A Methodology For Computing and Comparing Implied Equity and Corporate Debt Sharpe Ratios

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Abstract

This paper presents a macro-economic methodology for evaluating the forward-looking Sharpe Ratios of the equity and debt components of the United States public company capital structure. Using this framework, it is shown that the equity and debt Sharpe Ratios are both time variant and disparate. The methodology is used to review the risk aversion behavior of equity and debt market participants surrounding the past three major market events, the 1987 crash, the 2000-2001 Internet bubble and the 2008-2009 credit crisis. This paper then offers market segmentation and the differing behavior of equity and corporate bond investors as an explanation for the observed Sharpe Ratios. The observed results support the use of dynamic asset allocation as it relates to portfolios of equities and corporate bonds.

1 Introduction

Much attention has been given to the study of historical and expected risk premiums and Sharpe Ratios. There is debate as to whether the appropriate measure for valuation is an ex-post or ex-ante risk premium, whether these measures are dynamic in nature and, if so, what the causes are for this behavior. Although the equity risk premium has received the bulk of researchers' attention, the debt risk premium has also been studied extensively.

For corporate debt, in addition to studying general equilibrium models, a significant amount of research has been related to the use of Merton type models (1973) to arrive at debt values starting from available equity information. Since Merton models are partial equilibrium models, the approach neither can nor should be expected to provide any insight into risk premiums.

Since equity and corporate debt claims originate from the same assets, integrated markets should result in equivalent Sharpe Ratios for equity and debt, and this is an underlying assumption of the one-factor Merton model. In fact, Modigliani and Miller's landmark theorem (1958) requires that risk be priced the same for the equity and debt components of the firm. The purpose of this paper is to present a unified approach to examine and allow for differing equity and corporate debt Sharpe Ratios, evaluate these ratios through several market periods, and to offer market segmentation and the differing behavior of equity and corporate bond investors as an explanation for the observed differences. The observance as well as explanation for differing Sharpe Ratios supports the argument for tactical or dynamic asset allocation, at least as it relates to portfolios of equities and corporate bonds.

2 Equity and Debt Sharpe Ratios

The risk premium in equity securities is compensation for the systematic uncertainty surrounding expectations for future cash flows.

Equity risk premiums have been studied extensively and there is a wealth of literature on what has become known as the equity risk premium puzzle where observed premiums do not fit levels consistent with constant relative risk aversion utility models (Mehra 1985). Books have even been written on the subject (Cornell 1999). There have been many attempts to resolve this puzzle. For example, Campbell and Cochrane (1999) developed a consumption-based model that showed that habit could account for varying risk premiums. See Mehra (2003) for a comprehensive review of the various models proposed to resolve the puzzle.

However, historical, or ex-post, risk premiums are not the only way to measure risk premiums. Ex-ante equity risk premiums reflect premiums embedded in current prices to reflect the uncertainty of future cash flows. These ex-ante premiums can be arrived at by either survey (Welch 2000 and 2009) or by calculating implied premiums using current market and economic information. For example Damodaran (2011) uses a two-stage dividend growth model and prevailing long-term treasury rates to back out a risk premium. Using ex-ante risk premiums, Doran, Ronn, and Goldberg (2005) have shown that the equity Sharpe Ratio, which is a measure of risk aversion is time varying, and that the time variation can be explained as a function of investor sentiment arising from a wealth effect.

Risk premiums for corporate bonds have been studied in both general and partial equilibrium frameworks. Similar to the equity risk premium puzzle, there is a credit risk puzzle since observed corporate bond spreads are far in excess of the compensation required to recover historical defaults.

Huang and Huang (2003) studied credit spreads and found that credit risk accounts for only a small fraction of the observed yield spread for corporate bonds, and that the credit risk premium is systematic in nature. Hull, Predescu and White (2005) found that credit spreads might include some compensation for unsystematic risk because it is hard to hold a diversified portfolio of corporate bonds. Chen, Collin-Dulfresne and Goldstein (2009) found that structural models modified to incorporate varying Sharpe Ratios could explain credit spreads in excess of historical default rates. Finnery and Leistikow (1993) found that debt risk premiums are not mean reverting.

Elton and Gruber, et al. (2001) proposed that the promised yield reflects both compensation for default and a risk premium, and showed that the compensation for default makes up a small portion of the spread, with most of the spread representing a risk premium.

The approach this paper follows is that, similar to the equity case, the risk premium for debt securities is compensation for the systematic uncertainty surrounding expectations for future bond payments. These expectations for future bond payments are the default and recovery adjusted interest and principal payments. As with equity securities, the debt risk premium is a product of the level of uncertainty and the price of risk being charged by investors.

Standard and Poor’s and Moody’s have rating specific default and recovery data stretching back nearly 100 years. For a bond issued with a certain rating, there is a rich history of the expected cumulative default and recovery values for debt of various maturities. For example, based on Moody’s data an A rated 10 year bond has a cumulative loss probability over the 10 years of 3.13%.

