



What TiVo and JP Morgan teach us about Reverse Convertibles¹

Prior research on structured products has demonstrated that equity-linked notes sold to retail investors in initial public offerings are extraordinarily poor investments. In this paper, we review recent literature and market events and extend our previous work to document the systematic over-pricing of a particular type of enhanced-yield structured product – *Reverse Convertible Notes*. We show that these complex notes are typically significantly overpriced when sold in initial public offerings. As a result of their complex payoffs and the lack of a secondary market to correct the mispricing, reverse convertible notes continue to be sold at inflated prices because investors do not fully understand these products.

Despite this substantial overpricing, and the significant losses on the reverse convertible notes issued in 2008 that matured later in 2008 and 2009, there have been a substantial number of new issues of these dubious investments by JP Morgan, Barclays and many others brokerage firms in 2010. We offer JP Morgan's May 14, 2010 TiVo-linked reverse convertible as an extended illustration of the per se unsuitability for individual investors of many retail reverse convertible structured products.

I. Introduction

In a previous paper², we illustrated the two basic types of equity-linked structured products sold to retail investors in the United States – Principal-Protected Notes and Enhanced-Yield Notes³. In this paper we report the recent developments in our research into one type of enhanced-yield structured products – Reverse Convertible Notes or simply “reverse convertibles.”

Reverse convertibles are short-term notes whose principal repayment is linked to the performance of a stock or a group of stocks. If the underlying stock's price falls

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² See McCann and Luo (2006).

³ By way of examples of our general thesis that retail structured products were over-priced at their initial offering, we reported on the valuation of Merrill Lynch's 7-Year S&P 500 MITTS[®] issued on August 30, 2002, JP Morgan's 5-Year Capped Quarterly Observation Notes linked to the S&P 500 issued on June 22, 2004 and Citigroup's 3-Year, Intel-linked TARGETS[®] issued on February 15, 2005.

below a pre-specified level during the term of the note, investors may receive substantially less than the face value of the notes. Reverse convertibles tend to pay higher coupon rates than traditional notes because they expose investors to much more risk. Whereas the buy and hold investor in a traditional short term note is only exposed to the issuer's credit risk, investors in reverse convertibles are also exposed to the risk of a decline in the price of the reference security. Reverse convertibles are fundamentally notes with embedded short put options. Investors in reverse convertibles are partially compensated for the risk of the embedded short put options with higher periodic coupons. The risk of these embedded short put options was realized by many investors in late 2008 and early 2009 as the notes matured after substantial stock market declines.

We study reverse convertibles because they are common, simple to replicate and value, and because they provide insight into the pricing and sales practices of other equity-linked structured products. We conclude that reverse convertibles sold to retail investors in initial public offerings were dominated by other readily available investments and so are *per se* unsuitable.⁴

Our research is consistent with Henderson and Pearson (2010) who estimate that investors who purchased an aggregate of \$2 billion of short-term SPARQS[®] reverse convertibles from Morgan Stanley in 69 offerings from 2001 to 2005 paid on average 8% more than the securities' true value. Henderson and Pearson (2010) also document that the overpricing in the SPARQS[®] offerings resulted in significant investor losses compared to a direct investment in the reference stock or basket of stocks. They conclude "*it seems unlikely that investor purchases of structured equity products can be explained by any plausible normative model of the behavior of rational investors.*"⁵ More plainly, no rational and informed investor would buy these products.

Reverse convertibles have received a lot of attention lately both in the academic literature and in the popular press.⁶ For example, a 2009 Wall-Street Journal article⁷ raises the concern of whether investors fully comprehend the complexity of these

⁴ See also Laise (Wall Street Journal 2006) and Fisher (Forbes 2006).

⁵ See Henderson and Pearson (2010), page 4.

⁶ See Bethel and Ferrell (2007) for a review of the literature.

⁷ See Light (Wall Street Journal 2009).

investments and whether the brokers selling them fully explain the complexity and structure of these products to the investors.

Regulators have been paying attention to these products as well. The Financial Industry Regulatory Authority (FINRA) fined H&R Block in 2010 for failing to create adequate procedures for supervising sales of reverse convertibles to retail customers and fined and suspended H&R Block broker Andrew MacGill for selling unsuitable reverse convertibles to a retired couple. FINRA Chairman Richard Ketchum commented, *"Reverse convertibles are complex investments which, like many structured products, often entail significant risk of loss. For the typical retail investor, for instance, it would be unwise to put a significant portion of life savings into riskier structured products such as reverse convertibles."*⁸ FINRA followed by issuing an "Investor Alert"⁹ and a "Regulatory Notice"¹⁰ to highlight these concerns.

