer a right to call back the notes if the closing price of the reference stocks on any observation date reaches or exceeds the initial level. If the note is called, the principal and coupons at the term will be paid to the investors but the remaining future coupon payments are not. This auto-callable feature could be considered as an additional short call option embedded in the product. Similar to the short put option component, as the investor carries additional risk, a larger coupon is expected as a trade-off. As ACRCs consist of a short call and a short put option component with different strike prices, the payoff structure of ACRCs has a short-strangle-liked shape and the investor will receive maximum payoffs if the price of the underlying asset stays within the trigger and initial levels.

Specifically, the payoff structure of ACRCs is explained in Figure 2.1.1 and as follows:

- A pre-defined fixed coupon is paid if the observed disclosing price of the underlying asset is not below the trigger price, and
- If the observed price reaches or exceeds the initial price, the product will be called. The principal is paid to the investors and the investors' position of the notes is closed
- At the maturity, if the notes are not called in advance and the final observed closing value of the underlying assets is not below the trigger level, the investors receive the unpaid coupon and the full principal, otherwise

- The investors only receive part of the principal equal to: $principal * \frac{final\ observed\ price}{initial\ price}$

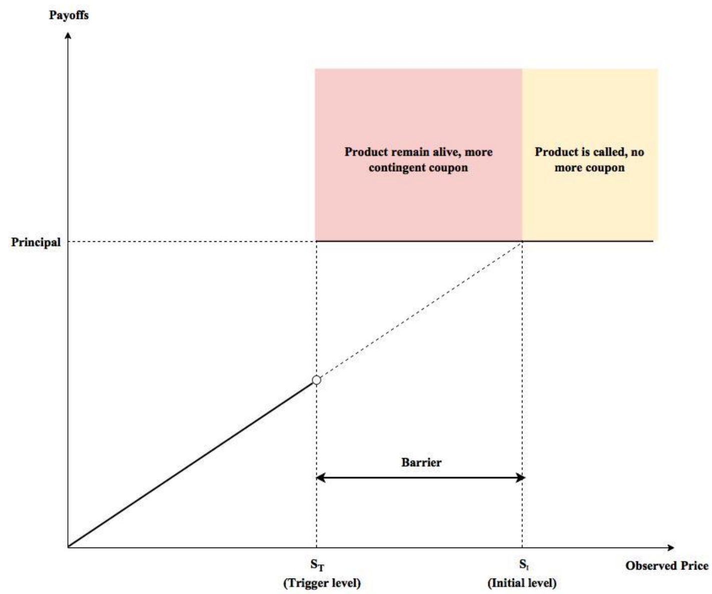

*Figure 2.1.1 ACRC payoff structure*

### 2.2 The regulatory efforts

In the U.S. market, the offer and sale of structured products is regulated by the Securities Act of 1933, which is also called as "the Truth in Securities Act". The primary purpose of this Act is to protect the investors in terms of the accuracy and completeness of product information disclosure during the sale of financial instruments. Over the years, there are several amendments have been made to the Act. Under the Act of 1933, Regulation S-K lays out the disclosure requirement of SEC-registered products regarding product information. In particular, Items 202, 501 and 505 specify the requirement of information disclosure of the offering documents.

In 2013, there is a major amendment of the requirement of information disclosure covered by Regulation S-K. Specifically, the SEC extended the disclosure requirements listed on Item 202, 501 and 505: the estimated value of the products and the evaluation method are considered as significant information. In the letter from the SEC, it stated that investors should be able to understand the value of the structured products offered and the difference between the estimated value and the offering price. Further, they believe the valuation should reflect the value of the fixed income bond and the derivative components of the products. Although there is no explicit enforcement date set in the letter or any other regulatory documents, it is observed that the estimated value of products traded after Sept 10, 2013 are disclosed in the prospectus.

# 3 Literature Review

## 3.1 The Functional role of structured products

To understand the rationale for developing structured products, it is important to examine how they have changed overtime and deviated from their original role of serving the investors. To the best of our knowledge, there is no historical study that has focused on the functional role of structured products in the financial system or on the purposes of developing financial products with embedded structure of derivatives. However, the studies regarding financial innovation, a process of inventing and developing new financial products, may provide insights into the desire function of structured products.

The studies of financial innovation usually focused on the period from the 1960s to the 1980s when the financial market experienced an extraordinary growth in terms of the volume and products variations. Miller (1986) described this period as a unique period in the history of the U.S. when there was a remarkable flood of new instruments and institutions in financial market. Mishkin (1990) documented the growth of money market mutual funds which grew from an asset value of less than US$4 billion in 1977 to more than US$230 billion in 1982, and eventually exceeded US$300 billion in 1990. Such a dramatic surge in market value created an incredibly strong incentive for banks to develop innovative products.

The change in the market environment is considered as the driving force of financial innovation. Mishkin (1990) argued that it is the banks' nature to search for profits. The change in market environment, including dramatic interest rate volatility, technology advancement and regulatory restrictions on bank services, would lead to losing a source of funds for the banks, and reduce the banks' profits, which eventually induces the invention of financial products. Also, the constraint-induced model of Silber (1983) suggested that the financial innovation is the process of banks overcoming external or internal constraints, such as capital, regulatory and marketplace constraints. Specified the relationship between regulatory efforts and financial innovation, Kane (1985) proposed the "regulatory dialectic" that the product development is a back-and-forth process between banks and regulators. When regulators impose restrictions on the sale of financial products, the banks will in turn develop adaptive products to release the constraints. Among the studies of structured products, for example, Gabaix and Laibson's (2006) explanation of firms' shrouding behavior in the market environment consisting of myopic investors and Carlin's (2009) theory of increasing product complexity could be evidence of these theories.

Given that structured products were developed in the period of financial innovation, they should carry the desire functions prescribed to the innovations. Ross (1989) and Horne (1985) argued the main function of financial innovation is to ameliorate market imperfections. Horne (1985) defined the "truly innovative" financial products as a means to enhance market efficiency and completion. Horne (1985) suggested that market efficiency could be improved by innovations that reduce the transaction costs and market friction by replacing a tailor-made portfolio with standardized products to retail investors and reducing differential taxes and other deadweight losses in the financial processes. Ross (1989) suggested that financial innovation can complete the market by offering contingent payoffs which is not spanned by existing products and alleviate the agency conflict induced by the opaque institutional investors. Grinblatt and Longstaff (2000) suggested that the development of financial products could benefit the investors in terms of tax treatment. Tufano (2003) conducted an in-depth review of the literature on financial innovation that captured the history, definition and function decomposition of the process and outcomes.

## 3.2 Phenomenon of structured products

### *3.2.1 The Price Distortion*

In the literature of structured products, attention has been focused on the phenomenon of overpricing of the products. Over the last two decades, the studies of structured products achieved a consensus that structured products are offered to the retail investor with a significant premium on their fair value. This price premium of structured products could be interpreted as a negative anomaly return locked on the investors, which indicates market inefficiencies. In their study of capital protected products in the Swiss market, Wasserfallen and Schenk (1996) is the only exception suggesting that the structured notes were fairly priced. Other studies, in various markets including the U.S., Switzerland, Germany, the Netherlands, and other international markets around the globe, reported significant price distortion across multiple types of structured products.

In the U.S. market, Chen and Sears (1990) examined the pricing of S&P 500 Index Notes (SPINs) by decomposing the products into bonds and call option components. They reported that the market price for the SPINs issued in the period from 1986 to 1987 were approximately 5% overpriced in the first sub-period. Chen and Kensigner (1990) also drew a consistent conclusion on Market Index Certificates of Deposits (MICDs), an unlisted counterpart of SPINs, that they were sold with significant mispricing.

Henderson and Pearson (2011) analyzed the pricing of a particular type of structured products, Stock Participation Accreting Redemption Quarterly-pay Securities (SPARQS) and revealed an average of 8% overpricing against the retail investors and suggested that SPARQS are unlikely to serve as hedging instruments. This finding is confirmed by Bernard, Boyle and Gornall (2011) in their investigation of locally capped products focusing on their sales prospectuses and pricing structure. Bernard, Boyle and Gornall (2011) suggest that the structured product sold in U.S. often contained unrealistic forecasts of future scenarios which is in-line with Carlin's (2009) explanation of firm's exploiting investors by complex products.

Concerning the Swiss market, Burth, Kraus and Wholwend (2001) compared the pricing of all vanilla concave products outstanding at 1999 to their market value determined by equivalent strategies. They reported a significant price distortion that could be seen as a compensation of managerial cost to the issuing institutions. They also revealed different pricing behavior across issuers that indicates market inefficiency.

In the analysis of structured products without principal protection in both primary and secondary markets, Grunbichler and Wohlwend (2005) compared the underlying volatilities of the products with the comparable options on the European Exchange. They suggested the inefficiency of the market enables the product managers to exploit their quasi-monopolistic position.

Also, Jorgensen, Norholm and Skovand (2012) reviewed the cost structure and pricing efficiency of principal protected notes in the Danish retail market. In addition to the average 6% overpricing of the products, the authors captured a significant hidden cost component embedded in the products which could explain the pricing bias.

In Germany, Wilkens, Erner and Röder (2003) was the first study that considered the issuer's credit risk when investigating the reverse convertibles and discount certificates. Using an approach similar to Burth, Kraus and Wohlwend (2001), Wilkens, Erner and Röder (2003) valued the products based on duplication strategies using call options traded on the European Exchange, and identified a significant difference between the market price and duplication cost that is in favor of the issuers. Consistent with their findings, Baule, Entrop and Wilkens (2008) analyzed the discount certificates traded in the German secondary market focusing on the banks' credit risk. They obtained a relatively lower price premium compared to the earlier studies, but they found a significant association between the issuers' credit risk and the overpricing.

Bergstresser (2008) conducted a comprehensive study of structured products with a sample that covered more than 1,000,000 notes issued before 2008 including 314,000 outstanding notes across Europe, Asia and the U.S. Bergstresser (2008) investigated the performance pattern of structured notes over time and across issuers. Their results revealed the structured notes were associated with significant return premia in line with Henderson and Pearson (2011) and Szymanwska, Ter Horst and Veld (2009). Further analysis of this research suggested a significant variation in the premia across issuers, which indicates issuer-manipulation of product return.

Concerning Reverse Convertibles (RCs), Benet, Giannetti and Pissaris (2006) investigated a sample of 31 Reverse Exchangeable note issued on AMEX as of July 2003 by replicating the payout structure with a linear portfolio of exchange-traded securities. They suggested the RCs were sold at a significant premium in favor of issuing institutions, with issuer's credit risk and market completeness as the possible explanation of the pricing bias. Consistently, Szymanwska, Ter Horst and Veld (2009) found about 6% overpricing of RCs issued in the Amsterdam Stock Exchange in the period of 1999 to 2002, while Wallmeier and Diethelm (2009) captured an average overpricing of at least 3.4% for 468 Multi-Asset Barrier Reverse Convertibles (MBRCs) outstanding at 2007 in Switzerland. Their findings of pricing bias among RCs provide a theoretical ground for this study.

### *3.2.2 Product complexity, information shrouding and price distortion*

To investigate the mechanism of marketing overpriced structured products, some studies focused on the issuers' behavior. There are two main theories that explain the issuers' mechanism of exploiting retail investors of structured products: information shrouding and increasing product complexity.

In studying the firms' shrouding behavior in a competitive market, Gabaix and Laibson (2006) suggested the firms would try to exploit the unaware investors by hiding information from them during the sale of structured products. The authors proposed a theory that in the market with only rational consumers, shrouding add-on prices would deteriorate banks' profits as the rational investors could recognize the shrouded information and expect the worse from the firms. But the existence of myopic investors would promote information shrouding because of their inability of fully analyze all available information in the future game tree, which provides opportunities for the issuers to shroud the information. Based on Gabaix and Laibson's (2006) theory, there are two kinds of exploitations: the banks will exploit myopic investors with shrouded information and offer overpriced products, while the sophisticated investors will take advantages of exploitative firms. Gabaix and Laibson (2006) provided counter-evidence to Shapiro's (1995) theory that information shrouding cannot survive in the presence of competitive pressure. Shapiro (1995) suggested that the competitive firms would educate other firms' customers regarding product information, and offer efficient pricing schemes to them. Thus, the existence of competitive firms can eliminate information shrouding. Gabaix and Laibson (2006) showed that nobody has incentive to educate myopic investors and turn them into sophisticated customers. These myopes create equilibrium of information shrouding that is robust to competitive pressure, which is consistent with Célérier and Vallée (2013) that a competitive environment would further induce price distortion.

Concerning the source of product complexity, Carlin (2009) reported product complexity was intentionally introduced by the financial institutions to raise the price anomalies. Carlin (2009) relied on a theory consistent with the constraint-induced model suggested by Silber (1983) that the firms develop complex products to enhance their market power and relieve the competitive pressure. Focusing on the strategies of introducing complexity, Carlin (2009) suggested that firms would partition the prices into several sub-charges, or adopt technical languages for the price disclosure. These pricing strategies prevent the investors from fully analyzing the products and comparing their investment options. In fact, Deng et al. (2014) suggested that the auto-callable feature of structured notes prevent the notes from being evaluated by a closed-form equation and imposed uncertainty of estimated fair value. Also, Carlin and Manso (2011) suggested that a new product structure would reset investors' learning, which provides incentive to the financial institutions to introduce product complexity.

Built on Carlin's (2009) theory, Célérier and Vallée (2013) developed a systematic analysis of product complexity based on the payoff structure. In their analysis of product development, Célérier and Vallée (2013) observed a shift of marketing effort of exotic structured products into saving bank customers, who are considered to be less sophisticated. Measuring product complexity by possible payoff combinations, Célérier and Vallée (2013) observed a significant increase in product complexity even after the financial crisis of 2008, which is consistent with the finding of Carlin (2009). Célérier and Vallée (2013) also documented an association between product complexity and the profitability of issuers. The authors reported that the products with a higher degree of complexity were more profitable to the issuers and with lower ex-post performance. This finding suggested the complex products were associated with higher profit captured by the banks, which came from the variation of realized product return. Besides, Célérier and Vallée (2013) recognized the competitive pressure in the market for structured products also induced the issuers to develop more complicated products, which is in-line with Gabaix and Laibson's (2006) theory about information shrouding.

#### *3.2.3 Behavior biases and investors' irrationality*

In addition to firms' intention to offer mispriced structured products, some studies suggested that the investors' irrationalities also contribute to the equilibrium of overpriced structured products. Shefrin and Statman (1993) suggested that in the design and marketing of financial products, the banks had exploited the investors' behavioral biases. For example, based on the Prospect theory (Tversky & Kahneman, 1992), investors value losses significantly more than gains. Also, based on Hedonic framing (Bondt & Thaler, 1985), investors are likely to over-value multiple cash flows than one aggregative cash flow with the same amount. These two theories can be combined to explain the investors over-emphasis of guaranteed coupons.