Since the purpose of a bond rating is to assess the likelihood of repayment, it is reasonable to assume, that at any given point in time, the historical cumulative default information is the best estimate for expected future default. Meaning, an A rated security has the same likelihood of default over the next 10 years as it had in prior 10-year periods. While it is true that the rating agencies have come in for some well-deserved criticism for the ratings of recent exotic securities, they have a long and rich history of rating plain vanilla corporate bonds.

Thus, a company's bond spread can be decomposed into expected recovery adjusted default compensation and a risk premium. During periods of economic stress, there is greater uncertainty regarding the long-term default estimate and likely an increase in risk aversion leading to a higher price for risk. Combined these two factors lead to higher risk premiums.

Looking at the behavior of Johnson and Johnson's credit default swap data over the 2007-2010 period shows an illustration of this risk premium effect. For an AAA rated security, Moody's cumulative default probability for 5-year debt is 0.164% and there is an expected 40% recovery in the event of default. Amortizing this default cost over 5 years yields 2 bps a year, approximately 20% of the J&J spread in 2007 of 10 bps. At the height of the credit crisis, J&J's 5-year CDS spread ballooned out to 150 bps. J&J was still a successful AAA rated company and it is unlikely that investors' perception of J&J's expected default likelihood had changed, but rather that the uncertainty surrounding the default estimate had increased and that investors' risk aversion and therefore their price of risk had also increased. The result was a significant increase in risk premium.

As stated earlier, in perfectly integrated markets, the Sharpe Ratios of the equity and debt components of the capital structure should be equivalent and equal to the Sharpe Ratio of the firm. Bhamra, Kuehn and Strebulaev (2009) combined a structural model of credit risk with a consumption-based asset-pricing model and found that both equity and debt are subject to the same risk factors. Goyenko and Ukhov (2009) showed a linkage between liquidity and volatility of equity and treasury markets. Allen and Gottesman (2005) found that the equity and syndicated loan markets are integrated as it relates to the dissemination of information. However, Damodaran (2011) found a variation of the ratio of equity risk premium to credit spread over time.

Market segmentation could lead to differing Sharpe Ratios as investors do not move freely from one market to the next and therefore do not arbitrage away risk free opportunities. Market segmentation has been studied across geographic markets. For example, Berben and Jansen (2005) found that European and US equity and government bond markets have become more integrated. De Jong and de Roon (2005) developed a pricing model for partially segmented equity markets that results in an extra risk premium for emerging markets. Kang-por fung, Chi-sang Tam, and Ip-wing Yu (2008) developed a model that shows interdependence of risk aversion across major international equity and government bond markets. Most relevant to the work of this paper, Titman (2002) proposed that market segmentation may exist in U.S. markets and suggested that this may be an opportunity for corporate treasurers to actively manage their capital structure.

This paper looks to study the expected Sharpe Ratios of both the equity and debt sides of the corporate capital structure without requiring equivalent Sharpe Ratios. Rather than looking at individual stocks, the S&P 500 is taken as the proxy for the US equity market and a BBB bond index is used as the proxy for the US debt market. A BBB index is an appropriate bond index since the average bond rating of the S&P 500 is BBB+, based on the ratings of 435 rated companies. In effect, one large US firm is analyzed, where the market value of the S&P 500 was $11Trillion in 2010 and the US investment grade bond market was approximately $6 Trillion. By using these large indexes, the risks and returns reflect the non-diversified systematic risks.

What follows is the model underlying the equity and debt Sharpe Ratios, the methodology for collecting the data and generating the Sharpe Ratios, and a review of the results.

3 The Model

Equity Sharpe Ratio

Similar to Doran, et al., the expected equity Sharpe Ratio is derived from the Gordon growth model and the Sharpe-Linter security market line. Under the constant-growth model,

$$K_{Et} = D_{ot}(1+g_t)/ P_t + g_t \quad (1)$$

Where

K_{Et} =Expected return on the equity asset as of date t

P_t = Price of equity asset at date t

D_{ot} = Dividends paid over the past 12 months, as of date t, and assumed to satisfy the relationship $D_{1t} = D_{ot}(1+g_t)$

g_t = Perpetual dividend growth as of date t

From the security market line, at date t,

$$K_{Et}= r_{et} + \lambda_{et}\sigma_{et} \quad (2)$$

Where

r_{et} = Risk free rate for equity

λ_{et} = Sharpe Ratio for equity

σ_{et} = Equity market's annualized volatility, as of date t

Equating eq. (1) and (2) results in

$$\lambda_{et} =[D_{ot}(1+g_t)/ P_t + g_t - r_{et}] / \sigma_{et} \quad (3)$$

where λ_{et} is an observable datum.