In the next section, we illustrate the basic problems with reverse convertibles using a recently issued JP Morgan note linked to the price of TiVo stock. We follow this example with a more general discussion of the types of reverse convertibles sold to retail investors in the United States.

II. Case Study – JPMorgan’s TiVo Reverse Convertible

A. TiVo’s stock price reflected patent litigation success and failure

TiVo, Inc. ("TiVo") manufactures and sells digital video recorders, or DVRs, that allow users to record and playback cable television shows at a later time.

In recent years TiVo’s stock price has been largely determined by the evolution of TiVo’s protracted patent infringement litigation with Dish Network Corp. and its parent EchoStar Communications Corp. On June 3, 2009 TiVo’s stock price increased by 43% in response to news that a federal court found that EchoStar was continuing to infringe on TiVo’s patents despite an earlier injunction and awarded TiVo an additional \$103 million in damages. A month later on July 3, 2009 EchoStar was granted a temporary injunction allowing its customers to continue to use EchoStar’s infringing DVRs. This decision

⁸ www.finra.org/Newsroom/NewsReleases/2010/P120914

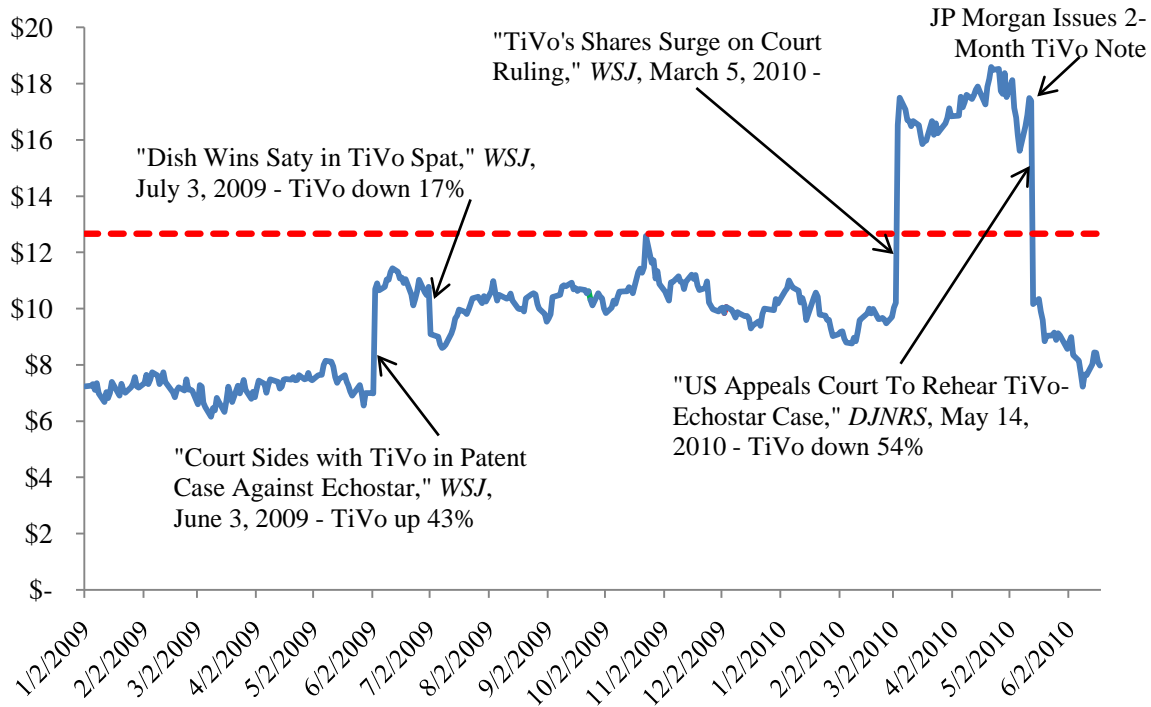
⁹ www.finra.org/Investors/ProtectYourself/InvestorAlerts/Bonds/P120883

¹⁰ FINRA Regulatory Notice 10-09, "Reverse Convertibles", February 2010.

weakened TiVo's bargaining position with EchoStar and TiVo's stock price fell 17%. On March 4, 2010 an appeals court affirmed an earlier \$200 million judgment in favor of TiVo and TiVo's stock price closed at \$16.53 - up 62% from its \$10.21 closing stock price the day before. See Figure 1.

Figure 1: TiVo Closing Stock Price, January 1, 2009 to June 18, 2010.

The three largest one-day changes in TiVo's stock price were all in response to developments in TiVo's patent infringement litigation with two competitors, Dish Network and EchoStar Communications.