In fact, Breuer & Perst (2007) explained investors' preference over discounted reverse convertibles and reverse convertible bonds based on prospect theory and hedonic framing. Breuer & Perst (2007) suggested that investors with bounded rationality over-weight the small probability of loss and over-valued discrete cash flows, and thus overly emphasize guaranteed coupon payments of reverse convertibles bonds. This finding is consistent with Wallmeier & Diethelm's (2009) result that there is a significant positive correlation between price distortion of multi-barrier reverse convertibles and their coupon levels. Wallmeier & Diethelm (2009) concluded that it is the behavioral biases of irrational investors towards coupon payments that contributes to the success of overpriced structured products. In addition, the investors' biases on products marketing, framing and representativeness are said as providing incentives to firms' exploitative behaviors and contributing to the price distortion of Grunbichler et al. (2005) and Szymanowska et al. (2009).

## 4 Theory and Hypotheses

The theory of this study begins with the puzzles of ACRCs' underperformance and the failure of the disclosure regulation. Based on the preliminary tests, the ex-post returns of ACRCs are found to be lower than that of the corresponding underlying assets. Specifically, the ACRCs are associated with a negative realized return of about -0.05% on average, while the underlying assets are found to have an average realized return of about 4.37%. There are about 95% of investors of ACRCs suffer a loss of capital. If the investors of ACRCs are rational and able to recognize the negative returns of these products, they would invest in the underlying assets instead. It is believed that this "underperforming" puzzle can be explained by the investors' inability to discover the actual return and risks of ACRCs from available information and so they do not recognize the performance of ACRCs, which is in-line with Carlin's (2009) theory about product complexity, and also with previous studies of structured notes overpricing.

The regulatory change in 2013 is presumed to improve the information disclosure of ACRCs. It requires the banks to disclose the estimated value of the structured product. The disclosed information could help the investors in discovering the return of ACRCs based on the estimated value. It is also a direct response to the studies reporting the overpricing of structured notes. Therefore, after 2013, the investors should be able to discover both the satisfactory and the unsatisfactory performance of ACRCs and require a better return of the products or they will abandon ACRCs. With the further protection of investors from the estimated value disclosure, the gap of return is expected to be reduced after the regulatory change in 2013.

However, from the t-test comparing the return difference between ACRCs with and without disclosure of estimated value, a contradictory result is identified. The negative return difference of the products with the estimated value disclosed are, instead of contracting, significantly broader than that of the products without disclosure. Given the issue of ACRCs also experienced a significant surge, an increased return difference suggests that the regulatory change did not function as expected, and the market of ACRCs is inefficient. Specifically, either the information disclosure is not improved, or the investors remain unable to identify the product return based on the disclosed estimated value. To facilitate further analysis, the return difference is specified as the return of ACRCs minus the return of the underlying assets, and named as "note return gain". This study also intends to solve the above "disclosure regulation failure" puzzle.

To further explain the puzzle of regulatory failure, this study hypothesizes that the investors of ACRCs have asymmetric information even after the regulatory change in 2013. There is critical information still shrouded by *The Bank* which is not explicitly stated in the offering documents nor captured by the estimated value. To explain *The Bank*'s rationale, this study relies on the theory of Mishkin (1990) that all banks are profit-driven in nature. The structured products, including ACRCs, are developed because of their profitability to the banks, and thus it is reasonable for *The Bank* to expect and maintain their profits from the structured products. Also, Silber's (1989) constraint-induced model and Kane's (1985) "regulatory dialectic" theory of financial innovation suggests that when there are regulatory constraints imposed on the banks which limit their profitability, *The Bank* would develop new financial products to overcome and relieve the regulatory pressure. Therefore, it is believed that *The Bank* would not forgo the profits obtained from ACRCs when the regulatory authority, the SEC, has further restricted the information disclosure in the sales and limited the room of profits. To avoid being spotted by investors and the SEC and suffering in any loss of market share, it is better for *The Bank* to modify existing products instead of developing a brand new structured product. Further, *The Bank* would require a greater profitability of the modified ACRCs to cover the R&D costs. Thus, it is believed that the regulatory change in 2013 has a negative impact on the variation of note return gain.

Hypothesis 1: the disclosure of the estimated value of ACRCs has negative impact on the variation of note return gain

Concerning the modification of ACRCs after the regulatory change in 2013, this study adopts the theory of information shrouding of Gabaix and Laibson (2006). Based on the work of Gabaix and Laibson (2006), the condition of banks' shrouding behavior is the existence of myopic investors or investors with bounded rationality in the market. These investors would create the equilibrium of information shrouding and promote overpriced structured products. As the market is likely to remain inefficient after the regulatory change in 2013, even if the information disclosure is improved, it is believed that *The Bank* is still able to generate profits by hiding critical information of ACRCs from retail investors. In other words, the disclosed estimated value cannot fully capture the expected return of ACRCs. The negative regulatory effect thus could be explained by the retail investors' inability to analyze the return of ACRCs because of (i) asymmetric information, or (ii) bounded rationality. As it is not able to control the rationality of investors, this study explains the puzzle by identifying the hidden information of ACRCs as the profiting mechanism of *The Bank* over ACRCs.

To explain the mechanism of information shrouding, it is hypothesized that the shrouded information should be the statistical attributes of the underlying assets, which is in-line with

Bergstresser (2008) that *The Bank* would manipulate the product returns by the underlying attributes. Although Jørgensen, Nørholm and Skovand (2012) had reported a significant hidden cost component embedded in principal protected notes in the Danish market, it is missing a clear relationship between the issuance cost of ACRCs and the product return. The banks may transfer the cost of issuance to the investors by providing smaller coupons, which are the major source of return of ACRCs. However, as the coupon is easily compared across products and issuers, the hidden cost component should not be the shrouded information that the issuers would manipulate to reduce the product performance. Meanwhile, the statistical attributes of the underlying assets, defined as the volatility, skewness and kurtosis of the returns of underlying assets, are not required to be disclosed and are obscure. Without an in-depth analysis of the past performance of the underlying assets, investors do not have the information to identify these ex-ante underlying attributes of ACRCs and may be unable to estimate the ex-post attributes.

Despite the obscureness, the underlying attributes play an important role in the product returns. According to the payoff structures of ACRCs, investors would obtain maximum return from the products if the price of the underlying assets remains in certain range. A product associated with a volatile asset is likely to have lower return than one associated with a stable asset given the underlying skewness. Thus, *The Bank* could issue ACRCs with significant gaps of return by selecting the underlying asset based on their underlying attributes (see Figure 4.1), and the investors would not be able to analyze these attributes of underlying asset. Furthermore, the underlying attributes are not necessarily captured in the valuation of ACRCs, and hence the disclosed estimated value might not reflect this information. It is hypothesized that *The Bank* shrouds the information of the statistical attributes of the underlying assets to increase the gap of return, and therefore the underlying attributes carry significant impact on the variation of note return gain.

Hypothesis 2: the variation of note return gain is affected by

- (H.2a) the underlying volatility
- (H.2b) the underlying skewness
- (H.2c) the underlying kurtosis

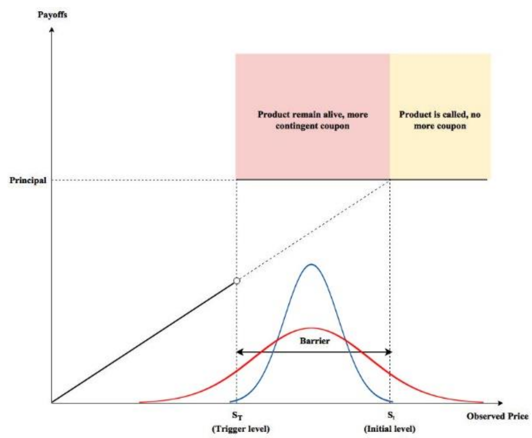


*Figure 4.1 Relationship between underlying attributes and payoffs of ACRCs*

Further, another profiting mechanism could be applied on ACRCs based on the underlying attributes. As the investors may not be able to accurately estimate the ex-post statistical attributes of underlying assets, *The Bank* could develop ACRCs with significant gaps of return by selecting underlying assets with inconsistent return patterns. Specifically, if the selected underlying assets experience significant changes in their return volatility, skewness and kurtosis, their ex-ante attributes may mislead investors' analysis of the product return. Therefore, in addition to the underlying attributes of ACRCs, the "shocks" of the underlying volatility and skewness should also explain the variation of the note return gain. A shock of an underlying attribute is defined as the ex-post attribute minus the ex-ante attribute.

Hypothesis 3: the variation of note return gain is affected by

- (H.3a) the shock of the underlying volatility
- (H.3b) the shock of the underlying skewness
- (H.3c) the shock of the underlying kurtosis

To verify the effects of the underlying attributes on the product performance, this study investigates the payoff structure of the products. According to the payoff structure of ACRCs, there are three features directly affecting the return of the products, which are (i) the auto-callable feature, (ii) the contingent coupons and (iii) the convertibility. Recalling that ACRCs are called if any observed price of underlying asset exceeds its initial price, which will cancel all future coupons. Also, if the observed price hits below the trigger level, the investors will not receive the coupon, but the product remains alive. Third, if the final observed price hits below the trigger level, in addition to the loss of coupon, the ACRC will be converted into its underlying asset at the final price and *The Bank* will pay the cash value of the converted assets to the investors, which could be significantly less than the principal. Therefore, the performance of the underlying assets directly affects the return of ACRCs through these product features. It is hypothesized that the underlying attributes as well as their shocks affect the probability of the exercise of these features if they have an impact on the return difference of ACRCs.

Hypothesis 4: the probability of ACRCs being called is affected by

- (H.4a) the underlying volatility
- (H.4b) the underlying skewness
- (H.4c) the underlying kurtosis
- (H.4d) the shock of the underlying volatility
- (H.4e) the shock of the underlying skewness

- (H.4f) the shock of the underlying kurtosis

Hypothesis 5: the probability of ACRCs being converted is affected by

- (H.5a) the underlying volatility
- (H.5b) the underlying skewness
- (H.5c) the underlying kurtosis
- (H.5d) the shock of the underlying volatility
- (H.5e) the shock of the underlying skewness
- (H.5f) the shock of the underlying kurtosis

Hypothesis 6: the probability of coupon loss is affected by

- (H.6a) the underlying volatility
- (H.6b) the underlying skewness
- (H.6c) the underlying kurtosis
- (H.6d) the shock of the underlying volatility
- (H.6e) the shock of the underlying skewness
- (H.6f) the shock of the underlying kurtosis

Finally, as it is hypothesized that there is information shrouding of ACRCs' performance remaining after the estimated value of the product is disclosed. It means that the estimated value does not capture all critical information of ACRCs, which significantly affects the product performance. Also, the fact that the ACRCs remain underperformed after the regulatory change suggests that the estimated value is not able to explain the note return gain.

Hypothesis 7: The estimated value is related to

- (H.7a) the probability of ACRCs being called
- (H.7b) the probability of conversion, and
- (H.7c) the probability of coupon loss
- (H.7d) the volatility of the underlying asset
- (H.7e) the skewness of the underlying asset
- (H.7f) the kurtosis of the underlying asset

Hypothesis 8: The estimated value does not affect the variation of the note return gain

# 5 Methodology and Data

### 5.1 Empirical situation

The sample of this study are the ACRCs issued by an anonymous bank (*The Bank*). The primary data of this study consists of 3,681 issues of ACRCs issued from 2011 and matured before the end of 2016. According to Bloomberg Brief, *The Bank* is one of the top-20 largest issuers of structured products around the globe in the first quarter of 2017.

ACRCs are experiencing a growth in the retail market of structured products. According to Deng et al.'s (2014) empirical analysis of structured products in the U.S., ACRCs was first introduced to the market in 2011. Since then, the issuing volume of ACRCs has increased over years, and, in 2013, the issuance of ACRCs dominated the other three types of reverse convertibles. The sample of this study also captures a developing trend of ACRCs consistent with Deng et al. (2014). Throughout the period from 2011 to 2014, the issuance of ACRCs by *The Bank* experienced a continuous upward trend. In our sample, the amount of ACRCs issued grew from about US$51 million in 2011 to more than US$330 million in 2014. Based on the theory of Célérier and Vallée (2013), the development of complicated structured products indicates the banks' profitability. Thus, it is believed that the growing trend of ACRCs reflects their profitability, which, by the proposed theory, is the gap between realized product return and the return of the underlying asset. Therefore, the market growth of ACRCs make it a suitable subject for this study.

However, time and resource constraints of this study limited the data collection of ACRCs to single issuer. In the U.S. market for structured products, there is yet to develop a comprehensive database which allows researchers to access the product-specified data of structured notes like the EUSIPA database in the European market. The only available source of product information is the SEC filing system of registered-notes, which contains the offering documents for all SEC-registered financial products. The offering documents collected need to be further processed into an analyzable dataset. As what will be discussed in the next section, the data collection and treatment consist of transforming the product information from each Prospectus into a comprehensive dataset, which requires substantial effort and resources. Also, the Prospectus files are in various formats across products and issuers, which requires extra-effort to be analyzed. Thus, based on the limited time and resource of this study, it is unable to consider multiple issuers of ACRCs in the sample.

### 5.2 Data collection and treatment

The data collection and treatment of this study relies heavily on an algorithm in collecting, screening, sorting and parsing the offering documents of ACRCs, and in converting the product information into an aggregated database. The entire process of data collection and cleaning can be categorized into 3 phases.

In the Phase I, the original prospectus document of each note is collected from the Edgar database provided by the U.S. Securities and Exchange Commission (SEC). The master index file of Edgar stores all filing information from 1994Q3 to the present including the path of filed documents, document type, date of filing, name of filer and corresponding CIK code, etc. In the master index, the documents filed by *The Bank* are identified by the CIK number, and the Prospectus files are found by “424B2” as the document type. All prospectus files from *The Bank* are downloaded using the corresponding location in the master index.

The goal of Phase II is to convert the prospectus documents into an excel file for further analysis. It begins with identifying all offering documents of the ACRCs by a key word search using “optimization” and “callable”. The first key word comes from “optimization notes” and “optimization securities” which are the common name of reverse convertibles used by *The Bank* while the second key word is used to identify all reverse convertibles containing an (auto-)callable feature. Then, the prospectus files are trimmed by removing redundant sections such as payoff scenarios and disclaimers. Only the tables containing key product features are retained. Each file is then iterated by the algorithm and converted to an aggregated Excel file.