Debt Sharpe Ratio

The expected return for corporate bonds is defined as:

$K_{dt} = M_{dt} - D_t$ (4)

Where

K_{dt} = Expected return on debt after adjusting for expected default and recovery, at date t

M_{dt} = Market return on debt at date t

D_t = Expected annualized cost of default after recovery, at date t

To arrive at D_t,, the present value of the expected default after recovery for each of the coupons and principal amount is calculated

$PVD_t = \sum_{n=1 \text{ to } N} PV_n[C_n*PD_n*(1-R)] + PV_N[PA* PD_N*(1-R)]$ (5)

Where

PVD_t =Present value cost of expected default after recovery for all coupons and principal

PV_n = Present value factor of cash flow at time n discounted at M_{dt}

C_n = Coupon at period n

PD_n = Expected cumulative probability of default from time 0 to time n

R = Expected recovery percentage after default

PA = Principal amount at time N

The long-term expectation for R is assumed to be constant, thus:

$PVD_t = (1-R) \sum_{n=1 \text{ to } N} PV_n[C_n*PD_n)] + PV_N[PA* PD_N]$ (6)

And then

$D_t = PVD_t / \sum_{n=1 \text{ to } N} PV_n$ (7)

From the security market line, at date t,

$K_{dt}= r_{dt} + \lambda_{dt}\sigma_{dt}$ (8)

Where

r_{dt} = Risk free rate

λ_{dt} = Sharpe Ratio for debt

σ_{dt} = Debt market's annualized volatility, as of date t

Equating eq. (4) and (8) results in

$$\lambda_{dt} = [\, M_{dt} - D_t - r_{dt} \,] / \sigma_{dt} \qquad (9)$$

where λ_{dt} is an observable datum.

To isolate the effects of corporate bond spreads,

$$\lambda_{st} = [\, M_{dt} - D_t - r_{dt} \,] / \sigma_{st} \qquad (10)$$

where

σ_{st} = Debt spread's annualized volatility, as of date t

and λ_{st} is an observable datum.

4 Data and Methodology

Equities

Daily stock prices were collected from Bloomberg for January 1986 through December 2010. Quarterly dividends for the S&P 500 were collected from Standard and Poor's. In order to utilize the most recent available information, D_{ot} was set equal to 4X the most recent quarterly level. 10-year GDP projections are used as the proxy for long-term dividend growth for the S&P 500. The data for the 10-year GDP growth forecast for the period December 1990 through December 2010 comes from the Livingston Survey, which provides semi-annual forecasts from industry, government, banking and academia. For the 1986 through 1990 period, the long-term GDP growth rate forecast is collected from the annual Congressional Budget Office economic forecasts.

A refinement of the model might be to use a two-stage dividend growth model with explicit S&P dividends forecast for the forward 1-2 years prior to reverting to the long-term GDP forecast. However, this would require a consistent historical set of near term S&P 500 dividend forecasts, which is not known to be available. It is unlikely that such a series would greatly add to the precision of the analysis during most market periods.

Using the most current dividend as the basis for future payments could be inconsistent with market expectations during periods of market crisis. For example, during the fall of 2008, the expected return and risk premium calculated from this model are 7.64% and 4.0% respectively, based on a dividend of $28 per share of the S&P. The semi-annual Livingston Survey includes a forecast of corporate profits. In December 2008, the one-year forward forecast was for a 2% drop in profits. Using the profit growth forecast as a proxy for dividend growth expectations, a dividend decline of 2% for the following year, prior to returning to a 5% growth rate, results in a return and premium decline of 0.35%.

To arrive at σ_{et} , 60 day trailing return volatility is calculated using the price changes in the S&P 500, with the daily result being annualized by multiplying by SQRT of 256 trading days. 60 days was chosen as a period long enough to produce a reasonable data stream but no so long that the information is dated. It would be preferable to use VIX or, better still, a market measure of long-term implied volatility, but there is no historical series of implied long-term volatility and, while VIX and VXO data are available, there is no comparable volatility measure available for corporate bonds dating back to 1986. [See below.] When comparing equity and debt Sharpe Ratios, as well as relative changes in the two Sharpe Ratios, it was decided that it would be best to utilize the same method for calculating volatility. As a test of the usefulness of the trailing return series to act as a proxy for expected volatility, a regression of VIX versus trailing 60-day volatility was run for the period from 1986 through 2010. The correlation of the two series is 0.85 with VIX averaging approximately 25% higher than the trailing volatility. See Exhibit 10. For the risk free rate for equities, r_{et}, daily 10-year Treasury rates were collected from Bloomberg. The 10-year Treasury rate was used as the best estimate for the long-term average of future expected short-term rates and is consistent with a long-term growth model where dividend growth is projected well into the future. The use of the 10-year Treasury rate ignores any term or risk premium incorporated in the treasury yield curve. 30-year Treasury rates were considered but rejected as those securities have not always been as liquid as 10-year notes and there is considerable volatility in the spread between the 10-year and 30-year notes, likely reflecting significant term premium dynamics between these two securities.