B. JP Morgan sells investors a bet on TiVo's litigation fortunes.

On May 14, 2010, JPMorgan Chase & Co. issued \$800,000 in notes linked to the price of TiVo's common stock.¹¹ The notes mature on July 15, 2010 and pay an annualized coupon of 64.25%. On July 15, 2010, in addition to coupon payments, investors in the TiVo-linked note will receive either \$1,000 or the market value of 59.24 TiVo shares if it is less than \$1,000 and TiVo's stock price ever declines below \$12.66 during the note's two-month term.¹² Thus, unlike a traditional note, reverse convertibles

¹¹ The note was priced on May 11, 2010 to settle on May 14, 2010. See SEC filing www.sec.gov/Archives/edgar/data/19617/000119312510119097/d424b2.htm

¹² \$12.66 is 75% of TiVo's \$16.88 closing stock price on May 11, 2010 when JPMorgan set the terms of the TiVo-linked note. The \$1,000 offering price was equal to the value if 59.24 shares of TiVo stock.

like this TiVo-linked note sometimes pay less than the face value of the note at maturity and investors must be fully compensated for this risk with higher coupon rates if the structured product is fairly priced. The high coupon rate on the TiVo-linked note only partially compensates investors for the risk they will receive less than \$1,000 at maturity.

Prior to March 4, 2010, TiVo's stock price had not closed above the note's \$12.66 trigger price since July 14, 2003 and had closed below \$12.66 on 99.8% of the days in the almost 10 years since November 20, 2000. The March 4, 2010 opinion which was being appealed accounted for a large fraction of TiVo's \$18 stock price and all of its excess over \$12.66. Moreover, excluding the daily returns on June 3, 2009, July 3, 2009 and March 4, 2010, the annualized standard deviation of TiVo's daily returns over the prior year was only 42.6%. Thus, it was extremely unlikely that TiVo's stock price would fall below \$12.66 within two months absent a major reversal in TiVo's patent litigation with EchoStar. Therefore, JP Morgan's TiVo-linked note was simply a bet on whether TiVo would suffer a major litigation setback between May, 14, 2010 and July 15, 2010. The stylized payoffs to this bet are listed in Table 1.

	No	Yes
Coupons	\$100	\$100
Maturity Payment	<u>\$1,000</u>	<u>\$600</u>
Total Payments	\$1,100	\$700
Less Issue Price	<u>-\$1,000</u>	<u>-\$1,000</u>
Net Payoff	\$100	-\$300

TiVo's stock price prior to the March 4, 2010 court decision had been around \$10 for many years and \$10 likely represents an upper bound on what the stock price would be if the March 4, 2010 decision was substantially undermined. We assume for simplicity that the note converts into 60 shares of TiVo stock and that JP Morgan's credit risk and the time value of money over the two-month term of the note is negligible. With these simplifying assumptions, investing in the JP Morgan note is equivalent to agreeing to pay JP Morgan at least \$400 if the March 4, 2010 decision was substantially undermined in exchange for a \$100 payment from JP Morgan.

Unfortunately for investors who took this bet with JP Morgan, on the same day the TiVo-linked note offering settled, an Appeals Court reversed the March 4, 2010 decision and TiVo's stock price dropped 42%. On the very first day the \$1,000 notes became almost certain to convert into 59.2417 shares of TiVo stock that were then worth only \$601.90, and which continued to decline such that by the reverse convertible's Observation Date, July 12, 2010, the Maturity Payment was only \$474.53 per \$1,000 face value. Ultimately, investors paid \$525.47 to settle the wager with JP Morgan for which they were paid \$107.08.

This JP Morgan note highlights many of the worst features of reverse convertibles. 1) Brokerage firms link reverse convertibles to extremely volatile stocks, making the embedded short put options extremely costly to investors and valuable to the brokerage firms. 2) Brokerage firms have much better information than retail investors about the events which will trigger the destructive conversion of the notes into shares of depreciated stock. 3) Brokerage firms significantly overcharge retail investors for reverse convertibles because they fail to compensate investors for the risks of the embedded put options and the issuers' credit risk. 4) As a direct result of their high hidden costs and short maturities, reverse convertibles typically have *negative* expected returns.

While TiVo had not been an unusually volatile stock for the past five years, the March 4, 2010 court opinion created significant short term uncertainty about the value of TiVo stock. Over the 12 months prior to May 14, 2010, excluding the three critical litigation-related dates identified in Figure 1, TiVo's stock price had a historical volatility of only 42.6%. Sophisticated market professionals recognized a decision was imminent and could have a dramatic impact on TiVo's stock price. TiVo's short term implied volatility nearly doubled in the two weeks prior to JP Morgan's note offering and declined quickly after the May 14, 2010 court decision.