In the Phase III, the data treatment and collection of market data are conducted simultaneously. First, based on the specified focus of this study, the products without auto-callable feature are dropped. Second, the underlying assets are broken down into underlying asset type and the company issuing the asset. To simplify the collection of market data, only products linked to common stock are kept and the corresponding 8-digit CUSIP numbers are identified by matching the company name with the list of CUSIPs obtained from the CRSP databased. Third, the daily closing price and adjusted daily return in the period from 2008 to 2016 of each CUSIP number are collected. The products that matured after December 31, 2016 are dropped from the dataset because of the limited availability of the daily stock price. Using the daily stock price, the total cash flow and the holding period return of each ACRC is computed according to the payoff structure, together with the holding period return for the underlying assets calculated by compounding the daily return throughout the holding period. Fourth, the daily composition level and dividend-adjusted returns of the S&P500 and the NASDAQ are obtained from the CRSP database and the holding period market returns are calculated by the change of the daily index between the trading date and the final valuation date. Also, this study adopts the 1-year T-bill rate obtained from the Federal Reserve data as the risk-free rate. Because of the relatively small scale, this study has not considered the daily compounding approach to calculate the holding period risk-free return, but uses the holding-period-adjusted risk-free rate on the trading date instead. Finally, other control variables are constructed as discussed in next section.

## 5.3 Variables construction

This section defines and illustrates the construction of variables included in the data analysis. As this study investigates the return difference of ACRCs from both ex-ante and ex-post approaches, some variables consist of both ex-ante and ex-post specifications. Ex-ante variables are defined as the product information determined based on the pre-sale information of ACRCs, and ex-post variables are the realized information reflecting the actual value during the holding period.

### *5.3.1 Note returns gain*

The note returns gain is the key dependent variable that this study intends to explain. It measures the “performance” of ACRCs that is the gap between the realized return of ACRCs and that of the underlying assets. The realized return of ACRCs are determined by the actual cash inflows obtained by investors throughout the holding period and the costs of ACRCs, i.e.

$$Return_{ACRC} = \frac{total\ cash\ inflow\ over\ the\ holding\ period}{total\ prinicpal\ invested} - 1$$

Also, the return of the underlying assets is the compounded daily return $r_i$ throughout the same n-days holding period, i.e.

$$Return_{underlying} = \prod_{i}^{n}(1 + r_i) - 1$$

The note returns gain, $NR_{gain}$, or return difference, is further adjusted by the risk-free rate $r_f$,, i.e.

$$NR_{gain} = Return_{ACRC} - Return_{underlying} - r_f$$

Where the risk-free rate is the 1-year T-bill rate on the date of issue adjusted by the holding period.

*5.3.2 Disclosure of estimated value*

The disclosure variable is a dummy that indicates whether the estimated value is disclosed in the Prospectus, i.e.

$$DISC = \begin{cases} 1, if\ the\ estimated\ value\ is\ disclosed \\ 0, if\ no\ estimated\ value\ is\ disclosed \end{cases}$$

*5.3.3 Underlying volatility, skewness and kurtosis*

From the theory and hypotheses, it is hypothesized that the underlying attributes are correlated to the variation of the note return gain. In the data analysis, in addition to the underlying volatility and skewness, the underlying kurtosis is also included as a control. The underlying volatility, skewness and kurtosis on day *i* are defined as the volatility, skewness and kurtosis of the daily return of the underlying asset computed by the dividend-adjusted daily returns on day *i* through a 252-days window. Also, day *e* refers to the date of trading and day *r* refers to the last observation date or the call date. i.e.

$$VOL_e = ex\ ante\ volatility\ of\ the\ underlying\ daily\ return$$

$$VOL_r = ex\ post\ volatility\ of\ the\ underlying\ daily\ return$$

$$SKW_e = ex\ ante\ skewness\ of\ the\ underlying\ daily\ return$$

$$SKW_r = ex\ post\ skewness\ of\ the\ underlying\ daily\ return$$

$$KUR_e = ex\ ante\ kurtosis\ of\ the\ underlying\ daily\ return$$

$$KUR_r = ex\ post\ kurtosis\ of\ the\ underlying\ daily\ return$$

Further, the shocks of volatility, skewness and kurtosis are the differences between the realized value and the expected value, i.e.

$$VOL_{shock} = VOL_r - VOL_e$$

$$SKW_{shock} = SKW_r - SKW_e$$

$$KUR_{shock} = KUR_r - KUR_e$$

The underlying attributes with subscripts e, r and shock are also named as ex-ante, ex-post and the "shock" specification of the attributes respectively.

*5.3.4 Final status, Auto-callable feature, conversion of underlying asset and loss of coupons*

In the raw dataset, there is a 3-level categorical variable, named as "*final status*", capturing the status of the ACRCs at maturity. The *final status* equals to "1" if the product is called in advance, "0" if the final observed price of the underlying asset lies between the initial price and the trigger price and the product is not converted into the underlying asset, and "-1" if the product is converted into the underlying asset and the investors lose a part of the principal. This categorical variable is transformed into 2 dummy variables in the regression models, in which the *CALL* variable captures the called products and the *CONV* variable captures the converted products. i.e.

$$CALL = \begin{cases} 1, if\ the\ product\ is\ called\ in\ advance \\ 0, if\ the\ product\ is\ not\ called \end{cases}$$

$$CONV = \begin{cases} 1, if\ the\ product\ is\ converted\ into\ the\ underlying\ asset\ at\ maturity \\ 0, if\ the\ product\ is\ not\ converted \end{cases}$$

Based on the product's structure, a ACRC might contain multiple observations and each observation is associated with a contingent coupon. If the observed price of the underlying asset hits below the trigger price on any observation, the investors will lose the corresponding coupon. Thus, in the life-cycle of ACRCs, the investors may lose more than one coupon payment. The number of coupon payments lost is captured by a discrete variable LOSS, i.e.

$LOSS = Total\ number\ of\ coupon\ payment\ lost$, where,

$$0 \leq LOSS \ \leq Number\ of\ Observations, \forall\ LOSS\ \in \mathbb{N}$$

Note that, although the investors might not obtain all the contingent coupons if the product is called, the coupons lost due to the auto-callable feature are not counted into *LOSS*. As a ACRC is considered as terminated once it is called, the future coupons are not considered as a loss of coupon. Thus, *LOSS* only captures the coupons lost due to the observed price hitting below the trigger level. The loss of coupons due to the auto-callable feature is controlled by another variable discussed in next section.

*5.3.5 Market excess returns*

In the data analysis, the market excess return is included in the regression models to control the market fixed effects on the return of the underlying asset. Because it is based on the CAPM theory, the asset expected return is correlated with the market return premium. If the market experiences an upward trend, it is likely that the asset return will be in similar direction and the return of ACRCs would be lower than expected, and vice versa. To control for the market effect, we included the market return premium defined as the risk-free-rate-adjusted percentage change of the market *i* index (*I*) *on* the date of trade (issue date) to the final valuation date or call date, i.e.

$$MKT_i = \frac{I_{final} - I_{trade}}{I_{trade}} - r_f$$

*5.3.6 Other product features*

Other product features of ACRCs disclosed in the Prospectus are included in the data analysis as control variables. The notation and description of these variables are as follows:

$$SIZE = issuing\ volume\ of\ the\ product, scaled\ in\ millions$$

$$BAR = barrier\ of\ the\ product = 1 - \frac{trigger\ level}{initial\ level}$$

$$COST = disclosed\ issuing\ costs$$

$$CPN = coupon\ rate\ per\ payment$$

$$TERM = expected\ lifetime\ of\ the\ product, in\ months$$

$$LIFE = realized\ lifetime\ of\ the\ product, in\ months$$

$$OBSDUR = duration\ between\ each\ observation, in\ months$$

$$OBSCNT = expected\ number\ of\ observations$$

$$OBSRLZ = realized\ number\ of\ observations$$

$$BEV = bank's\ estimated\ value = \frac{disclosed\ estimated\ value}{principal - COST}$$

Because the ACRC may be called during the holding period, the actual number of observations and the actual lifetime of the products may not be the same as they are prescribed in the Prospectus. This study tries to capture both expected and realized effects of the product features, and 2 variables for the product lifetime and the number of observation are constructed. The *OBSCNT* and *OBSRLZ* variables control the loss of coupons if the product is called.

To illustrate the difference between expected and realized observations (*OBSCNT*, *OBSRLZ*), and the number of coupons lost (*LOSS*), suppose there is a 12-month ACRC paying monthly contingent coupons. In the Prospectus, the initial level is $12.00, and the trigger level is $10.50. During the holding period, the prices of underlying asset are observed as follow:

| **Months** | **1$^{st}$** | **2$^{nd}$** | **3$^{rd}$** | **4$^{th}$** | **5$^{th}$** | **6$^{th}$** | **7$^{th}$** | **8$^{th}$** | **9$^{th}$** | **10$^{th}$** | **11$^{th}$** | **12$^{th}$** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Price ($)** | 10.00 | 9.30 | 11.00 | 11.20 | 11.15 | 12.10 | - | - | - | - | - | - |

Based on the payoff structure, the investors do not receive coupons at the first and second months, and the product is called at the 6$^{th}$ month. Under this circumstance, *LOSS* = 2 (1$^{st}$ and 2$^{nd}$ month), *OBSCNT* = 12 and *OBSRLZ* = 6 (1$^{st}$ – 6$^{th}$ month). We also know that the investors receive coupons 4 times (*OBSRLZ – LOSS = 6 – 2 = 4*).

## 5.4 Data analysis and Models specification

### *5.4.1 Preliminary tests*

The data analysis of this study begins with several preliminary tests. The first test is a paired t-test that compares the realized return of ACRCs (*Note return*) and the return of their underlying assets (*Asset return*) from the aggregate sample. Other three 2-sample t-tests compare the note return, asset return and note returns gain ($NR_{gain}$) of the ACRCs between the sub-sample of ACRCs without and with the disclosure of the estimated value (*DISC = 0* and *DISC =1*). The null hypothesis of the paired t-test is that the mean of product returns equals to the mean of asset returns, and the null hypothesis of the 2-sample t-test is that the mean of note returns gain of the ACRCs with disclosed estimated value equals to that without such disclosure.

As discussed in the theory section, the first t-test is intended to reveal the relationship between the product return and the asset return, and the relationship between the volatilities. The 2-sample t-tests are conducted to examine the change in the note and the asset performances after the disclosure regulation. These tests provide a basic understanding of the effect of regulatory change in 2013 and direct the theory development of this study. In the theory development, the test results uncover puzzles of the performance of ACRCs.

*5.4.2 Linear regressions*

To investigate the impact of disclosure regulation on the note return gain as suggested by Hypothesis 1, a linear regression is conducted with the note return gain as the dependent variable and the disclosure dummy as the independent variable. As suggested by the theory, the linear model is further expanded by the underlying attributes of the products to verify Hypotheses 2 and 3. Also, other control variables, including dummies of called and converted products, number of coupons lost and variables of product features, are added into the model. In order to investigate the puzzle from both ex-ante and ex-post perspectives, the ex-ante model includes the expected variables while the ex-post model includes the realized variables as follows:

$$\begin{aligned} NR_{gain} = \alpha &+ \beta_1 DISC + \beta_2 VOL_e + \beta_3 SKW_e + \beta_4 KUR_e + \beta_5 CALL + \beta_6 CONV \\ &+ \beta_7 LOSS + \beta_8 MKT + \beta_9 BAR + \beta_{10} COST + \beta_{11} CPN + \beta_{12} TERM \\ &+ \beta_{13} OBSDUR + \beta_{14} OBSCNT + \beta_{15} SIZE + \varepsilon \end{aligned} \tag{1}$$

$$NR_{gain} = \alpha + \beta_1 DISC + \beta_2 VOL_r + \beta_3 SKW_r + \beta_4 KUR_r + \beta_5 CALL + \beta_6 CONV + \beta_7 LOSS + \beta_8 MKT + \beta_9 BAR + \beta_{10} COST + \beta_{11} CPN + \beta_{12} LIFE + \beta_{13} OBSDUR + \beta_{14} OBSRLZ + \beta_{15} SIZE + \varepsilon \quad (2)$$

As well, in response to Hypotheses 4 and 5, another linear model that replaces the underlying attributes by the shocks of the attributes in the ex-post model is estimated by a linear regression. i.e.:

$$NR_{gain} = \alpha + \beta_1 DISC + \beta_2 VOL_{shock} + \beta_3 SKW_{shock} + \beta_4 KUR_{shock} + \beta_5 CALL + \beta_6 CONV + \beta_7 LOSS + \beta_8 MKT + \beta_9 BAR + \beta_{10} COST + \beta_{11} CPN + \beta_{12} LIFE + \beta_{13} OBSDUR + \beta_{14} OBSRLZ + \beta_{15} SIZE + \varepsilon \quad (3)$$

To examine the modification mechanism of ACRCs, a sub-sample analysis is conducted by estimating a similar set of models by sorting the samples into 2 sub-samples using the disclosure dummy (*DISC)*. According to the theory of this study, a different set of relationships between regressors and regressand is expected, especially for the underlying attributes.

In estimation of the above models, both the S&P and the NASDAQ composition indexes are adopted to compute the market premium as a robustness comparison. A similar pattern was identified and the S&P composite index was retained as the market premium in further analysis.

*5.4.3 Probit regressions*

Probit regressions are conducted in response to Hypotheses 6 – 17. As discussed above, the relationships between the probability of calling, converting of ACRCs and cancelling coupons, and the product attributes are essential to confirm the effect of the underlying attributes on the variation of note return gain. Thus, the follow probit models are estimated:

$$CALL = \alpha + \beta_1 DISC + \beta_2 VOL_x + \beta_3 SKW_x + \beta_4 KUR_x + \beta_5 MKT + \beta_6 SIZE + \beta_7 BAR + \beta_8 COST + \beta_9 CPN + \beta_{10} LIFE + \beta_{11} OBSDUR + \beta_{12} OBSRLZ + \varepsilon \tag{4}$$

$$CONV = \alpha + \beta_1 DISC + \beta_2 VOL_x + \beta_3 SKW_x + \beta_4 KUR_x + \beta_5 MKT + \beta_6 SIZE + \beta_7 BAR + \beta_8 COST + \beta_9 CPN + \beta_{10} LIFE + \beta_{11} OBSDUR + \beta_{12} OBSRLZ + \varepsilon \tag{5}$$

$$LOSS = \alpha + \beta_1 DISC + \beta_2 VOL_x + \beta_3 SKW_x + \beta_4 KUR_x + \beta_5 MKT + \beta_6 SIZE + \beta_7 BAR + \beta_8 COST + \beta_9 CPN + \beta_{10} LIFE + \beta_{11} OBSDUR + \beta_{12} OBSRLZ + \varepsilon \tag{6}$$

$\forall x \in \{e, r, shock\}$

Similarly, a further sub-sample analysis is conducted with *DISC* dropped in the models. There are 9 models in the full sample analysis and 18 models in the sub-sample analysis.

Subsequence t-tests of the underlying attributes are required to explain the positive relationship between the underlying volatility and the note return gain as well as the probability of the product being call, which is opposite to our presumption described in Figure 3. A series of 2-sample t-tests are conducted that compare the underlying volatility, skewness and kurtosis, in the expected, realized and "shock" specifications, before and after the regulatory change in 2013. There are 9 t-tests conducted.