Bonds

The average corporate bond rating of the S&P 500 is BBB+, based on the bond ratings of 435 rated companies. As a proxy for the S&P 500 corporate bond universe, daily yields of Moody's Baa index of seasoned corporate bonds were collected from the Federal Reserve for the period January 1986 to December 2010. These bonds have maturities ranging from 20-30 years, corresponding to a duration of approximately 12 years. To arrive at corporate spreads, the average of the daily 10-year and 30-year treasury yields were subtracted from the Moody's series.

As a check on the robustness of this series, the Moody's series was compared to the Merrill Lynch Corporate Bond Master Index (COAO) for investment grade bonds that is available for the 1997-2010 period. COAO has an average duration of 7 and the average rating for the index is A3, so the quality of the COAO index is slightly higher and the duration of the Moody's index is longer. Both of these factors would point to slightly higher spreads for the Moody's index. Over the 1997-2010 period, the average rate of the Moody's index is 1.15X the COAO index, and the average spread is 1.42X, consistent with longer duration and the general existence of a positively sloped credit spread curve. Most important, the correlation between the two series is 0.92 for rates and 0.96 for credit spreads.

To calculate D_t , corporate default and recovery data was taken from the Moody's 2009 study of defaults for the 1920-2008 period. Specifically, a schedule of yearly cumulative probability of default data was taken for the 20 years following corporate issuance for Baa companies. The average recovery rate for bonds that default is 40%. However, while the probability of default expectations and recovery rates are assumed to be stable over the long-term, both factors are subject to variability, which is the leading source of the bond risk premium. For example, although the average ten year cumulative probability of default for BBB debt has been 4.4% over the 1970-2008 period, 10-year cohorts ranged from 1.15% in 1991 to 9.55% in 1982. Similarly, according to Moody's, the recovery rate for all senior unsecured debt averaged 32% for the 1987-2008 period, though the recovery rates for 2007 and 2008 were 57% and 26%, respectively. Recovery rates are based on 30-day post-default trading prices.

Daily 10-year and 30-year treasury yields were collected from Bloomberg for the January 1986 through December 2010 period. As noted above, the risk free rate, r_{dt}, is the average of the two yields. There is no inconsistency in using the longer treasury rates for the bond risk free rate compared to the equity risk free rate since, for the bond case, the spread is being isolated and any additional term premium embedded in the 30-year treasury rate is also embedded in the corresponding corporate bond yield.

To arrive at σ_{dt} , 60 day trailing return volatility is calculated using the yield changes in the bond index that are then converted to price changes using the duration factor. Multiplying by SQRT of

256 trading days annualizes the daily result. As noted above, there is no comparable measure to VIX for the corporate bond universe. The closest proxy is SMOVE, which is a Merrill Lynch index of implied swaption volatility, which is an indirect measure of the volatility of the banking system. SMOVE data is available back to 1997 and the series was compared to the Moody's bond series. Over the 1997-2010 time period, the correlation between the SMOVE and Moody's Baa series was 0.8 and duration adjusted SMOVE averaged 31% above the Moody's 60-day trailing volatility.

To isolate the effect of corporate spreads from the rate contribution to the debt Sharpe Ratio, it is necessary to calculate the volatility of the bond due only to spread moves. σ_{st} is calculated using 60 day trailing daily spread history determined by subtracting treasury yields from bond yields. Multiplying by SQRT of 256 trading days annualizes the daily result.

5 Discussion of Results

The 1986-2010 period exhibited highly dynamic, yet largely independent equity and debt Sharpe Ratios series, with a correlation -0.1. The correlation of the percentage changes in equity and debt Sharpe Ratios is 0.1. Removing the fixed rate component from the debt and just looking at the relationship of credit spread Sharpe Ratios versus equities Sharpe Ratios results in a correlation of 0.1. [See Exhibits 1-2.] Daily returns of stocks and bonds, with and without the fixed rate component, also have low correlations of 0.02 and 0.01, respectively.

The period of 1986-2010 contained three major stock market events, the 1987 Crash, the 2000-2001 Internet Bubble, and the 2008-2009 Credit Crisis. [See Exhibit 4.]

For all three events, equity and debt risk premiums narrowed prior to the market bottoms, contributing to decreased Sharpe Ratios, which indicated a greater appetite for risk. Following all three events, risk premiums increased, generally more than offsetting declines in volatility, resulting in periods of greater risk aversion. The difference is that the memory of the market events appears to have persisted for a longer time period for equities versus debt.

These periods are reviewed below.

1987 Market Crash

The equity Sharpe Ratio began a substantial decline in early 1987, as stock prices rose, falling from 0.3 to approximately zero in October 1987, coinciding with the sudden market crash. [See Exhibit 5.] Greater risk aversion, as characterized by an increasing Sharpe Ratio, followed the crash and then increased again following the 1990 stock market correction. The ratio reached a peak in excess of 0.6 in the fall of 1993. At this point risk aversion began a decline, culminating in the stock market sell-off of 2000-2001. In total, a period of six years transpired from the time of the 1987 crash until investor appetite for risk began to increase.