Even knowing that TiVo's short term implied volatility was unusually high wouldn't fully convey the significant risk of JP Morgan's reverse convertible since the embedded put option was nearly binary. Either TiVo would continue to be worth about \$18 per share over the next couple of months or it would drop back to \$10 per share or less. There was a substantial likelihood that EchoStar's petition would be successful and

a successful petition would almost certainly cause TiVo's stock price to drop below the note's \$12.66 trigger price resulting in substantial investor losses. JP Morgan's prospectus didn't tell investors about EchoStar's pending petition to have the court reconsider its March 4, 2010 ruling even though the only way for the note to convert into TiVo stock and for investors to lose money was if EchoStar's petition was successful. The prospectus only offered the uninformative boilerplate statement, "*Since its inception, the reference stock has experienced significant fluctuations*".

C. JP Morgan overcharged for the TiVo litigation bet and other reverse convertibles

JP Morgan significantly overcharged investors for the TiVo-linked note. Bloomberg valued the note at only \$945 per \$1,000 and we value it between \$945 and \$960 depending on the volatility assumed.¹³ Part of the \$40 to \$55 overcharge was the \$17.50 selling concession that the underwriter, JPMorgan Chase, paid on a note that matured in only two months. On an annualized basis, the selling concession was 10.05%. In addition to steep selling concessions, other hidden embedded costs make reverse convertibles like this note worth much less than their offering price.

The JP Morgan note's \$945 fair value on the issue date is the \$106.94 present discounted value of the coupon payments to be received during the term of the note and the \$838.06 present discounted value of the \$839.60 expected maturity payment to be received on July 15, 2010. The \$839.60 expected maturity payment is the weighted-average of a) \$1,000 received if the note does not convert into TiVo stock and b) the \$652.14 expected value of 59.24 shares of TiVo stock if the note does convert, weighted by the likelihood of a) and b).¹⁴ See Table 2.

Table 2
JP Morgan's TiVo Reverse Convertible
Issue Date Present and Future Value

	Future	Present
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¹³ See Faux (Bloomberg 2010).

¹⁴ The probability of the note converting and the average payment given the note converts are calculated from Monte Carlo simulations based on implied volatilities derived from prices of options on TiVo stock.

			Value	Value
Coupons Payments			\$107.10	\$106.94
Expected Maturity Payment	Payment	Probability		
	Doesn't Convert	\$1,000.00	54%	\$538.90
	Converts	\$652.14	46%	\$300.70
			<u>\$839.60</u>	<u>\$838.06</u>
TiVo Reverse Convertible			<u>\$946.70</u>	<u>\$945.00</u>

On the date JP Morgan issued this note, the *future expected* value of the coupon payments plus the expected maturity payment was only \$946.70. That is, JP Morgan sold investors a note for \$1,000 that exposed investors to substantial risks and yet had an expected total repayment of only \$946.70 when it was scheduled to mature in 2 months. This note's -5.33% 2-month expected return amounts to a -28% annualized expected return and clearly demonstrates that this investment was per se unsuitable.¹⁵

We report the breakdown of the value of JP Morgan's TiVo reverse convertible into the value of the unsecured note and the value of the embedded option in Table 3. The component was worth \$1,105.11 because of the very high coupon and the put option was worth -\$160.11. Investors who purchased this reverse convertible failed to appreciate the put option's cost.

Table 3	
JP Morgan's TiVo Reverse Convertible Note and Option Value	
	Value
Coupon Payments	\$106.94
Note Maturity Payment	<u>\$998.17</u>
Note	\$1,105.11
Put Option	<u>-\$160.11</u>
TiVo Reverse Convertible	<u>\$945.00</u>

The TiVo-linked reverse convertible was not the only problematic structured product recently issued by JP Morgan. In 2010, JP Morgan issued at least 558 structured products, 280 of which were reverse convertibles linked to individual stocks or indices.

¹⁵ Some care is required when interpreting expected returns calculated "in the risk neutral world." These negative expected returns should be compared to the risk free rate of return. Incorporating the equity risk premium and the note's equity exposure would not change the \$945.00 valuation but would increase the expected future value one or two percent.

The average issue date value of JP Morgan's recent reverse convertibles is only \$957.7 per \$1,000. The linked stock price has fallen below the trigger level in 67 of the 280 reverse convertibles issued by JP Morgan. *See* Table 4.