*5.4.4 Disclosed estimated value analysis*

Finally, to further verify the interpretation of the results in response to Hypotheses 18 and 19, this study estimates the linear relationship between the disclosed value (BEV) and other product attributes. Any insignificant relationship identified means that the estimated value has not captured the information of the corresponding variables, and if that variable carries significant impact on the note return, it suggests there is critical information hidden beyond the estimated value. A linear regression of note return gain that extends Models 1 – 3 by the disclosed value could further verify the idea.

$$BEV = \alpha + \beta_2 VOL_x + \beta_3 SKW_x + \beta_4 KUR_x + \beta_5 CALL + \beta_6 CONV + \beta_7 LOSS + \beta_8 MKT + \beta_9 BAR + \beta_{11} CPN + \beta_{12} LIFE + \beta_{13} OBSDUR + \beta_{14} OBSRLZ + \beta_{15} SIZE + \varepsilon \tag{7}$$

$$NR_{gain} = \alpha + \beta_2 VOL_x + \beta_3 SKW_x + \beta_4 KUR_x + \beta_5 CALL + \beta_6 CONV + \beta_7 LOSS + \beta_8 MKT + \beta_9 BAR + \beta_{10} COST + \beta_{11} CPN + \beta_{12} LIFE + \beta_{13} OBSDUR + \beta_{14} OBSRLZ + \beta_{15} SIZE + \beta_{16} BEV + \varepsilon \tag{8}$$

$\forall x \in \{e, r, shock\}$

***Table 6.1.1 Descriptive statistics***

| Column | (1) Full sample | | (2) DISC = 0 | | (3) DISC =1 | |
|---|---|---|---|---|---|---|
| **Variable** | **Mean** | **Std. Dev.** | **Mean** | **Std. Dev.** | **Mean** | **Std. Dev.** |
| ***$NR_{gain}$*** | -0.0497 | 0.1746 | -0.0385 | 0.1593 | -0.0588 | 0.1857 |
| ***DISC*** | 0.5509 | 0.4975 | - | - | - | - |
| ***CALL*** | 0.7851 | 0.4108 | 0.8106 | 0.3919 | 0.7643 | 0.4245 |
| ***CONV*** | 0.1138 | 0.3176 | 0.0581 | 0.2340 | 0.1593 | 0.3660 |
| ***LOSS*** | 0.5075 | 1.3562 | 0.3527 | 1.2082 | 0.6336 | 1.4539 |
| ***$VOL_e$*** | 0.0253 | 0.0107 | 0.0248 | 0.0070 | 0.0257 | 0.0130 |
| ***$VOL_r$*** | 0.0245 | 0.0084 | 0.0231 | 0.0065 | 0.0256 | 0.0095 |
| ***$VOL_{shock}$*** | -0.0008 | 0.0085 | -0.0017 | 0.0046 | 0.0000 | 0.0106 |
| ***$SKW_e$*** | 0.2227 | 1.5178 | 0.0434 | 0.7641 | 0.3688 | 1.9129 |
| ***$SKW_r$*** | 0.0067 | 1.2862 | -0.0489 | 0.8446 | 0.0520 | 1.5548 |
| ***$SKW_{shock}$*** | -0.2160 | 1.2553 | -0.0923 | 0.6587 | -0.3168 | 1.5762 |
| ***$KUR_e$*** | 7.1511 | 16.2596 | 3.3310 | 5.8899 | 10.2648 | 20.7388 |
| ***$KUR_r$*** | 6.1734 | 12.2058 | 3.8322 | 6.9210 | 8.0816 | 14.9439 |
| ***$KUR_{shock}$*** | -0.9777 | 13.0965 | 0.5012 | 3.8927 | -2.1832 | 17.1989 |
| ***$MKT_{SP}$*** | 0.0622 | 0.0627 | 0.0885 | 0.0696 | 0.0409 | 0.0466 |
| ***$MKT_{NQ}$*** | 0.0780 | 0.0795 | 0.1002 | 0.0941 | 0.0600 | 0.0596 |
| ***TERM*** | 13.5713 | 3.3738 | 12.0000 | 0.0000 | 14.8521 | 4.1243 |
| ***LIFE*** | 6.4382 | 5.0206 | 5.7528 | 4.0607 | 6.9969 | 5.6239 |
| ***CPN*** | 0.0307 | 0.0135 | 0.0299 | 0.0139 | 0.0315 | 0.0132 |
| ***OBSCNT*** | 5.1296 | 2.2649 | 5.1754 | 2.7181 | 5.0922 | 1.8134 |
| ***OBSRLZ*** | 2.2684 | 2.0091 | 2.2341 | 2.0585 | 2.2964 | 1.9680 |
| ***OBSDUR*** | 0.0980 | 0.0382 | 0.0907 | 0.0313 | 0.1039 | 0.0422 |
| ***BAR*** | 0.2897 | 0.0686 | 0.2870 | 0.0748 | 0.2919 | 0.0630 |
| ***SIZE*** | 0.2327 | 0.2116 | 0.1929 | 0.1496 | 0.2652 | 0.2464 |
| ***BEV*** | 0.9788 | 0.0062 | - | - | 0.9788 | 0.0062 |
| ***COST*** | 0.1445 | 0.0141 | 0.1430 | 0.0150 | 0.1457 | 0.0132 |
| ***N*** | 3,681 | | 1,653 | | 2,028 | |

*Table 6.1.1 Descriptive Statistics*

*This table reports the mean and standard deviation of the variables of regression models. Column 1,2 and 3 are reporting the statistics of full sample, sub-sample of ACRCs without disclosure of estimated value and sub-sample of ACRCs with disclosure of estimated value. The reported variables include note return gain (NRgain), disclosure dummy (DISC), dummy of called products (CALL), dummy of conversion (CONV), coupon loss count (LOSS), underlying volatility (VOL), underlying skewness (SKW), underlying kurtosis (KUR), market premium of S&P500 (MKTsp) and NASDAQ (MKTnq), expected term (TERM), realized holding period (LIFE), expected observations (OBSCNT), realized observations (OBSRLZ), duration between each observations (OBSDUR), issuing volume (SIZE), bank's disclosed estimated value adjusted by principal and cost (BEV), and disclosed cost (COST). The sub-scripts e, r and shock of underlying attributes represent ex-ante, ex-post and the shock specifications respectively. The less column reporting the number of observations in the sample or sub-sample.* The bottom row indicates the sample size (N).

# 6 Empirical Findings

## 6.1 Data description

In table 6.1.1, the mean of note returns gain ($NR_{gain}$) in the full sample is about -0.05, which means, on average, the ACRCs in the sample are generating 5% return premium to *The Bank*, and this average return premium before and after the regulatory change in 2013 is about 3.85% and 5.88% respectively. Also, the means of CALL and CONV dummy suggest that about 78.5% of the ACRCs in the sample are called while 11.4% are converted into underlying assets. In other words, only 1 out of 10 notes is not called or converted. On average, each note is expected to lose 0.5 times of the coupon payment throughout the holding period.

Further, regarding the product features, the average expected term of the ACRCs (TERM) is about 13.5 months, but the mean of actually holding period (LIFE) is 6.44 months, which indicates that, on average, investors only hold ACRCs for about half of the expected holding length. The comparison of OBSCNT and OBSRLZ variables also shows a consistent result. While the notes have about 5 observations on average, the products are observed only 2.27 times. Both TERM-LIFE, and OBSCNT-OBSRLZ comparisons reveal that the investors are unlikely to hold the products until their maturity, which is expected considering the ratio of ACRCs being called or converted. Note that, ACRCs are only sold in primary market from the issuers, thus the reduced actual holding period only reflects the products being called.

In the sample of ACRCs, the overall average issuing volume is about US$0.23 million, while the issuing volume increased from US$0.19 million to US$0.27 million after the regulatory change. On average, *The Bank* provides 30% of initial level as the barrier of ACRCs, and about 3% coupon per payment.

***Table 6.2.1.1 Preliminary T-tests***

| | Variable | Min. | Max. | Mean | t-stat |
|---|---|---|---|---|---|
| **Panel A** | ***Note return*** | -0.8695 | 0.2882 | -0.00516 | |
| | ***Asset return*** | -0.9648 | 0.6989 | 0.04370 | |
| | ***Difference*** | | | -0.04886 | -16.9437 |
| **Panel B** | ***Note return, DISC = 0*** | -0.8695 | 0.2773 | 0.03190 | |
| | ***Note return, DISC = 1*** | -0.8689 | 0.2882 | -0.03538 | |
| | ***Difference*** | | | 0.06728 | 11.8218 |
| **Panel C** | ***Asset return, DISC = 0*** | -0.8836 | 0.5999 | 0.06971 | |
| | ***Asset return, DISC =1*** | -0.9648 | 0.6989 | 0.02250 | |
| | ***Difference*** | | | 0.04721 | 5.8756 |
| **Panel D** | ***NRgain, DISC = 0*** | -0.5484 | 0.6513 | -0.03853 | |
| | ***NRgain, DISC = 1*** | -1.4063 | 1.0710 | -0.05875 | |
| | ***Difference*** | | | 0.02022 | 3.5002 |

*Table 6.2.1.1 Preliminary t-tests*

*This table illustrates the result of multiple t-test. Panel A compares the overall note return and asset return. Panel B, C and D compare the note return, asset return and note return gain, before and after the regulatory change, respectively.*

## 6.2 Regression results and analysis

### *6.2.1 Preliminary tests*

Table 6.2.1.1 illustrates the result of t-tests as the preliminary test of this study. The panel A shows that the realized return of ACRCs is significantly less than the realized return of underlying assets for about 4.89%. This result suggests that, on average, ACRCs are less profitable than the underlying asset. From Panel B and C, it is observed that the investors of ACRCs are suffered in return deterioration from 3% to -3% after the regulatory change in 2013, while the investors in the underlying assets still obtained a 2% return after the change.

Also, in panel D, there is a significant difference between the note return gain ($NR_{gain}$) of the ACRCs with disclosure of an estimated value and those without such disclosure. The average note return gain for the products disclosed estimated value is 2% less than those without disclosure suggesting that the ex-post performance of ACRCs after the regulatory change in 2013 is worse than before, and *The Bank* obtains more profit from ACRCs after the change.

Figure 6.2.1.1 illustrates the distributions of note return gain of the full sample and sub-sample without and with estimated value disclosure. It is observed that the note return gains are slightly left skewed from 0, which means most the investors of ACRCs obtain return less than the investors underlying assets.

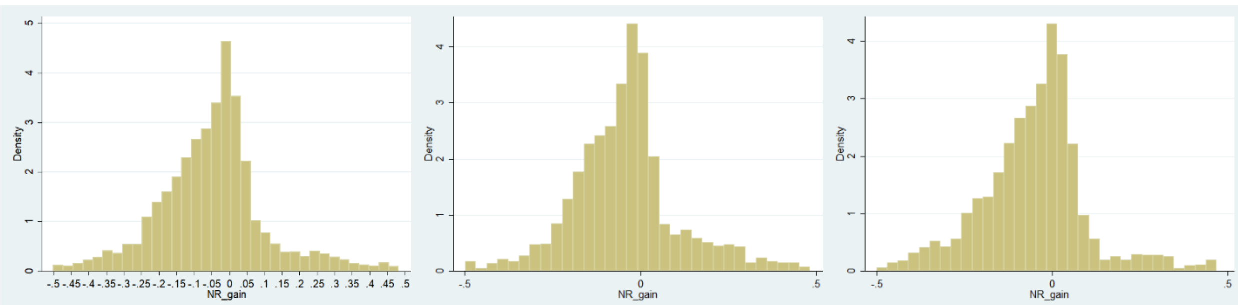


*Figure 6.2.1.1 Note return gain distributions of Full sample, sub-sample without and with estimated value disclosure*

*6.2.2 Full sample linear regressions*

Based on the results of full sample linear regression of note return gain (Table 6.2.2.1), Hypotheses 2 and 3 are found partially supported by the estimation. Although the ex-ante underlying volatility, skewness and kurtosis are insignificant to explain the variation of note return gain, the realized and the shock of these underlying attributes are found carrying significant effects on the note return gain. The insignificant ex-ante underlying attributes also suggest that the investors are not able to predict the note return gain based on ex-ante information, while the ex-post underlying attributes do affect the return of ACRCs.

Among these significant underlying attributes, the negative coefficients of realized skewness and kurtosis ($SKW_r$, $KUR_r$) means the right-skewness and evenly-distributed-tendency of underlying return during the holding period would reduce the return gained from ACRCs over the underlying assets. Also, the negative impacts of the underlying skewness and kurtosis shocks indicate that the increase in skewness and kurtosis during the holding period will also reduce the note return gain. These effects are matched with the payoff structure of ACRCs that if the returns of the underlying asset skew to the right or are more evenly distributed, the product is more likely to be called or converted to the underlying assets. Again, the investors of ACRCs would be in the best payoff scenario only if the average return of the underlying asset lies within zero and the barrier, such that the price of the underlying asset remains in the range from the trigger level to the initial level.

Further, other significant control variables are found to have effects as expected. For example, the called and converted products are found to have less note return gain, which is consistent with the payoffs structured of ACRCs. It also means that the investors could receive a better note return if the product is not called and converted. The similar coefficients and significance of variables when the NASDAQ composition index is adopted to compute the market premium suggests the model is robust to different market indexes.

At first glance, the positive significant effects of the realized and the shock of volatility may not be reasonable as the increase in underlying volatility may be associated with an increase in the probability of the product being called or converted. However, it is in fact reasonable as the increase in underlying volatility would reduce the probability of call. Recalling the payoff structure of ACRCs, the product is called when the observed price is above the initial level. In other words, the product will be called if the aggregative underlying return is greater than 0. To satisfy this condition, the shift in volatility is not necessary because as long as the asset price remains stable but right-skewed, the product is likely to be called. In contrast, if the asset price is right-skewed but volatile, the underlying return is more likely to stay within the barrier. Therefore, the volatility of the underlying return is expected to have negative impact on the probability of the product being called. Given that about 80% of the ACRCs ended up being called, the positive effects of underlying volatility on note return gain is reasonable.