The debt Sharpe Ratio time series did not display similar behavior during the 1987-1993 period; rather there were multiple periods of short duration increases and decreases. There was a short period of greater risk-taking in 1987 leading up to the equity market crash, but the ratio rapidly recovered and then continued to oscillate through the fall of 1993.

2000-2001 Internet Bubble

The equity Sharpe Ratio declined during the late 1990s, reaching zero in January 2000, coinciding with the market peak. [See Exhibit 6.] Risk aversion began to increase, in conjunction with the decline in the equity market, and continued the increase well after the market bottomed and began its recovery. The ratio reached a final peak in excess of 0.4 in February 2007. Risk aversion then began to decline, once again culminating in the stock market bottom reached in late 2008-early 2009. A period of four years transpired from the market bottom in 2002 to the end of the high-risk aversion period in 2007, but the full period of increasing risk aversion spanned six years.

The debt Sharpe Ratio oscillated during the late 1990s-early 2000s, with risk aversion rising and falling quickly, likely in response to a number of macro events, including the Asian and Russian debt crisis, the LTCM collapse and the Internet bubble. Risk aversion began a sustained decline in 2003 that continued until the credit crisis began in late 2007.

2008-2009 Credit Crisis

The equity Sharpe Ratio began a significant decline in early 2007 prior to the equity market peak and reached a short-term low of under 0.15 in the fall of 2007 coinciding with the peak. As with the other two market periods cited, following the market peak, risk aversion began to increase, but then took a further drop in the fall of 2008 as the market crisis intensified bottoming at less than 0.1. [See Exhibit 7.] The interpretation of this second drop in risk aversion during the crisis period is that the short-term volatility measure increased dramatically and persistently for a sustained period, overwhelming the increase in risk premium resulting from the price decline. It is possible that a longer-term measure of volatility, if available, would not have had as significant an impact on the Sharpe Ratio. Risk aversion has been increasing since 2008 and was at approximately 0.3 at year-end 2010.

The debt Sharpe Ratio began a sustained increase in the summer of 2008 and peaked in the fall of 2008. Similar to the 1987 and 2000-2001 periods, the period of enhanced risk aversion ended fairly quickly with the ratio declining in 2009. 2010 saw a return to oscillation.

Since the S&P 500 and the BBB bond indexes are proxies for the equity and debt components of major companies in the United States, one would expect to see similar and correlated Sharpe Ratios for the two major categories of the firm's capital structure. A possible explanation for the observed results is that there is significant Market Segmentation occurring between these two major asset classes.

Specifically, it is suggested that households affect the marginal pricing of equities, but play a much smaller role in the marginal pricing of corporate bonds. Households own nearly 60% of equities, with 38% held directly and 20% held through mutual funds. In comparison, households own only 30% of corporate bonds, with 19% held directly and 10% held through mutual funds. (U.S. Census Bureau, 2009) Compared to equities, corporate bonds largely are managed by professional agents for the benefit of institutional investors.

It is likely that individuals make the trade-off decision between holding equities and cash balances, while professional bond managers, who are typically benchmarked against a broad bond index, make the trade-off between holding credit product such as corporate bonds, and risk-free treasury securities. Therefore, it is not surprising that there is a wealth effect exhibited for equity securities while debt securities recover much more quickly from negative market events. Individuals have a memory bias while professional managers, who are judged every quarter, need to lose the memory in order to perform against a benchmark.

It is possible that the presence of fixed rate as opposed to floating rate debt introduces a diversification benefit for holding both the debt and equity securities of a firm and that this would account for the differing Sharpe Ratios. Changes in underlying treasury rates may affect equity and bond prices differently. For example, an increase in rates would generally cause a decrease in value for both assets. However, an increase in rates could be associated with an increase in growth expectations that would temper, or possibly, completely offset the negative effect on equity prices.

Although this is an unlikely explanation for the observed differing Sharpe Ratios, particularly given the dynamic nature of the relative equity and debt Sharpe Ratios, isolating the spread component of the debt would remove any such diversification benefit. In effect, the investment grade debt can be treated as a long-term floating rate security.

There are times when spreads and rates are positively correlated, and times when rates and spreads are negatively correlated. Over the 1986-2010 period, there is a 0.51 correlation between the fixed rate Sharpe Ratio and the floating rate Sharpe Ratio. [See Exhibit 3.] Furthermore, the daily returns of stocks and floating rate bonds have a low correlation of 0.01 and the correlation of credit spread Sharpe Ratios with equities Sharpe ratio is only 0.1. Clearly, fixed rates are not the source of the differences between the debt and equity Sharpe Ratios.