Table 4	
JP Morgan's Reverse Convertibles	
January 1, 2010 to December 31, 2010	
Number of Issues	280
Aggregate Offering Value	\$189.3 million
Average Implied Volatility	45.80%
Average Issue Date Value per \$1,000	\$957.7
Number Already Breaching Trigger	67

D. Barclays also issued a TiVo-linked reverse convertible

JP Morgan was not the only brokerage firm to issue a short-term reverse convertible linked to TiVo's stock after the March 4, 2010 court ruling caused TiVo's stock price to increase dramatically. Barclays issued a similar reversed convertible on April 30, 2010.¹⁶ Barclays' TiVo-linked reverse convertible was worth only \$915.42 when Barclays sold it to retail investors. *See* Table 5 and 6.

Table 5				
Of Barclay's TiVo Reverse Convertible				
Issue Date Present and Future Value				
			Future Value	Present Value
Coupons Payments			\$45.00	
Expected Maturity Payment	Payment	Probability		
Doesn't Convert	\$1,000.00	59.5%	\$594.80	
Converts	\$685.72	40.5%	\$277.85	
			\$872.65	
TiVo Reverse Convertible			\$917.69	\$915.42

The Barclays TiVo-linked note was worth even less than the JP Morgan note because the Barclays note only paid an 18% annualized coupon which provided very little compensation for the embedded put option on TiVo stock. Barclays also did not tell investors about EchoStar's pending petition to have the court reconsider the March 4, 2010 ruling that had caused TiVo's stock price to rise from \$10 to \$18 even though there was a substantial likelihood that EchoStar's petition would be successful and a successful

¹⁶ www.sec.gov/Archives/edgar/data/312070/000119312510099015/d424b2.htm

petition would almost certainly cause TiVo's stock price to drop below the note's trigger price resulting in substantial investor losses.¹⁷

	Value
Coupon Payments	\$44.93
Note Maturity Payment	\$997.53
Note	\$1,042.46
Put Option	-\$127.04
TiVo Reverse Convertible	\$915.42

In 2010, Barclays issued at least 1631 structured products – 1253 of which were reverse convertibles linked to individual stocks or indices. The average issue date value of Barclays' 2010 reverse convertibles is only \$932.0 per \$1,000. The linked stock price has fallen below the trigger level in 339 of the 1,253 notes. *See* Table 7.

Number of Issues	1,253
Aggregate Offering Value	\$1.64 billion
Average Implied Volatility	45.8%
Average Issue Date Value per \$1,000	\$932.0
Number Already Breaching Trigger	339

III. Three Reverse Convertibles Types

Reverse convertibles have been sold by many different brokerage firms in addition to JP Morgan and Barclays, including Citigroup, Morgan Stanley, Wachovia, Lehman Brothers, Royal Bank of Canada, and ABN AMRO. Although many firms have branded their reverse convertibles, most are similar in structure.

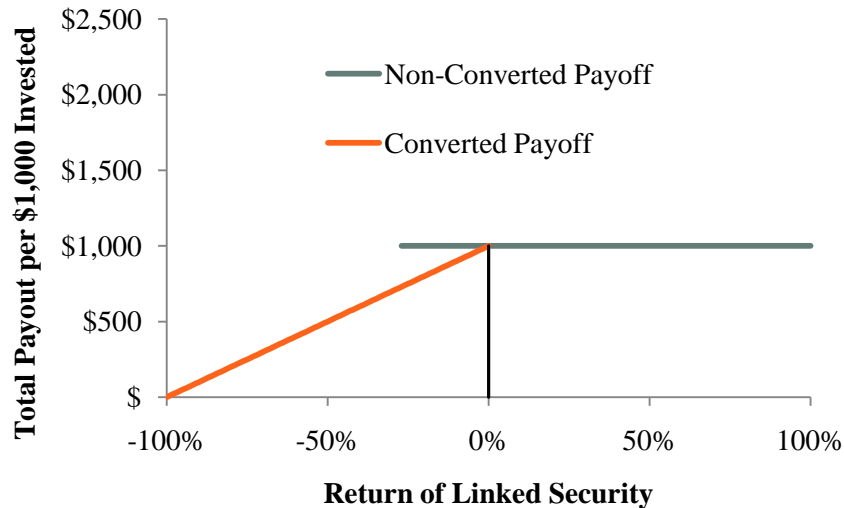
A. Basic Reverse Convertibles

The basic reverse convertible design is an unsecured note issued by the brokerage firm with a short contingent put option on the referenced security. The put option can only be exercised by the brokerage firm if the referenced security's stock price falls

¹⁷ The closing value of TiVo on the Observation Date, July, 27, 2010, was \$8.93. Ultimately, at maturity an investor receives \$503.38 per \$1,000 face value plus the total coupon payments which sum up to \$45.

below a threshold price at some point during the term of the note. This type of contingent option is typically referred to as a “knock-in” option. If the referenced security’s price never drops below the threshold, the reverse convertible note will pay investors the face value of the note at maturity. If the price of the referenced security does drop below the threshold, the reverse convertible note will pay the lesser of the face value of the note and the market value of the number of shares of the referenced security which could have been purchased on the note’s pricing date with \$1,000. *See* Figure 2.