***Table 6.2.2.1 Linear regressions of note return gain***

| $NR_{gain}$ | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $MKT_{SP}$ | -0.0741 | -0.280*** | -0.349*** | | | |
| | -1.75 | -6.33 | -8.16 | | | |
| $MKT_{NQ}$ | | | | -0.103** | -0.243*** | -0.307*** |
| | | | | -3.28 | -7.6 | -9.79 |
| *DISC* | -0.00754 | -0.0207*** | -0.0307*** | -0.00888 | -0.0181*** | -0.0277*** |
| | -1.32 | -4.06 | -6.05 | -1.61 | -3.71 | -5.74 |
| $VOL_e$ | -0.491 | | | -0.587 | | |
| | -1.44 | | | -1.72 | | |
| $SKW_e$ | 0.00322 | | | 0.00333 | | |
| | 1.77 | | | 1.83 | | |
| $KUR_e$ | -0.000309 | | | -0.00029 | | |
| | -1.5 | | | -1.4 | | |
| $VOL_r$ | | 1.969*** | | | 2.054*** | |
| | | 4.51 | | | 4.79 | |
| $SKW_r$ | | -0.00712*** | | | -0.00748*** | |
| | | -4.07 | | | -4.28 | |
| $KUR_r$ | | -0.000601** | | | -0.000591** | |
| | | -2.99 | | | -2.96 | |
| $VOL_{shock}$ | | | 3.074*** | | | 3.313*** |
| | | | 8.23 | | | 8.89 |
| $SKW_{shock}$ | | | -0.0157*** | | | -0.0167*** |
| | | | -7.3 | | | -7.78 |
| $KUR_{shock}$ | | | -0.000487 | | | -0.000496* |
| | | | -1.94 | | | -1.99 |
| *CALL* | -0.365*** | -0.264*** | -0.261*** | -0.367*** | -0.262*** | -0.258*** |
| | -43.67 | -26.33 | -26.08 | -44.52 | -26.18 | -25.88 |
| *CONV* | -0.219*** | -0.204*** | -0.205*** | -0.220*** | -0.200*** | -0.200*** |
| | -17.5 | -16.78 | -17 | -17.71 | -16.57 | -16.78 |
| *LOSS* | -0.0101*** | -0.0329*** | -0.0358*** | -0.00980*** | -0.0329*** | -0.0362*** |
| | -3.42 | -10.32 | -11.44 | -3.34 | -10.36 | -11.6 |
| *CPN* | 1.307*** | 0.987*** | 1.496*** | 1.343*** | 0.899*** | 1.426*** |
| | 5.02 | 3.74 | 6.5 | 5.19 | 3.47 | 6.27 |
| *TERM* | -0.000159 | | | 0.0000356 | | |
| | -0.18 | | | 0.04 | | |
| *LIFE* | | 0.00690*** | 0.00668*** | | 0.00715*** | 0.00698*** |
| | | 6.42 | 6.25 | | 6.66 | 6.55 |
| *OBSDUR* | -0.585*** | -0.548*** | -0.666*** | -0.595*** | -0.529*** | -0.651*** |
| | -5.67 | -5.54 | -7.11 | -5.78 | -5.38 | -6.98 |
| *OBSCNT* | 0.00392** | | | 0.00372* | | |
| | 2.61 | | | 2.48 | | |
| *OBSRLZ* | | 0.0202*** | 0.0229*** | | 0.0199*** | 0.0227*** |
| | | 7.62 | 8.64 | | 7.55 | 8.64 |
| *BAR* | -0.0325 | -0.161*** | -0.0802* | -0.0264 | -0.163*** | -0.0781* |
| | -0.84 | -3.98 | -2.43 | -0.68 | -4.06 | -2.37 |
| *SIZE* | 0.018 | 0.0139 | 0.0091 | 0.0172 | 0.0141 | 0.00881 |
| | 1.65 | 1.33 | 0.87 | 1.58 | 1.35 | 0.85 |
| *COST* | -0.511** | -0.476** | -0.367* | -0.505** | -0.469** | -0.350* |
| | -2.91 | -2.89 | -2.24 | -2.88 | -2.85 | -2.15 |
| *constant* | 0.368*** | 0.227*** | 0.232*** | 0.372*** | 0.223*** | 0.226*** |
| | 12.05 | 8.03 | 8.32 | 12.26 | 7.89 | 8.15 |
| *N* | 3681 | 3681 | 3681 | 3681 | 3681 | 3681 |
| adj. R-sq | 0.391 | 0.437 | 0.447 | 0.393 | 0.44 | 0.451 |

*Table 6.2.2.1 Linear regressions of note return gain*

This table shows the results of full sample linear regression using Model 1 – 3. The regression models predicting the note return gain ($NR_{gain}$) based on market premium (MKT), dummy of estimated value disclosure (DISC), underlying volatility (VOL), skewness (SKW), and kurtosis (KUR), dummies of called and converted notes (CALL, CONV), number of coupon lost (LOSS), coupon rate per payment (CPN), expected product lifetime (TERM), realized holding period (LIFE), duration between observations (OBSDUR), expected number of observation (OBSCNT), actual number of observation (OBSRLZ), barrier (BAR), issuing volume (SIZE) and disclosed cost of the product (COST). The column 1 – 3 illustrate the regression results of ex-ante, ex-post and the "shock" models respectively using S&P composition index as market return, while column 4 – 6 illustrate the same set of models using NASDAQ composition index as market return. The bottom 2 rows represent the sample size (N) and R-square (adj. R-sq). For the test statistics, * indicates significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.

***Table 6.2.3.1 Sub-sample linear regression of note return gain***

| $NR_{gain}$ | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***MKTsp*** | **-0.428***** | **-0.513***** | **-0.400***** | **-0.397***** | **-0.463***** | **-0.473***** | | | | | | |
| | -8.03 | -6.36 | -7.72 | -4.94 | -8.77 | -6.06 | | | | | | |
| ***MKTnq*** | | | | | | | **-0.257***** | **-0.481***** | **-0.225***** | **-0.409***** | **-0.296***** | **-0.463***** |
| | | | | | | | -7.46 | -7.51 | -6.84 | -6.46 | -8.52 | -7.46 |
| ***$VOL_e$*** | **-1.099*** | **-1.215**** | | | | | **-1.007*** | **-1.217**** | | | | |
| | -2.16 | -2.7 | | | | | -1.98 | -2.72 | | | | |
| ***$SKW_e$*** | **0.00898*** | 0.0000972 | | | | | **0.0105**** | 0.000028 | | | | |
| | 2.41 | 0.04 | | | | | 2.79 | 0.01 | | | | |
| ***$KUR_e$*** | -0.000327 | 0.00018 | | | | | -0.0000807 | 0.000132 | | | | |
| | -0.67 | 0.67 | | | | | -0.16 | 0.5 | | | | |
| ***$VOL_r$*** | | | -0.119 | **3.370***** | | | | | 0.365 | **3.401***** | | |
| | | | -0.18 | 5.62 | | | | | 0.55 | 5.75 | | |
| ***$SKW_r$*** | | | **-0.0149***** | **-0.00979***** | | | | | **-0.0143***** | **-0.0101***** | | |
| | | | -4.19 | -4.19 | | | | | -4.02 | -4.34 | | |
| ***$KUR_r$*** | | | **-0.00248***** | -0.000501 | | | | | **-0.00243***** | -0.000505 | | |
| | | | -5.48 | -1.93 | | | | | -5.35 | -1.95 | | |
| ***$VOL_{shock}$*** | | | | | 0.271 | **4.675***** | | | | | 0.6 | **4.732***** |
| | | | | | 0.44 | 9.03 | | | | | 0.96 | 9.18 |
| ***$SKW_{shock}$*** | | | | | **-0.0256***** | **-0.0156***** | | | | | **-0.0271***** | **-0.0159***** |
| | | | | | -5.86 | -5.69 | | | | | -6.1 | -5.81 |
| ***$KUR_{shock}$*** | | | | | **-0.00277***** | **-0.00112***** | | | | | **-0.00277***** | **-0.00107***** |
| | | | | | -4.28 | -3.45 | | | | | -4.28 | -3.3 |
| ***CALL*** | **-0.247***** | **-0.257***** | **-0.248***** | **-0.255***** | **-0.241***** | **-0.262***** | **-0.248***** | **-0.248***** | **-0.248***** | **-0.245***** | **-0.241***** | **-0.251***** |
| | -22.88 | -14.15 | -23.2 | -14.18 | -22.23 | -14.68 | -22.86 | -13.55 | -23.11 | -13.53 | -22.13 | -14.04 |
| ***CONV*** | **-0.146***** | **-0.201***** | **-0.149***** | **-0.211***** | **-0.150***** | **-0.212***** | **-0.142***** | **-0.193***** | **-0.145***** | **-0.204***** | **-0.145***** | **-0.204***** |
| | -9.27 | -10.88 | -9.45 | -11.49 | -9.56 | -11.67 | -8.96 | -10.45 | -9.19 | -11.14 | -9.2 | -11.26 |
| ***LOSS*** | **-0.0276***** | **-0.0328***** | **-0.0270***** | **-0.0439***** | **-0.0290***** | **-0.0462***** | **-0.0273***** | **-0.0331***** | **-0.0271***** | **-0.0444***** | **-0.0292***** | **-0.0467***** |
| | -8.28 | -6.32 | -7.96 | -7.93 | -8.51 | -8.64 | -8.17 | -6.4 | -7.97 | -8.06 | -8.56 | -8.78 |
| ***CPN*** | **1.836***** | **2.071***** | **1.608***** | 0.402 | **1.582***** | **1.476***** | **1.655***** | **1.998***** | **1.336***** | 0.336 | **1.415***** | **1.417***** |
| | 6.53 | 4.91 | 5.34 | 0.93 | 6.28 | 3.9 | 5.95 | 4.8 | 4.49 | 0.79 | 5.65 | 3.79 |
| ***LIFE*** | **0.0141***** | **0.00526**** | **0.0132***** | **0.00482**** | **0.0136***** | 0.00342 | **0.0119***** | **0.00623***** | **0.0113***** | **0.00572**** | **0.0116***** | **0.00439*** |
| | 9.03 | 2.86 | 8.78 | 2.64 | 8.54 | 1.88 | 8.07 | 3.38 | 7.77 | 3.13 | 7.6 | 2.4 |
| ***OBSDUR*** | **-0.993***** | **-0.746***** | **-0.872***** | **-0.364*** | **-0.908***** | **-0.567***** | **-0.913***** | **-0.751***** | **-0.768***** | **-0.362*** | **-0.822***** | **-0.573***** |
| | -6.77 | -5.24 | -5.84 | -2.51 | -6.55 | -4.15 | -6.23 | -5.29 | -5.12 | -2.51 | -5.9 | -4.22 |
| ***OBSRLZ*** | **0.0128***** | **0.0266***** | **0.0130***** | **0.0302***** | **0.0147***** | **0.0330***** | **0.0132***** | **0.0267***** | **0.0131***** | **0.0309***** | **0.0152***** | **0.0335***** |
| | 4.96 | 4.61 | 5.03 | 5.26 | 5.65 | 5.78 | 5.08 | 4.67 | 5.05 | 5.42 | 5.84 | 5.91 |
| ***BAR*** | -0.05 | 0.105 | **-0.100*** | **-0.133*** | **-0.0923**** | -0.00729 | -0.0576 | 0.109 | **-0.126**** | **-0.133*** | **-0.0925**** | -0.00439 |
| | -1.15 | 1.68 | -2.13 | -2.02 | -2.61 | -0.13 | -1.32 | 1.75 | -2.7 | -2.02 | -2.61 | -0.08 |
| ***SIZE*** | -0.00549 | 0.0107 | -0.00466 | 0.015 | -0.00545 | 0.00652 | -0.00227 | 0.00984 | -0.00108 | 0.014 | -0.00222 | 0.00535 |
| | -0.33 | 0.76 | -0.28 | 1.08 | -0.33 | 0.47 | -0.14 | 0.7 | -0.07 | 1.01 | -0.14 | 0.39 |
| ***COST*** | -0.365 | **-0.575*** | **-0.418*** | **-0.561*** | -0.321 | -0.454 | -0.344 | **-0.582*** | **-0.407*** | **-0.558*** | -0.29 | -0.454 |
| | -1.86 | -2.19 | -2.16 | -2.16 | -1.66 | -1.76 | -1.75 | -2.22 | -2.09 | -2.16 | -1.5 | -1.77 |
| ***constant*** | **0.239***** | **0.206***** | **0.243***** | **0.171***** | **0.214***** | **0.195***** | **0.232***** | **0.201***** | **0.234***** | **0.163***** | **0.205***** | **0.189***** |
| | 7.59 | 4.35 | 7.66 | 3.64 | 6.79 | 4.23 | 7.36 | 4.28 | 7.35 | 3.49 | 6.48 | 4.12 |
| ***N*** | 1653 | 2028 | 1653 | 2028 | 1653 | 2028 | 1653 | 2028 | 1653 | 2028 | 1653 | 2028 |
| ***adj. R-sq*** | 0.607 | 0.337 | 0.612 | 0.349 | 0.616 | 0.365 | 0.605 | 0.342 | 0.61 | 0.354 | 0.615 | 0.37 |

*Table 6.2.3.1 Sub-sample linear regressions of note return*

This table shows the results of sub-sample linear regression using Model 1 – 3, with samples grouped by disclosure dummy (DISC). The regression models predicting the note return gain ($NR_{gain}$) based on market premium (MKT), underlying volatility (VOL), skewness (SKW), and kurtosis (KUR), dummies of called and converted notes (CALL, CONV), number of coupon lost (LOSS), coupon rate per payment (CPN), product lifetime (LIFE), duration between observations (OBSDUR), number of observation (OBSRLZ), barrier (BAR), issuing volume (SIZE) and disclosed cost of the product (COST). The column 1 – 6 illustrate the regression results of ex-ante, ex-post and the "shock" models respectively using S&P composition index as market return, while column 7 – 12 illustrate the same set of models using NASDAQ composition index as market return. Also, odd columns represent the results of sub-sample without estimated value disclosure while even columns represent the results of sub-sample with estimated value disclosure. The bottom 2 rows represent the sample size (N) and R-square (adj. R-sq). For the test statistics, * indicates significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.

### *6.2.3 Sub-sample linear regression*

From table 6.2.3.1, as it is hypothesized that ACRCs are modified to shroud critical information from the investors, a sub-sample analysis of note return gain is conducted and the result is reported in table 4. The internal modification of ACRCs could be found on the control variables if their effects on note return gain do not carry over the regulatory change in 2013. The appearance or vanishing of significant effects after the regulatory change would reflect a different explanation or prediction of note return gain and be evidence of product modification.

Recalling the insignificance of ex-ante underlying volatility in the full sample analysis, it is found to have significant impact in sub-sample regression. The negative effects suggest that the greater the underlying volatility on the trade date, the less note return gain over the holding period will be obtained. Also, the switch in significance would be explained as a change in effects of ex-ante underlying attributes before and after the regulatory change in 2013, which offset each other in the full sample analysis.