These results offer a possible explanation for why Merton models return debt values that are not in line with debt market values. The Merton model uses equity volatility to derive the firm volatility and debt value, and implicitly therefore, the debt volatility. For these relationships to be valid requires an equivalence of Sharpe Ratios for the equity and debt securities related to the asset. Differences in Merton debt valuations from market debt values may reflect actual asset volatilities that are not consistent with asset volatilities derived from equity volatilities.

Market Segmentation offers an explanation for differing risk appetites for equity and bond investors. Understanding the dynamics of market segmentation and its potential effect on the Sharpe Ratio of related debt and equity securities should be useful both in understanding why Merton debt values diverge from market values and in the field of asset allocation.

6 Conclusion

This paper presented a macro-economic methodology for evaluating the forward-looking Sharpe Ratios of the equity and debt components of the United States public company capital structure. Risk premiums for equity and debt were put on a common footing, reflecting the systematic uncertainty surrounding dividend forecasts, and probability of default and recovery forecasts, respectively.

Using this framework, it is shown that the equity and debt Sharpe Ratios are both time variant and disparate, which is counter to the assumptions of Modigliani and Miller as well as the one-factor Merton model. Equity Sharpe Ratios are shown to exhibit a longer memory effect than debt Sharpe ratios following the three most recent major market sell-offs, the 1987 crash, the 2000-2001 Internet bubble and the 2008-2009 credit crisis.

Market segmentation between equity and corporate bond investors and their associated differing behavior is offered as an explanation for the observed Sharpe Ratios. The observed results support the use of dynamic asset allocation as it relates to portfolios of equities and corporate bonds.