Figure 2: Maturity payoffs of a basic reverse convertible note.



On April 30, 2010 Barclays issued \$750,000 of reverse convertible notes referencing the common stock of the Stillwater Mining Company (ticker: SWC).¹⁸ Barclays’ Stillwater-linked notes were sold in \$1,000 units, matured on July 30, 2010 and paid a 12% annualized coupon. When the notes were priced, Stillwater’s stock price was \$16.51 and the threshold was set at \$12.38 per share. There are three potential payouts:

- 1) If Stillwater’s stock price does not fall below \$12.38 before July 30, 2010 investors will receive the \$1,000 face value of the note at maturity.
- 2) If Stillwater’s stock price falls below \$12.38 before July 30, but rebounds back above \$16.51 on July 30, the investors will receive the \$1,000 face value of the notes at maturity.

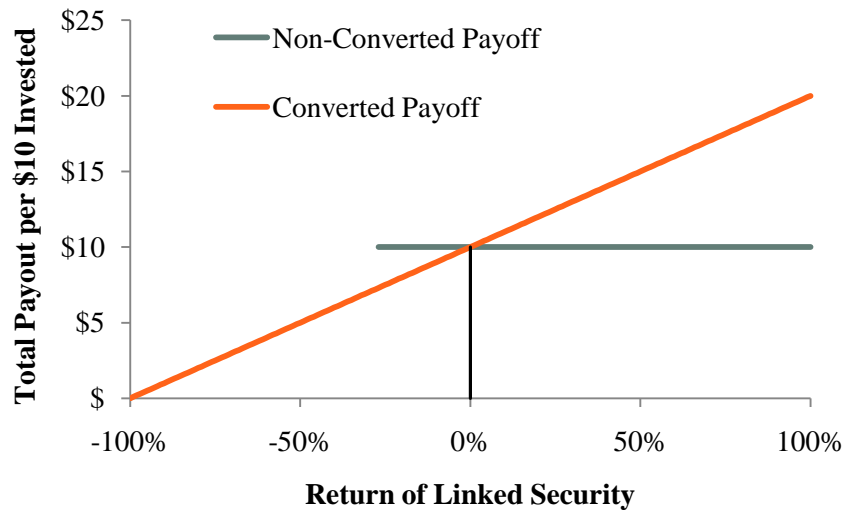
¹⁸ www.sec.gov/Archives/edgar/data/312070/000119312510099015/d424b2.htm

- 3) If Stillwater's stock price drops below \$12.38 before July 30, 2010 and is still lower than \$16.51 on July 30, investors will receive the market value of 60.57 shares of Stillwater, which will then be worth less than \$1,000.

B. ELKS[®]

ELKS[®] are reverse convertibles that have a contingent forward contract, instead of a put option, attached to the issuer's note. If the reference security's price falls below the threshold price, the note effectively converts into a non-dividend-paying equity investment in the reference security and the note's payment at maturity becomes a multiple of the reference security's price on the valuation date.¹⁹ See Figure 3.

Figure 3: Maturity payoffs of an ELKS[®]



On May 27, 2010 Citigroup issued \$11.8 million of an ELKS[®] reverse convertible note linked to the price of Yahoo! stock (Ticker: YHOO), with a 12% coupon and a six month term.²⁰ Citigroup issued the note when Yahoo!'s stock price was \$15.54 and set the threshold price at \$12.43 or 80% of Yahoo!'s \$15.54 initial price. This ELKS[®] had two potential payouts at maturity:

- 1) If Yahoo! stock price does not fall below \$12.43 during the note's term, investors will receive the \$10 face value of the note.

¹⁹ The multiple is equal to the face value of the note divided by the initial price of the reference security.

²⁰ www.sec.gov/Archives/edgar/data/831001/000119312510129509/d424b2.htm

- 2) If during the note's term, Yahoo!'s stock price falls below \$12.43, investors will receive the market value of 0.2681 shares of Yahoo! which may be worth more or less than \$10 depending on whether Yahoo!'s stock price is then greater or less than \$15.54.

C. SPARQS[®]

SPARQS[®] are reverse convertibles that convert from equity-like payoffs to debt-like payoffs at the discretion of the issuer. If the issuer does *not* exercise its call option, the payout will be the value the coupons paid plus the value at the valuation date of the number of the reference security's shares which could have been purchased on the structured product's offering date for the face value of the note. If the issuer does exercise the call option, the note is liquidated on the call date and investors are paid an amount so that they earn a pre-specified annualized return (the "yield to call") on the note's face value. SPARQS[®] are similar to basic reverse convertibles since stock and short call options have payoffs which are quite similar to notes and short put options. In both cases, investors are exposed to the downside risk of the reference security with little or no participation in the security's upside.