Further, comparing the effects of the underlying attributes of ACRCs, the realized and the shock of volatility are found to be significant only for the products with disclosure of estimated value, while the ex-ante underlying skewness and ex-post underlying kurtosis only significantly impact the products without the estimated value disclosure. The difference in significance of underlying attributes of the ACRCs with and without disclosure of estimated value are considered as evidence that the ACRCs before and after the regulatory change in 2013 are carrying distinct profit-enhancing mechanisms for *The Bank*. For example, while the investors may estimate the note return gain of ACRCs issued before 2013 based on ex-ante underlying skewness, such estimation is no longer effective for the products issued after 2013. In other words, the prediction of product performance that works before the regulatory change may not work afterwards, which may result in inaccurate estimation of product performance. As for other control variables, no significant change has been found in the regression results.

*Table 6.2.4.1 T-tests of underlying attributes*

| | Variable | DISC | Mean | t-stat |
|---|---|---|---|---|
| | $VOL_e$ | 0 | 0.0248 | |
| **Panel A** | | 1 | 0.0257 | |
| | *Difference* | | -0.0009 | -2.4791 |
| | $VOL_r$ | 0 | 0.0231 | |
| **Panel B** | | 1 | 0.0256 | |
| | | | -0.0025 | -9.151 |
| | $VOL_{shock}$ | 0 | -0.0017 | |
| **Panel C** | | 1 | 0.0000 | |
| | *Difference* | | -0.0016 | -5.8317 |
| | $SKW_e$ | 0 | 0.0434 | |
| **Panel D** | | 1 | 0.3688 | |
| | *Difference* | | -0.3253 | -6.5048 |
| | $SKW_r$ | 0 | -0.0489 | |
| **Panel E** | | 1 | 0.0520 | |
| | *Difference* | | -0.1009 | -2.3684 |
| | $SKW_{shock}$ | 0 | -0.0923 | |
| **Panel F** | | 1 | -0.3168 | |
| | *Difference* | | 0.2245 | 5.4169 |
| | $KUR_e$ | 0 | 3.3310 | |
| **Panel G** | | 1 | 10.2648 | |
| | *Difference* | | -6.9338 | -13.1671 |
| | $KUR_r$ | 0 | 3.8322 | |
| **Panel H** | | 1 | 8.0816 | |
| | *Difference* | | -4.2494 | -10.6661 |
| | $KUR_{shock}$ | 0 | 0.5012 | |
| **Panel I** | | 1 | -2.1832 | |
| | *Difference* | | 2.6844 | 6.2171 |

*Table 6.2.4.1 T-tests of underlying attributes*

*This table illustrates the result of multiple t-test. From Panel A – I, the results represent the comparison of underlying volatility (VOL), skewness (SKW) and kurtosis (KUR) before and after the regulatory change in 2013 denoted in column (DISC) with 0 and 1 respectively. The sub-scripts e and r represent the ex-ante and ex-post specification of corresponding variable.*

### *6.2.4 Probit regressions and more t-tests*

Table 6.2.4.1 illustrates the result of t-tests of the underlying attributes (*VOL, SKW, KUR*) with ex-ante, ex-post and the shock specifications before and after the regulatory change in 2013. There are several significant differences to highlight. First, the shock of underlying volatility for the ACRCs with disclosure of the estimated value has a mean close to zero. With 0.0002 standard deviation, it means that most of ACRCs issued after 2013 have a stabilized volatility throughout the product life-cycle. Second, both ex-ante and ex-post underlying skewness increased significantly after the regulatory change in 2013. Compared to the ACRCs issued before the regulatory change, the return of the underlying assets before the trading date of the product are more right-skewed and the underlying returns during the holding period switch from left-skewed to right-skewed. Third, both ex-ante and ex-post underlying kurtosis are found to be increased significantly after the regulatory change in 2013. The increasing platykurtic underlying return indicates that the returns of underlying asset are more evenly distributed around its mean.

Based on the results of the t-tests, the significant changes of the underlying attributes suggest that the underlying assets of ACRCs without disclosure of estimated value carry a distinct return pattern different than those of ACRCs with disclosed estimated value. The distinct return pattern of underlying asset is evidence of a change in the profiting mechanism of ACRCs to *The Bank*.

***Table 6.2.4.2  Probit regressions of probabilies of call, conversion and coupon***

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| ***$MKT_{SP}$*** | **2.855*** | **-2.927*** | **-1.824*** | **2.507*** | -0.922 | -0.132 | **3.767*** | **-3.330*** | **-2.375*** |
| | 4.21 | -4.59 | -3.61 | 3.47 | -1.29 | -0.25 | 5.39 | -5.17 | -4.76 |
| ***DISC*** | **0.271*** | **0.348*** | 0.133 | **0.422*** | 0.194 | -0.0471 | **0.520*** | 0.069 | -0.117 |
| | 2.29 | 3.2 | 1.51 | 3.51 | 1.62 | -0.52 | 4.31 | 0.6 | -1.33 |
| ***$VOL_e$*** | 2.673 | **15.13*** | **11.39*** | | | | | | |
| | 0.41 | 2.55 | 2.43 | | | | | | |
| ***$SKW_e$*** | -0.0304 | -0.0052 | -0.00498 | | | | | | |
| | -0.67 | -0.15 | -0.16 | | | | | | |
| ***$KUR_e$*** | -0.00129 | -0.00198 | -0.00192 | | | | | | |
| | -0.28 | -0.5 | -0.55 | | | | | | |
| ***$VOL_r$*** | | | | **-46.36*** | **101.0*** | **93.65*** | | | |
| | | | | -6.01 | 13.54 | 19.24 | | | |
| ***$SKW_r$*** | | | | **0.337*** | **-0.560*** | **-0.287*** | | | |
| | | | | 8.04 | -8.06 | -10.05 | | | |
| ***$KUR_r$*** | | | | **0.0121*** | **-0.0554*** | **-0.0224*** | | | |
| | | | | 3.06 | -6.88 | -7.63 | | | |
| ***$VOL_{shock}$*** | | | | | | | **-31.45*** | **47.83*** | **43.51*** |
| | | | | | | | -5.77 | 9.35 | 12.34 |
| ***$SKW_{shock}$*** | | | | | | | **0.248*** | **-0.226*** | **-0.185*** |
| | | | | | | | 6.88 | -7.47 | -8.11 |
| ***$KUR_{shock}$*** | | | | | | | 0.00449 | **-0.0172*** | **-0.0162*** |
| | | | | | | | 1.16 | -5.16 | -6.65 |
| ***CPN*** | **-17.23*** | **25.32*** | **27.60*** | -4.442 | -1.672 | 3.647 | **-15.36*** | **25.38*** | **29.34*** |
| | -4.03 | 6.49 | 8.4 | -0.91 | -0.35 | 1.03 | -3.74 | 6.73 | 9.56 |
| ***LIFE*** | **-0.302*** | **0.136*** | **0.179*** | **-0.310*** | **0.126*** | **0.174*** | **-0.305*** | **0.119*** | **0.162*** |
| | -14.38 | 11.2 | 17.49 | -13.78 | 8.96 | 16.17 | -14.23 | 9.21 | 15.54 |
| ***OBSDUR*** | 0.142 | **-4.563*** | **-8.218*** | **-3.099*** | 2.637 | -2.436 | -0.336 | **-3.908*** | **-8.436*** |
| | 0.1 | -3.41 | -6.69 | -1.96 | 1.73 | -1.93 | -0.24 | -2.9 | -6.92 |
| ***OBSRLZ*** | **-0.356*** | **0.218*** | **0.279*** | **-0.357*** | **0.196*** | **0.282*** | **-0.364*** | **0.240*** | **0.311*** |
| | -7.19 | 7.91 | 12.16 | -6.99 | 6.19 | 12.1 | -7.27 | 8.32 | 13.48 |
| ***BAR*** | -0.111 | **-3.072*** | **-5.279*** | **1.926*** | **-7.671*** | **-10.49*** | -0.117 | **-2.557*** | **-5.308*** |
| | -0.15 | -4.57 | -9.7 | 2.46 | -9.61 | -17.15 | -0.18 | -4.11 | -10.53 |
| ***SIZE*** | **0.638*** | 0.0648 | 0.0664 | **0.708*** | -0.0451 | -0.218 | **0.719*** | -0.134 | -0.216 |
| | 2.75 | 0.37 | 0.47 | 2.75 | -0.21 | -1.46 | 2.86 | -0.66 | -1.47 |
| ***COST*** | -2.938 | **6.934*** | -0.209 | -2.33 | **8.041*** | 0.755 | -3.866 | **8.468*** | 1.516 |
| | -1 | 2.32 | -0.09 | -0.76 | 2.39 | 0.32 | -1.29 | 2.75 | 0.68 |
| ***constant*** | **5.070*** | **-4.130*** | mixed | **5.572*** | **-4.852*** | mixed | **5.155*** | **-3.995*** | mixed |
| | 10.08 | -8.69 | sig. | 10.36 | -9.12 | sig. | 10.02 | -8.25 | sig. |
| ***N*** | 3681 | 3681 | 3681 | 3681 | 3681 | 3681 | 3681 | 3681 | 3681 |
| ***pseudo R-sq.*** | 0.72 | 0.494 | 0.404 | 0.745 | 0.594 | 0.474 | 0.74 | 0.539 | 0.435 |

*Table 2.2.4.2 Probit regressions of probabilies of call, conversion and coupon*

This table shows the results of probit regressions using Model 4 – 6 . The regression models predicting the probability of products being called (CALL), the probability of conversion (CONV), and the probability of coupon loss (LOSS) based on market premium (MKT), disclosure dummy (DISC), underlying volatility (VOL), skewness (SKW), and kurtosis (KUR), coupon rate per payment (CPN), product lifetime (LIFE), duration between observations (OBSDUR), number of observation (OBSRLZ), barrier (BAR), issuing volume (SIZE) and disclosed cost of the product (COST). The column 1 – 3, 4 – 6, 7 – 9 illustrate the regression results of ex-ante, ex-post and the "shock" models respectively. Also, each column in a three-columns section represents the dependent variable using CALL, CONV and LOSS respectively. The bottom 2 rows represent the sample size (N) and R-square (pseudo R-sq). For the test statistics, * indicates significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.

Table 6.2.4.2 reports the probit regression results of Models 4 – 6, with ex-ante, ex-post and the shock specifications of underlying attributes of ACRCs. The results are found to be supportive to Hypotheses 4 – 6.

First, among 3 dependent variables, the disclosure dummy is only significant for *CALL* in all specifications of underlying assets. It means that the ACRCs with disclosed estimated value are significantly more likely to be called than those without the disclosure, while the probability of being converted and the probability of coupon losses do not have significant difference across the sub-samples.

Second, just as the estimation of note return gain, most of the ex-ante underlying attributes are not significant to explain the probabilities while most the ex-post and the shock of underlying attributes carry significant impact on the probabilities. This result indicates that while the investors may not be able to predict whether the ACRCs will be called or converted during the product life-cycle based on the ex-ante underlying attributes, the underlying attributes do explain the probability of the product being called or converted, which is consistent with their effects on the note return gain of ACRCs. The consistent effects also indicate that the auto-callable, convertible features and coupon payment criteria are critical in reducing the product returns.

Also, as it is discussed in the full sample linear regression of note return gain, the ex-post and the shock of underlying volatility is found to have negative effects on the probability of the product being called but have positive effects on the probability of conversion and coupon loss. This result is consistent with the explanation of the positive effects of underlying volatility to note return gain. It means that if the underlying asset returns fluctuate more during the holding period, the products are less likely to be called.

***Table 6.2.5.1 Sub-sample probit regressions of the probability of product being called***

| CALL | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $MKT_{SP}$ | **5.783**** | **7.679***** | 1.806 | **6.792***** | **6.351***** | **7.448***** |
| | 3.24 | 7.13 | 1.24 | 5.95 | 3.49 | 7.02 |
| $VOL_e$ | **103.2***** | **-21.38*** | | | | |
| | 4.63 | -2.01 | | | | |
| $SKW_e$ | **-0.477*** | 0.0781 | | | | |
| | -2.17 | 1.59 | | | | |
| $KUR_e$ | -0.0107 | 0.00623 | | | | |
| | -0.22 | 0.96 | | | | |
| *VOLr* | | | **-138.3***** | **-43.81***** | | |
| | | | -4.91 | -5.06 | | |
| $SKW_r$ | | | **0.742***** | **0.257***** | | |
| | | | 3.32 | 5.35 | | |
| $KUR_r$ | | | **0.0551*** | **0.0104*** | | |
| | | | 2.04 | 2.35 | | |
| $VOL_{shock}$ | | | | | **-113.3***** | **-24.55***** |
| | | | | | -5.74 | -3.58 |
| $SKW_{shock}$ | | | | | 0.268 | **0.140***** |
| | | | | | 1.89 | 3.44 |
| $KUR_{shock}$ | | | | | 0.0301 | 0.00556 |
| | | | | | 1.39 | 1.32 |
| *CPN* | **-60.13***** | **-18.17**** | 9.65 | -8.305 | **-31.77***** | **-19.60**** |
| | -4.55 | -2.66 | 0.91 | -1.14 | -3.36 | -3.16 |
| *LIFE* | **-3.897**** | **-0.136***** | **-2.363*** | **-0.119***** | **-3.540**** | **-0.128***** |
| | -3.13 | -4.58 | -2 | -3.76 | -2.64 | -4.24 |
| *OBSDUR* | **21.25***** | **-4.357*** | -1.4 | **-7.092**** | **11.98**** | **-4.093*** |
| | 4.03 | -2.2 | -0.32 | -3.22 | 2.87 | -2.14 |
| *OBSRLZ* | **-0.275**** | **-0.761***** | **-0.207*** | **-0.804***** | **-0.236**** | **-0.760***** |
| | -3.2 | -8.33 | -2.5 | -8.46 | -2.64 | -8.28 |
| *BAR* | **-6.137***** | 0.687 | **3.761*** | **2.511*** | -2.364 | 0.607 |
| | -3.47 | 0.61 | 2.29 | 2.09 | -1.81 | 0.58 |
| *SIZE* | 1.073 | **0.589*** | 0.512 | **0.678*** | 0.705 | **0.698*** |
| | 1.91 | 2.17 | 0.91 | 2.18 | 1.22 | 2.38 |
| *COST* | -9.828 | -4.719 | -5.217 | -3.985 | -7.951 | -6.036 |
| | -1.86 | -1.09 | -0.99 | -0.9 | -1.45 | -1.42 |
| *constant* | **47.15**** | **5.748***** | **31.00*** | **5.745***** | **43.40**** | **5.501***** |
| | 3.07 | 8 | 2.14 | 7.8 | 2.63 | 7.78 |
| *N* | 1653 | 2028 | 1653 | 2028 | 1653 | 2028 |
| *pseudo R-sq.* | 0.778 | 0.774 | 0.785 | 0.793 | 0.795 | 0.779 |

*Table 6.2.5.1 Sub-sample probit regressions of the probabilities of product being called*

This table shows the results of probit regressions using Model 4 with samples grouped by disclosure dummy (DISC). The regression models predicting the probability of products being called (CALL) based on market premium (MKT), disclosure dummy (DISC), underlying volatility (VOL), skewness (SKW), and kurtosis (KUR), coupon rate per payment (CPN), product lifetime (LIFE), duration between observations (OBSDUR), number of observation (OBSRLZ), barrier (BAR), issuing volume (SIZE) and disclosed cost of the product (COST). The column 1 – 2, 3 – 4, 5 – 6 illustrate the regression results of ex-ante, ex-post and the "shock" models respectively. Also, odd columns represent the results of sub-sample without estimated value disclosure while even columns represent the results of sub-sample with estimated value disclosure. The bottom 2 rows represent the sample size (N) and R-square (pseudo R-sq). For the test statistics, * indicates significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.