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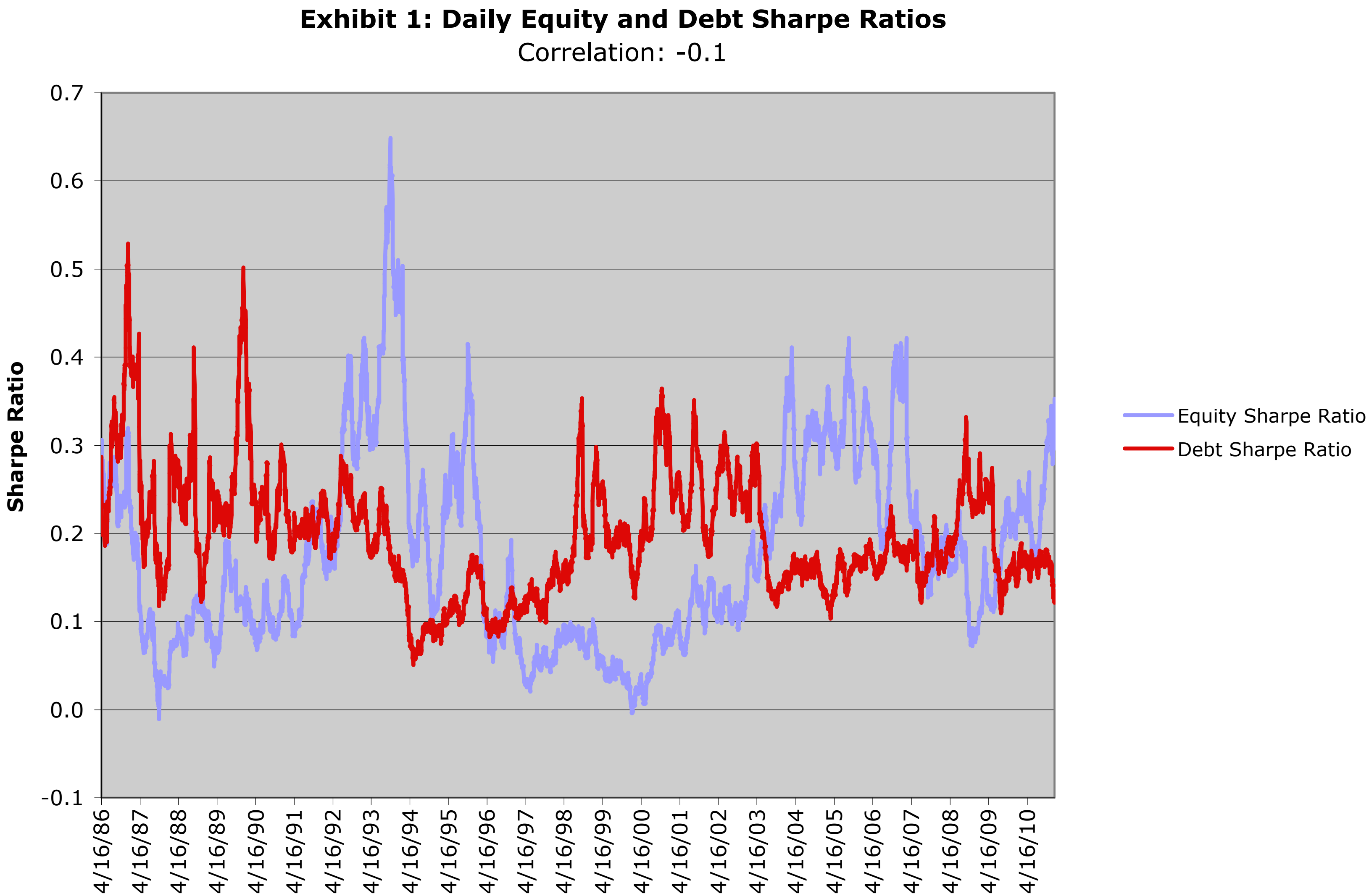
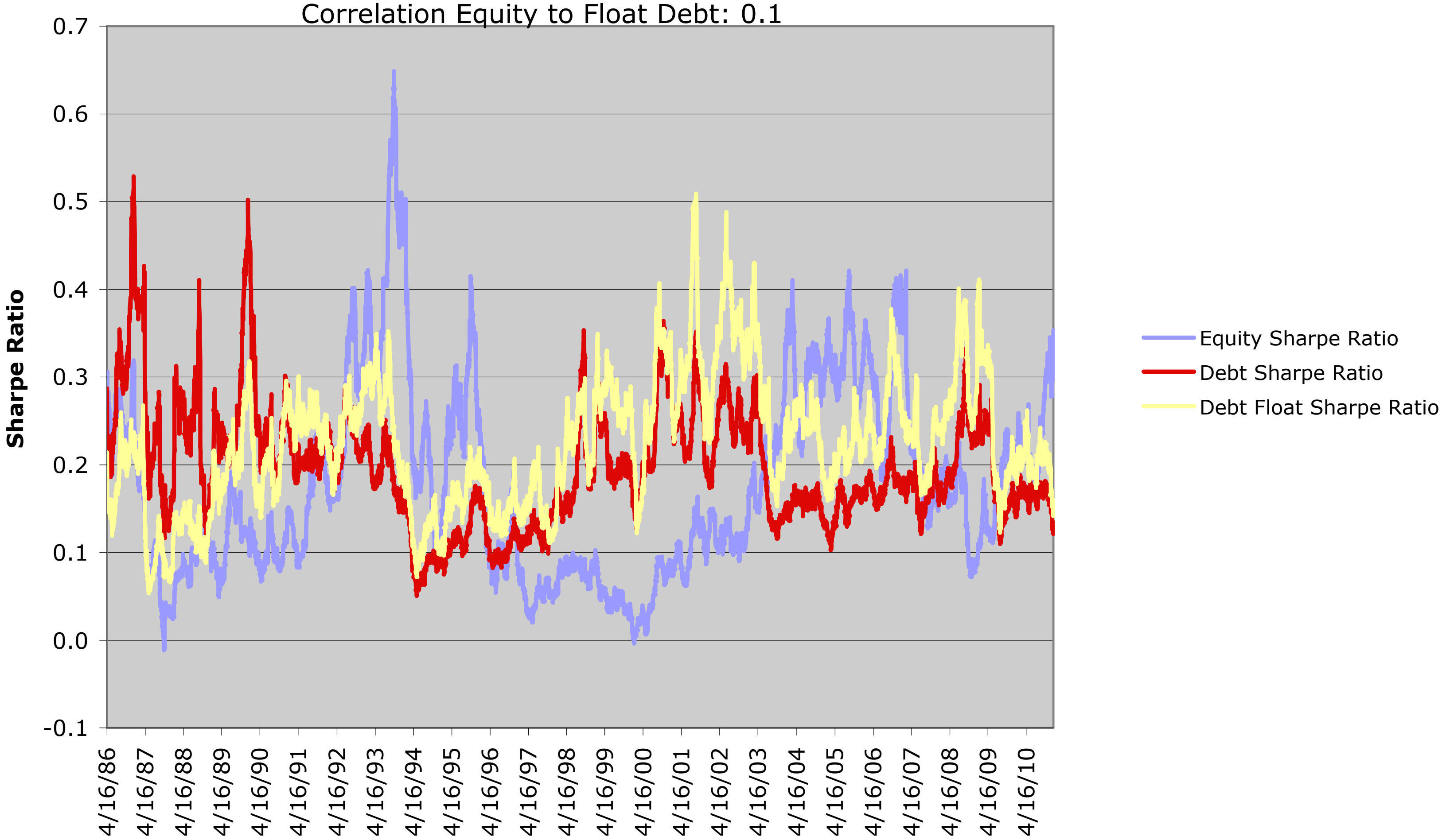


Exhibit 1: Daily Equity and Debt Sharpe Ratios
Correlation: -0.1
Sharpe Ratio
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
4/16/86
4/16/87
4/16/88
4/16/89
4/16/90
4/16/91
4/16/92
4/16/93
4/16/94
4/16/95
4/16/96
4/16/97
4/16/98
4/16/99
4/16/00
4/16/01
4/16/02
4/16/03
4/16/04
4/16/05
4/16/06
4/16/07
4/16/08
4/16/09
4/16/10
Equity Sharpe Ratio
Debt Sharpe Ratio