On March 24, 2008 Morgan Stanley issued \$20 million of a 10% coupon paying SPARQS[®] with a \$19.015 face value.²¹ This note was issued with AT&T's stock as the reference stock and a term of 12 months. Morgan Stanley had the right to call the note any time during the last 6 months in exchange for a payment that would make the realized "yield-to-call" equal to 19%. This note has two potential payout scenarios:

- 1) If Morgan Stanley does *not* call the reverse convertible, the note-holder will receive coupon payments and the market value of 0.5 shares of AT&T.
- 2) If Morgan Stanley calls the reverse convertible, the note-holder will receive coupon payments due plus an amount sufficient to yield a 9.5% return (i.e., a 19% annualized return).

We analyze 101 SPARQS[®] issued by Morgan Stanley since June 2001 with an aggregate size of \$2.97 billion. All are linked to the returns of single stocks. The

²¹ www.sec.gov/Archives/edgar/data/895421/000095010308000803/dp09258_424b2-ps540.htm

SPARQS[®]'s average term is 1.1 years, with a maximum of two years. The notes' embedded call options have strike prices that generate annualized yields to call between 15% and 53% with a mean of 22.8%.

Table 8 reports summary statistics of a sample of additional reverse convertible note offerings between 2001 and 2010. Wachovia issued the most basic reverse convertibles in our sample by dollar value and Lehman Brothers issued the most by number of individual issues. Citigroup issued ELKS[®] until its retail brokerage unit was acquired by Morgan Stanley and now Morgan Stanley issues ELKS[®]. Morgan Stanley issues SPARQS[®].

Issuers	Brand Name	Issues	\$ Millions
UBS	Reverse Convertibles	49	\$12
Lehman Brothers	Reverse Exchangeable Notes	78	\$53
RBC	Reverse Convertibles	43	\$67
Morgan Stanley	ELKS [®]	28	\$148
Morgan Stanley	Reverse Convertibles Notes	42	\$216
Wachovia	EYS [®]	50	\$701
Morgan Stanley	SPARQS [®]	101	\$2,970
Citigroup	ELKS [®]	141	\$6,375

IV. Valuing Reverse Convertibles

We value a sample of 262 basic reverse convertibles, 169 ELKS[®] and 101 SPARQS[®] described in Table 8 and report the results in Table 9.²² All 262 basic reverse convertibles were issued at a face value of \$1,000, but our valuations show that on average they were worth substantially less than \$950. Some Lehman Brothers' reverse convertibles were worth as little as \$779.²³ On average, the reverse convertibles we analyzed paid investors including coupons much less than \$1,000. Total payments made by issuers other than Lehman ranged from \$811 per reverse convertible note to \$1041. We estimate the fair value of ELKS[®] at between \$8.66 and \$9.94 per \$10. 92 of the 96 Citigroup offerings have matured and returned an average of \$9.85 per \$10 note.

²² See Deng, Guedj, Liu, Mallett, and McCann (2010) and Li (1998) for an extensive methodological discussion.

²³ Lehman Brothers defaulted on all their 78 reverse convertibles in our sample. This highlights the inherent risk in reverse convertibles that investors may underestimate, default risk.

Following Henderson and Pearson (2010), we estimate the issue date valuation of SPARQS[®] using a finite-difference estimation method. The reverse convertibles expose investors to the downside market risk of the underlying security and the credit risk of the issuer. On average, the issue date value of the 101 SPARQS[®] is 93% of the SPARQS[®]'s issue price. The lowest issue date value is 78.6% of the issue price, and the highest issue date value is 99.4% of the issue price. Interestingly, SPARQS[®] are worth less on their issue date than basic reverse convertibles or ELKS[®], perhaps because SPARQS[®] are much more difficult to replicate and price than basic reverse convertibles or ELKS[®].