*Table 6.2.5.2 Sub-sample probit regressions of the probability of conversion*

| CONV | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $MKT_{SP}$ | **-2.947*** | **-4.850***** | **2.268** | **-2.610**** | **-2.361** | **-4.839***** |
| | -2.31 | -5.73 | 1.4 | -2.73 | -1.68 | -5.63 |
| $VOL_e$ | -7.971 | **20.59**** | | | | |
| | -0.54 | 2.72 | | | | |
| $SKW_e$ | 0.212 | -0.0591 | | | | |
| | 1.26 | -1.56 | | | | |
| $KUR_e$ | **0.0422*** | -0.00339 | | | | |
| | 2.02 | -0.71 | | | | |
| *VOLr* | | | **240.5***** | **91.28***** | | |
| | | | 7.92 | 10.86 | | |
| $SKW_r$ | | | -0.385 | **-0.530***** | | |
| | | | -1.68 | -6.9 | | |
| $KUR_r$ | | | **-0.0872*** | **-0.0487***** | | |
| | | | -2.41 | -5.5 | | |
| $VOL_{shock}$ | | | | | **76.50***** | **45.32***** |
| | | | | | 5.8 | 7.56 |
| $SKW_{shock}$ | | | | | -0.0686 | **-0.204***** |
| | | | | | -0.63 | -5.96 |
| $KUR_{shock}$ | | | | | **-0.0400**** | **-0.0166***** |
| | | | | | -2.67 | -4.54 |
| *CPN* | **45.21***** | **21.74***** | -15.07 | -8.363 | **47.96***** | **21.15***** |
| | 4.99 | 3.93 | -1.3 | -1.26 | 5.87 | 4.11 |
| *LIFE* | 0.963 | **0.0838***** | 1.062 | 0.0465 | **0.902*** | **0.0581**** |
| | 1.76 | 4.13 | 1.54 | 1.72 | 2.24 | 2.63 |
| *OBSDUR* | **-16.74***** | -1.867 | 3.527 | **6.348**** | **-20.38***** | -0.717 |
| | -3.49 | -1.11 | 0.69 | 3.13 | -4.13 | -0.42 |
| *OBSRLZ* | **0.129**** | **0.352***** | 0.0447 | **0.399***** | 0.0828 | **0.386***** |
| | 3.14 | 5.99 | 0.93 | 5.05 | 1.8 | 6.05 |
| *BAR* | **-4.119**** | **-1.842*** | **-17.03***** | **-6.032***** | **-4.138***** | **-1.848*** |
| | -2.89 | -2.09 | -7.79 | -5.88 | -3.4 | -2.21 |
| *SIZE* | -0.302 | 0.0177 | 0.566 | -0.0937 | -0.0543 | -0.172 |
| | -0.5 | 0.09 | 0.83 | -0.4 | -0.09 | -0.78 |
| *COST* | 6.404 | **8.361*** | 3.01 | **8.748*** | 8.579 | **10.11**** |
| | 0.96 | 2.31 | 0.4 | 2.17 | 1.22 | 2.73 |
| *constant* | -12.27 | **-4.449***** | -15.59 | **-4.917***** | **-11.40*** | **-4.326***** |
| | -1.82 | -7.55 | -1.85 | -7.49 | -2.28 | -7.2 |
| *N* | 1653 | 2028 | 1653 | 2028 | 1653 | 2028 |
| *pseudo R~q* | 0.511 | 0.505 | 0.643 | 0.603 | 0.567 | 0.544 |

*Table 6.2.5.2 Sub-sample probit regressions of the probability of conversion*

This table shows the results of probit regressions using Model 5 with samples grouped by disclosure dummy (DISC). The regression models predicting the probability of conversion (CONV) based on market premium (MKT), disclosure dummy (DISC), underlying volatility (VOL), skewness (SKW), and kurtosis (KUR), coupon rate per payment (CPN), product lifetime (LIFE), duration between observations (OBSDUR), number of observation (OBSRLZ), barrier (BAR), issuing volume (SIZE) and disclosed cost of the product (COST). The column 1 – 2, 3 – 4, 5 – 6 illustrate the regression results of ex-ante, ex-post and the "shock" models respectively. Also, odd columns represent the results of sub-sample without estimated value disclosure while even columns represent the results of sub-sample with estimated value disclosure. The bottom 2 rows represent the sample size (N) and R-square (pseudo R-sq). For the test statistics, * indicates significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.

*Table 6.2.5.3 Sub-sample probit regressions of the probability of coupon loss*

| LOSS | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $MKT_{SP}$ | -2.895** | -3.891*** | 1.509 | -1.948** | -2.821** | -3.927*** |
| | -3.01 | -5.5 | 1.5 | -2.66 | -2.85 | -5.61 |
| $VOL_{e}$ | -12.86 | 17.98** | | | | |
| | -1.14 | 2.82 | | | | |
| $SKW_{e}$ | 0.330** | -0.100** | | | | |
| | 2.59 | -3.07 | | | | |
| $KUR_{e}$ | 0.0319 | -0.00176 | | | | |
| | 1.84 | -0.42 | | | | |
| $VOL_{r}$ | | | 195.8*** | 90.69*** | | |
| | | | 12.51 | 16.38 | | |
| $SKW_{r}$ | | | -0.390** | -0.259*** | | |
| | | | -3.03 | -8.08 | | |
| $KUR_{r}$ | | | -0.0485** | -0.0213*** | | |
| | | | -2.66 | -6.67 | | |
| $VOL_{shock}$ | | | | | 73.95*** | 44.53*** |
| | | | | | 8.03 | 10.67 |
| $SKW_{shock}$ | | | | | -0.168* | -0.125*** |
| | | | | | -2.03 | -4.88 |
| $KUR_{shock}$ | | | | | -0.0222* | -0.0196*** |
| | | | | | -2.02 | -7.26 |
| CPN | 37.13*** | 30.48*** | -19.30* | 2.943 | 39.00*** | 31.85*** |
| | 5.4 | 6.24 | -2.53 | 0.59 | 6.65 | 7.27 |
| LIFE | 0.489*** | 0.104*** | 0.527*** | 0.0821*** | 0.515*** | 0.0709*** |
| | 8.91 | 7 | 9.64 | 5.35 | 9.48 | 4.76 |
| OBSDUR | -18.09*** | -5.470*** | 0.796 | 1.43 | -22.65*** | -4.498** |
| | -4.68 | -3.65 | 0.21 | 0.94 | -6.15 | -3.09 |
| OBSRLZ | 0.130*** | 0.542*** | 0.064 | 0.610*** | 0.0795* | 0.605*** |
| | 3.81 | 12.6 | 1.82 | 13.52 | 2.23 | 13.9 |
| BAR | -7.151*** | -3.414*** | -19.01*** | -8.484*** | -7.650*** | -3.857*** |
| | -6.5 | -4.64 | -14.01 | -10.61 | -8.42 | -5.52 |
| SIZE | -0.394 | 0.000526 | 0.259 | -0.322 | -0.185 | -0.314 |
| | -0.92 | 0 | 0.59 | -1.93 | -0.43 | -1.91 |
| COST | -2.954 | 4.294 | -7.656 | 5.998 | -1.346 | 6.538* |
| | -0.73 | 1.46 | -1.85 | 1.92 | -0.33 | 2.22 |
| constant | mixed | mixed | mixed | mixed | mixed | mixed |
| | sig. | sig. | sig. | sig. | sig. | sig. |
| N | 1653 | 2028 | 1653 | 2028 | 1653 | 2028 |
| pseudo R-sq. | 0.411 | 0.452 | 0.496 | 0.53 | 0.448 | 0.481 |

*Table 6.2.5.3 Sub-sample probit regressions of the probability of coupon loss*

This table shows the results of probit regressions using Model 6 with samples grouped by disclosure dummy (DISC). The regression models predicting the probability of coupon loss (LOSS) based on market premium (MKT), disclosure dummy (DISC), underlying volatility (VOL), skewness (SKW), and kurtosis (KUR), coupon rate per payment (CPN), product lifetime (LIFE), duration between observations (OBSDUR), number of observation (OBSRLZ), barrier (BAR), issuing volume (SIZE) and disclosed cost of the product (COST). The column 1 – 2, 3 – 4, 5 – 6 illustrate the regression results of ex-ante, ex-post and the "shock" models respectively. Also, odd columns represent the results of sub-sample without estimated value disclosure while even columns represent the results of sub-sample with estimated value disclosure. The bottom 2 rows represent the sample size (N) and R-square (pseudo R-sq). For the test statistics, * indicates significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.

### *6.2.5 Sub-sample probit regressions*

Tables 6.2.5.1 – 6.2.5.3 provide the sub-sample probit regression results of Models 4 – 6 by grouping the samples based on the disclosure dummy. Comparing the significance of underlying attributes for the ACRCs, there are several underlying attributes found to have significant effects only for the products issued after the regulatory change in 2013. Specifically, for the probability of the products being called, the effect of underlying skewness shock is found to be significant only after the regulatory change. The positive effect suggests that the increase in skewness of the return of underlying assets throughout the life-cycle of ACRCs will increase the chance of the product being called.

Also, both realized and shock of underlying skewness are found to have negative effects on the probability of the products being converted only after the regulatory change. The negative effects are expected as the underlying returns are likely to hit below the barrier if they shift towards the right, and thus there is a smaller chance for the product to be converted. The underlying attributes have similar effects and significance for the probability of coupon loss.

As for other control variables, the changes are consistent. For example, the actual number of observations is found to have negative effects on the probability of conversion and coupon loss only after the regulatory change. Its effects are in-line with the fact that the proportion of ACRCs being converted is greater than before.

*Table 6.2.6.1 Linear regression of bank estimated value*

| *BEV* | (1) | (2) | (3) |
|---|---|---|---|
| $MKT_{SP}$ | **0.0122*** ** | **0.0139*** ** | **0.0177*** ** |
| | 4.6 | 5.05 | 6.58 |
| $VOL_e$ | **-0.196*** ** | | |
| | -13.24 | | |
| $SKW_e$ | **0.000289*** ** | | |
| | 3.69 | | |
| $KUR_e$ | **0.0000402*** ** | | |
| | 4.54 | | |
| $VOL_r$ | | **-0.158*** ** | |
| | | -7.7 | |
| $SKW_r$ | | **0.000240** ** | |
| | | 3 | |
| $KUR_r$ | | 0.0000056 | |
| | | 0.63 | |
| $VOL_{shock}$ | | | **0.158*** ** |
| | | | 8.84 |
| $SKW_{shock}$ | | | -0.000152 |
| | | | -1.6 |
| $KUR_{shock}$ | | | **-0.0000562*** ** |
| | | | -5.02 |
| *CALL* | -0.000735 | -0.000555 | -0.000803 |
| | -1.23 | -0.9 | -1.31 |
| *CONV* | **0.00154*** | **0.00150*** | **0.00123*** |
| | 2.53 | 2.4 | 1.96 |
| *LOSS* | 0.0000569 | **0.000476*** | **-0.000507** ** |
| | 0.33 | 2.51 | -2.75 |
| *CPN* | **-0.124*** ** | **-0.145*** ** | **-0.199*** ** |
| | -8.95 | -9.83 | -15.23 |
| *LIFE* | -0.000111 | -0.0000307 | **-0.000150*** |
| | -1.83 | -0.49 | -2.39 |
| *OBSDUR* | **0.0120*** | **0.0151** ** | **0.0308*** ** |
| | 2.56 | 3.03 | 6.53 |
| *OBSRLZ* | -0.0000358 | -0.000266 | 0.000175 |
| | -0.19 | -1.36 | 0.9 |
| *BAR* | **-0.0252*** ** | **-0.0266*** ** | **-0.0359*** ** |
| | -12.26 | -11.76 | -18.44 |
| *SIZE* | **0.00573*** ** | **0.00616*** ** | **0.00585*** ** |
| | 12.43 | 13.04 | 12.36 |
| *constant* | **0.992*** ** | **0.992*** ** | **0.991*** ** |
| | 992.33 | 966.15 | 974.2 |
| *N* | 2028 | 2028 | 2028 |
| *adj. R-sq* | 0.363 | 0.326 | 0.329 |

*Table 6.2.6.1 Linear regressions of bank disclosed estimated value*

*This table shows the results of full sample linear regression using Model 7. The regression models predicting the bank disclosed estimated value adjusted by principal and costs (BEV) based on S&P market premium (MKT), underlying volatility (VOL), skewness (SKW), and kurtosis (KUR), dummies of called and converted notes (CALL, CONV), number of coupon lost (LOSS), coupon rate per payment (CPN), expected product lifetime (TERM), realized holding period (LIFE), duration between observations (OBSDUR), expected number of observation (OBSCNT), actual number of observation (OBSRLZ), barrier (BAR), issuing volume (SIZE). The column 1 – 3 illustrate the regression results of ex-ante, ex-post and the "shock" specifications of underlying attributes respectively. The bottom 2 rows represent the sample size (N) and R-square (adj. R-sq). For the test statistics, * indicates significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.*

*6.2.6 Analysis of the disclosed estimate value*

Table 6.2.6.1 illustrates the results verifying Hypothesis 7. Note that it is expected H7 should not be fully supported if the theory concerning the disclosed estimated value is valid. The disclosed estimated value may not carry some critical information of the underlying attributes as a means to prevent the investors' analysis of ACRCs performance. Among the sub-hypotheses of H7, it is found that the realized underlying kurtosis and underlying skewness shock do not have significant impact on the disclosed estimated value. In other words, the disclosed estimated value does not carry this information. Recalling the linear regression of note return gain, both ex-post underlying kurtosis and underlying skewness shock contain negative effects on the return of ACRCs. Thus, the investors would over-estimate the note returns if they relied on the estimated value.

More importantly, the regression results show that the estimated value is not related to the dummy of product being called (CALL). It means the estimated value does not incorporate the auto-callable feature, even though there are about 80% ACRCs in the sample called. As the note return will be reduced if the product is called, the estimated value would lead to over-estimation of the note returns.