Issuers	Issues	Positive returns	Price Issued	Average Fair Value	Range Fair Value	Average Payout
Basic Reverse Convertibles						
UBS	49	44	\$1,000	\$948	\$880-\$1001	\$1,041
Lehman Brothers	78	0	\$1,000	\$937	\$779-\$987	\$0
RBC	43	31	\$1,000	\$968	\$927-\$1,007	\$975
Morgan Stanley	42	18	\$1,000	\$934	\$879-\$960	\$811
Wachovia	50	35	\$1,000	\$938	\$908-\$972	\$979
ELKS[®]						
Citigroup	141	102	\$10	\$9.5	\$8.66 – \$9.94	\$9.85
Morgan Stanley	28	22	\$10	\$9.5	\$9.09 – \$9.66	\$10.34
SPARQS[®]						
Morgan Stanley	101	NA	\$100	\$93.3	\$78.6 - \$99.4	NA

V. Risk Analysis

Reverse convertibles expose investors to significant downside risk and limited upside potential. We develop two measures based on negative and positive semi-variance to illustrate the risk of the reverse convertible.²⁴ The first measure, Relative Downside Risk (RDR), compares the reverse convertible's risk of earning less than the risk-free rate to the reference security's risk of earning less than the risk-free rate. An RDR of 0% means that the reverse convertible's return is never less than the risk-free rate or return. Conversely, an RDR of 100% means that the reverse convertible exposes investors to the

²⁴ Semi-variance is a measure of the dispersion of all observations that fall below the mean or target value of a data set. Semi-variance is similar to variance; however, it only considers observations below the mean. Hence, semi-variance provides a measure for downside risk. By neutralizing all values above the mean, or an investor's target return, semi-variance estimates the dispersion of losses that a portfolio could incur.

same risk of earning less than the risk-free-rate that the investors would experience if they invested in the reference security.²⁵

We follow Nawrocki (1999) to calculate the RDR and use simulations to evaluate the RDR of reverse convertibles. We simulate 50,000 price paths for each structured product's underlying security, and use the simulated price paths to calculate 50,000 holding period returns for each reference security and its associated structured product. Table 10 presents summary statistics for the RDR of the 344 reverse convertibles in our sample. The data indicates that, on average, reverse convertibles are exposed to 74% of the reference security's downside risk.

	RDR		RUP		Issues
	Range	Mean	Range	Mean	
Reverse convertibles	60%-88%	75%	8%-40%	18%	262
ELKS [®]	67%-84%	74%	11%-39%	24%	169

Relative Upside Potential (RUP) compares the reverse convertible note's possibility of earning more than the risk-free interest rate to the reference security's possibility of earning more than the risk-free rate. A RUP of 0% means that the reverse convertible note's return never exceeds the risk-free rate of return, regardless of what the reference security's return is.²⁶ A RUP of 100% means that investors enjoy the same upside potential above the risk-free-rate as if they had invested in the reference stock rather than the reverse convertible note.

The RUP of basic reverse convertibles is generally substantially lower than 100% as reverse convertibles do not participate in any of the gains of the reference security. The RUP of reverse convertibles really measures how much the reverse convertible's coupon payments exceed the risk-free rate or return. The RUP of ELKS[®] reflects both the difference between the coupon payment and the risk-free rate of return and the ELKS[®] exposure to the reference security's upside potential.

²⁵ The RDR of reverse convertibles is generally less than 100% because the reverse convertibles' trigger feature, which prevents the issuer from exercising its option(s) unless the reference security drops below a certain level, effectively protects investors from small losses sustained by the reference security.

²⁶ Any investment with an RUP of 0% and a non-zero RDR would be a poor investment, as it would expose the investor only to potential losses but not commensurate the investor with any gains.

It might seem that the average RUP of ELKS[®] would be substantially higher than that of basic reverse convertibles since the ELKS[®] allows an investor to participate in the reference security's gains if the reference security falls and then rises back above the issue-date price. However, we find that the RUPs of ELKS[®] and basic reverse convertibles are indistinguishable. This lack of upside benefit is because ELKS[®] have smaller coupon payments than basic reverse convertibles and because there is little value in the exposure to the reference security's upside potential once the security's price has fallen enough to cause the note to convert into stock.

On average, reverse convertibles share a large portion of the reference security's risk of returning less than the risk free rate, while sharing only a small portion of the likelihood of returning more than the risk free rate.

VI. Conclusions

Reverse convertibles are common structured products which have payoffs that are relatively easily replicated and hence are simple to value. After estimating the issue date value of 2,111 reverse convertibles we find that, on average, the reverse convertibles were only worth 93% of their offering price. Of these 2,111 notes, 492 have matured which allows us to calculate their realized yield to maturity. The yield to maturity, which is the discount rate that makes the present value of the reverse convertible note's actual cash flows equal to the note's issue price, is on average -25.6%. The realized yields to maturity range from -99.99% to 46.1%. These numbers highlight the high, unnecessary costs incurred by investors buying reverse convertibles.

The vast majority of reverse convertibles could have been replicated for less than the reverse convertible note's issue price. Given the complex nature of the products' payoffs, the unsophisticated clientele to which they were sold, and the lack of a secondary market to correct the mispricing, it is quite likely that these reverse convertibles were sold at a premium because investors did not fully understand the products and their risks.

VII. Bibliography

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