Besides, the coefficient of conversion dummy (CONV) and the coupon loss count (LOSS) also found the estimated value problematic. From table 10, it is found that both dummies carry positive impact on the disclosed estimated value. It means that if the ACRC is more likely to be converted or associated with coupon loss, the product is estimated to have greater value. Given that both dummies carry negative effects on note return gain, this result suggests the products with less return would be more valuable, which is not reasonable. Thus, the estimated value of ACRCs disclosed by *The Bank* cannot properly reflect the product returns.

***Table 6.2.6.2 Extended linear regression of note return gain***

| $NR_{gain}$ | (1) | (2) | (3) |
|---|---|---|---|
| $MKT_{SP}$ | **-0.522*** ** | **-0.425*** ** | **-0.474*** ** |
| | -6.44 | -5.26 | -6.02 |
| *BEV* | 0.746 | **1.992** ** | 0.107 |
| | 1.1 | 3.06 | 0.17 |
| $VOL_e$ | **-1.068*** | | |
| | -2.28 | | |
| $SKW_e$ | -0.000118 | | |
| | -0.05 | | |
| $KUR_e$ | 0.00015 | | |
| | 0.55 | | |
| $VOL_r$ | | **3.685*** ** | |
| | | 6.07 | |
| $SKW_r$ | | **-0.0103*** ** | |
| | | -4.4 | |
| $KUR_r$ | | **-0.000512*** | |
| | | -1.97 | |
| $VOL_{shock}$ | | | **4.658*** ** |
| | | | 8.82 |
| $SKW_{shock}$ | | | **-0.0156*** ** |
| | | | -5.68 |
| $KUR_{shock}$ | | | **-0.00111*** ** |
| | | | -3.41 |
| *CALL* | **-0.257*** ** | **-0.254*** ** | **-0.262*** ** |
| | -14.12 | -14.14 | -14.67 |
| *CONV* | **-0.202*** ** | **-0.214*** ** | **-0.212*** ** |
| | -10.93 | -11.66 | -11.67 |
| *LOSS* | **-0.0329*** ** | **-0.0448*** ** | **-0.0461*** ** |
| | -6.33 | -8.1 | -8.61 |
| *CPN* | **2.164*** ** | 0.691 | **1.497*** ** |
| | 5.03 | 1.57 | 3.75 |
| *LIFE* | **0.00534** ** | **0.00488** ** | 0.00344 |
| | 2.9 | 2.68 | 1.88 |
| *OBSDUR* | **-0.755*** ** | **-0.394** ** | **-0.570*** ** |
| | -5.29 | -2.71 | -4.13 |
| *OBSRLZ* | **0.0266*** ** | **0.0307*** ** | **0.0330*** ** |
| | 4.61 | 5.36 | 5.78 |
| *BAR* | **0.124** | **-0.0805** | **-0.00344** |
| | 1.92 | -1.18 | -0.06 |
| *SIZE* | 0.00646 | 0.0028 | 0.0059 |
| | 0.44 | 0.19 | 0.41 |
| *COST* | **-0.580*** | **-0.564*** | **-0.455** |
| | -2.21 | -2.17 | -1.77 |
| *constant* | -0.534 | **-1.804** ** | 0.0896 |
| | -0.79 | -2.79 | 0.14 |
| *N* | 2028 | 2028 | 2028 |
| *adj. R-sq* | 0.337 | 0.352 | 0.364 |

*Table 6.2.6.2 Extended linear regressions of note return gain*

*This table shows the results of extended linear regression using Model 9. The regression models predicting the note return gain ($NR_{gain}$) based on S&P market premium (MKT), bank's disclosed estimated value adjusted by principal and cost (BEV), underlying volatility (VOL), skewness (SKW), and kurtosis (KUR), dummies of called and converted notes (CALL, CONV), number of coupon lost (LOSS), coupon rate per payment (CPN), expected product lifetime (TERM), realized holding period (LIFE), duration between observations (OBSDUR), expected number of observation (OBSCNT), actual number of observation (OBSRLZ), barrier (BAR), issuing volume (SIZE) and disclosed cost of the product (COST). The column 1 – 3 illustrate the regression results of ex-ante, ex-post and the "shock" specifications of underlying attributes respectively. The bottom 2 rows represent the sample size (N) and R-square (adj. R-sq). For the test statistics, * indicates significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.*

To verify the above claims, Table 6.2.6.2 reports the extended linear regression of note return gain using Model 8. From the regression results, Hypothesis 8 is found supported that the disclosed estimated value adjusted by principal and costs (*BEV)* only have significant impact to the note return gain with ex-post specification of underlying attributes shown in column 2. It means that under ex-ante setting, the disclosed estimated value does not reflect the return of ACRCs, which is consistent with the interpretation of table 10. Thus, it is believed that the estimated value disclosure does not improve information shrouding as suggested above.

# 7 Discussion

Recalling that there are 2 primary puzzles that this study is intended to solve: (1) the underperforming of ACRCs and (2) the ineffectiveness of estimated value disclosure. To explain these puzzles, it is believed that *The Bank* shrouded the information of underlying attributes to prevent investors from accurately analyzing the return of ACRCs.

From the data analysis, there are several significant findings that support our theory. First, it is found that the ex-post and the shock of underlying attributes carry significant impacts on the return of ACRCs over the return of underlying assets, named as note return gain, while the ex-ante underlying attributes do not have significant effects. This finding suggests that the investors cannot rely on the ex-ante underlying attributes to predict the performance of ACRCs, while these attributes do affect the product return. Further, the effects of underlying attributes on the note return varied after the regulatory change in 2013, suggesting that the ACRCs were modified to cope with the disclosure requirement of product estimated value. Therefore, the information disclosure is not improved after the regulatory change as presumed.

Second, it is found that the underlying attributes affect the note return gain based on the auto-callable and conversion features as well as contingent coupon condition. The ACRCs are found to be associated with a significant chance to be called for converted. From the descriptive statistics analysis, there are only 10% of ACRCs were not called or converted. Knowing the negative effects of product call and conversion on the note return, the significant proportion of ACRCs being called and converted could explain the underperformance of ACRCs. While the underlying skewness and kurtosis are found to have positive effects on the probability of products being called and converted, the return of underlying assets are significantly right-skewed and more platykurtic after 2013. Thus, it is implied that *The Bank* intentionally introduced ACRCs with a greater chance to be called or converted by their selection of underlying assets, which explain with the underperformance of ACRCs and in-line with Bergstresser's (2008) theory of issuers' manipulation of product returns.

Third, it is found that the disclosed estimated value does not capture some critical information and does not properly reflect the return of ACRCs. From the analysis of disclosed estimated value, the value is found unrelated to the ex-post underlying kurtosis, the shock of underlying skewness, and the probability of the product being called. This shrouded information would lead to an over-estimation of product performance. Also, the estimated value cannot properly reflect the negative effects of the converted product and the coupon loss on the note return gain. The results of analysis suggest that ACRCs with a greater chance to be converted and lower performance are associated with greater estimated value, which is not reasonable. Therefore, if the investors rely on the estimated value disclosed to predict the performance of ACRCs, they are not likely to obtain an accurate result, and this is the reason that the information disclosure is not improved by the regulatory change in 2013.

Still, there is a remaining puzzle about the disclosed estimated value of ACRCs that is beyond the scope of this study. According to Table 1, the average disclosed estimated value adjusted by cost and principal are 0.9788 (0.0062) which means, even accounted for the disclosed issuing cost, the disclosed estimated values of ACRCs are less than the face values (principals). In other words, the investors of ACRCs are paying a premium to the bank, which is contradictory to the CAPM theory. According to CAPM theory, the investors would require a higher expected return as a trade-off of the risks embedded in the investment. For example, the price of a zero-coupon bond should be equals to the principal payment at maturity discounted throughout the holding period and the yield of the bond should be greater than the risk-free rate to reflect the default risk of the issuer. If the selling price is higher than the discounting value, an investor with concave utility will reject the investment. However, the sales of ACRCs are not supported by the negative difference between the disclosed estimated value and principal of ACRCs.

Regarding this puzzle, a possible explanation is that the investors might consider the gap as an additional cost of accessing the payoffs of ACRCs. As suggested by Ross (1989), the structured products should serve as a means for the unsophisticated investors to access complex payoff structure that are not offered by existing products. Thus, the investors may consider the premium as a “cost” for them to access the payoff structure of the product and hence they are willing to pay a premium as a trade-off for the payoff structure of ACRCs. This explanation is also consistent with Carlin (2009) and Célérier and Vallée (2013) that the banks introduced product complexity to strengthen their profits from structured products. When the payoff structure is harder to duplicate, the unskilled investors may will to pay more for the complex payoffs in addition to the fundamental value. Still, further studies are needed to verify this explanation.

## 8 Conclusion

To conclude, *The Bank* relies on information shrouding of the underlying attributes to hinder the investors' analysis of the performance of ACRCs. Even with the products that are associated with a negative mean of realized return, investors still consider ACRCs as a favorable investment. The disclosure of estimated value of ACRCs cannot improve the information disclosure in the sales as the estimated value disclosed does not properly reflect the product performance.

Regarding future research, one possible route is to verify the information shrouding on other structured notes and other issuers, and investigate the relationship between the shrouded information and the product return. Another possible direction is to develop a systematic valuation of structured notes which captures the return and payoff structure of the product, and compare the estimated fair value with the disclosed value. However, a foreseeable challenge will be whether the fair value estimation can properly reflect the underlying attributes.

## References


Baule, R., Entrop, O., & Wilkens, M. (2008). Credit risk and bank margins in structured financial products: Evidence from the German secondary market for discount certificates. *Journal of Futures Markets*, *28*(4), 376-397.

Benet, B. A., Giannetti, A., & Pissaris, S. (2006). Gains from structured product markets: The case of reverse-exchangeable securities (RES). *Journal of Banking & Finance*, *30*(1), 111-132.

Bernard, C., Boyle, P. P., & Gornall, W. (2011). Locally capped investment products and the retail investor. *The Journal of Derivatives*, *18*(4), 72-88.

Bergstresser, D. (2008). The retail market for structured notes: Issuance patterns and performance, 1995-2008. *Harvard Business School, Boston MA*.

Bloomberg Structured Notes Brief. 2017 first quarter review. April 2017.

Bondt, W. F., & Thaler, R. (1985). Does the stock market overreact? *The Journal of finance*, *40*(3), 793-805.

Breuer, W., & Perst, A. (2007). Retail banking and behavioral financial engineering: The case of structured products. *Journal of Banking & Finance*, *31*(3), 827-844.

Burth, S., Kraus, T., & Wohlwend, H. (2001). The pricing of structured products in the Swiss market. *The Journal of Derivatives*, *9*(2), 30-40.

Carlin, B. I. (2009). Strategic price complexity in retail financial markets. *Journal of Financial Economics*, *91*(3), 278-287.

Carlin, B. I., & Manso, G. (2010). Obfuscation, learning, and the evolution of investor sophistication. *The Review of Financial Studies*, *24*(3), 754-785.

Célérier, C., & Vallée, B. (2013, September). What drives financial complexity. In *A look into the retail market for structured products, A Look into the Retail Market for Structured Products (July 1, 2013). Paris December 2012 Finance Meeting EUROFIDAI-AFFI Paper*.

Chen, A. H., & Kensinger, J. W. (1990). An analysis of market-index certificates of deposit. *Journal of Financial Services Research*, *4*(2), 93-110.

Chen, K. C., & Sears, R. S. (1990). Pricing the SPIN. *Financial Management*, 36-47.

Deng, G., Dulaney, T., Husson, T., McCann, C., & Yan, M. (2015). Ex Post Structured-Product Returns: Index Methodology and Analysis. *The Journal of Investing*, *24*(2), 45-58.

Gabaix, X., & Laibson, D. (2006). Shrouded attributes, consumer myopia, and information suppression in competitive markets. *The Quarterly Journal of Economics*, *121*(2), 505-540.

Grinblatt, M., & Longstaff, F. A. (2000). Financial innovation and the role of derivative securities: An empirical analysis of the treasury STRIPS program. *the Journal of Finance*, *55*(3), 1415-1436.

Grünbichler, A., & Wohlwend, H. (2005). The valuation of structured products: Empirical findings for the Swiss market. *Financial markets and portfolio management*, *19*(4), 361-380.

Henderson, B. J., & Pearson, N. D. (2011). The dark side of financial innovation: A case study of the pricing of a retail financial product. *Journal of Financial Economics*, *100*(2), 227-247.

Horne, J. C. (1985). Of financial innovations and excesses. *The Journal of Finance*, *40*(3), 620-631.

Jørgensen, P. L., Nørholm, H., & Skovmand, D. (2011). Overpricing and hidden costs of structured products for retail investors: Evidence from the danish market for principal protected notes.

Kane, E. J. (1985). The gathering crisis in federal deposit insurance. *MIT Press Books*, *1*.

McConnell, J. J., & Schwartz, E. S. (1992). The origin of LYONs: A case study in financial innovation. *Journal of Applied Corporate Finance*, *4*(4), 40-47.

Miller, M. H. (1986). Financial innovation: The last twenty years and the next. *Journal of Financial and Quantitative Analysis*, *21*(4), 459-471.

Mishkin, F. S. (1990). *Financial innovation and current trends in US financial markets* (No. w3323). National Bureau of Economic Research.

Ross, S. A. (1989). Institutional markets, financial marketing, and financial innovation. *The Journal of Finance*, *44*(3), 541-556.

Shapiro, C. (1995). Aftermarkets and consumer welfare: Making sense of Kodak. *Antitrust Law Journal*, *63*(2), 483-511.

Shefrin, H., & Statman, M. (1993). Behavioral aspects of the design and marketing of financial products. *Financial Management*, 123-134.

Silber, W. L. (1983). The process of financial innovation. *The American Economic Review*, *73*(2), 89-95.

Stoimenov, P. A., & Wilkens, S. (2005). Are structured products 'fairly'priced? An analysis of the German market for equity-linked instruments. *Journal of Banking & Finance*, *29*(12), 2971-2993.

Szymanowska, M., Horst, J. T., & Veld, C. (2009). Reverse convertible bonds analyzed. *Journal of Futures Markets*, *29*(10), 895-919.

Tufano, P., & Poetszcher, C. (1996). Financial Engineering and Tax Risk: The Case of Times Mirror PEPS (297-056).

Tufano, P. (2003). Financial innovation. *Handbook of the Economics of Finance*, *1*, 307-335.

Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and uncertainty*, *5*(4), 297-323.

Wallmeier, M., & Diethelm, M. (2009). Market pricing of exotic structured products: The case of multi-asset barrier reverse convertibles in Switzerland. *The Journal of Derivatives*, *17*(2), 59-72.

Wasserfallen, W., & Schenk, C. (1996). Portfolio insurance for the small investor in Switzerland. *The Journal of derivatives*, *3*(3), 37-43.

Wilkens, S., Erner, C., & Röder, K. (2003). The pricing of structured products in Germany. *The Journal of Derivatives*, *11*(1), 55-69.