Exhibit 2: Daily Equity and Debt Fixed and Floating Rate Sharpe Ratios

Correlation Equity to Fixed Debt: -0.1

Correlation Equity to Float Debt: 0.1



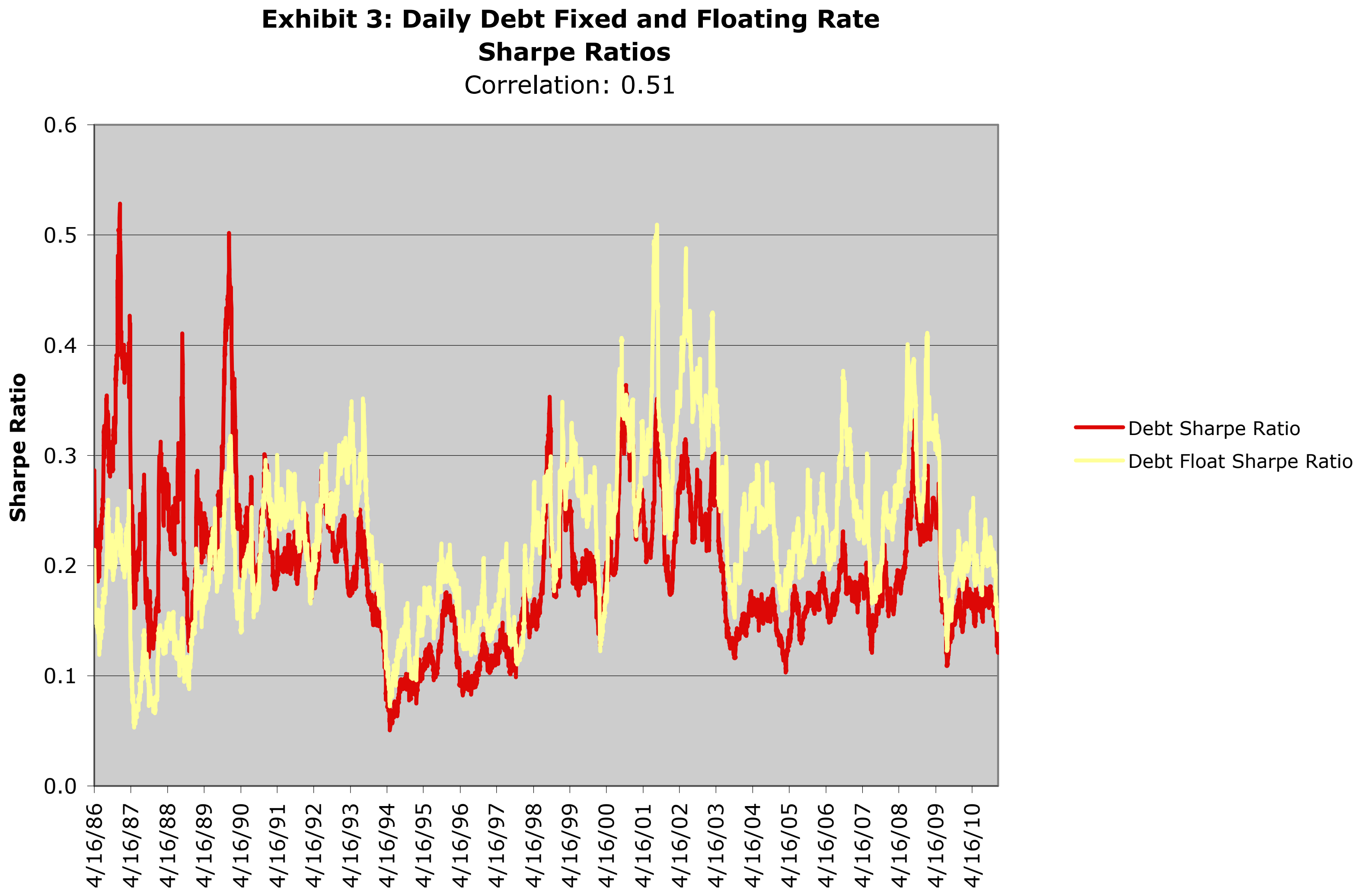


Exhibit 3: Daily Debt Fixed and Floating Rate
Sharpe Ratios
Correlation: 0.51
Sharpe Ratio
0.6
0.5
0.4
0.3
0.2
0.1
0.0
4/16/86
4/16/87
4/16/88
4/16/89
4/16/90
4/16/91
4/16/92
4/16/93
4/16/94
4/16/95
4/16/96
4/16/97
4/16/98
4/16/99
4/16/00
4/16/01
4/16/02
4/16/03
4/16/04
4/16/05
4/16/06
4/16/07
4/16/08
4/16/09
4/16/10
Debt Sharpe Ratio
Debt Float Sharpe Ratio

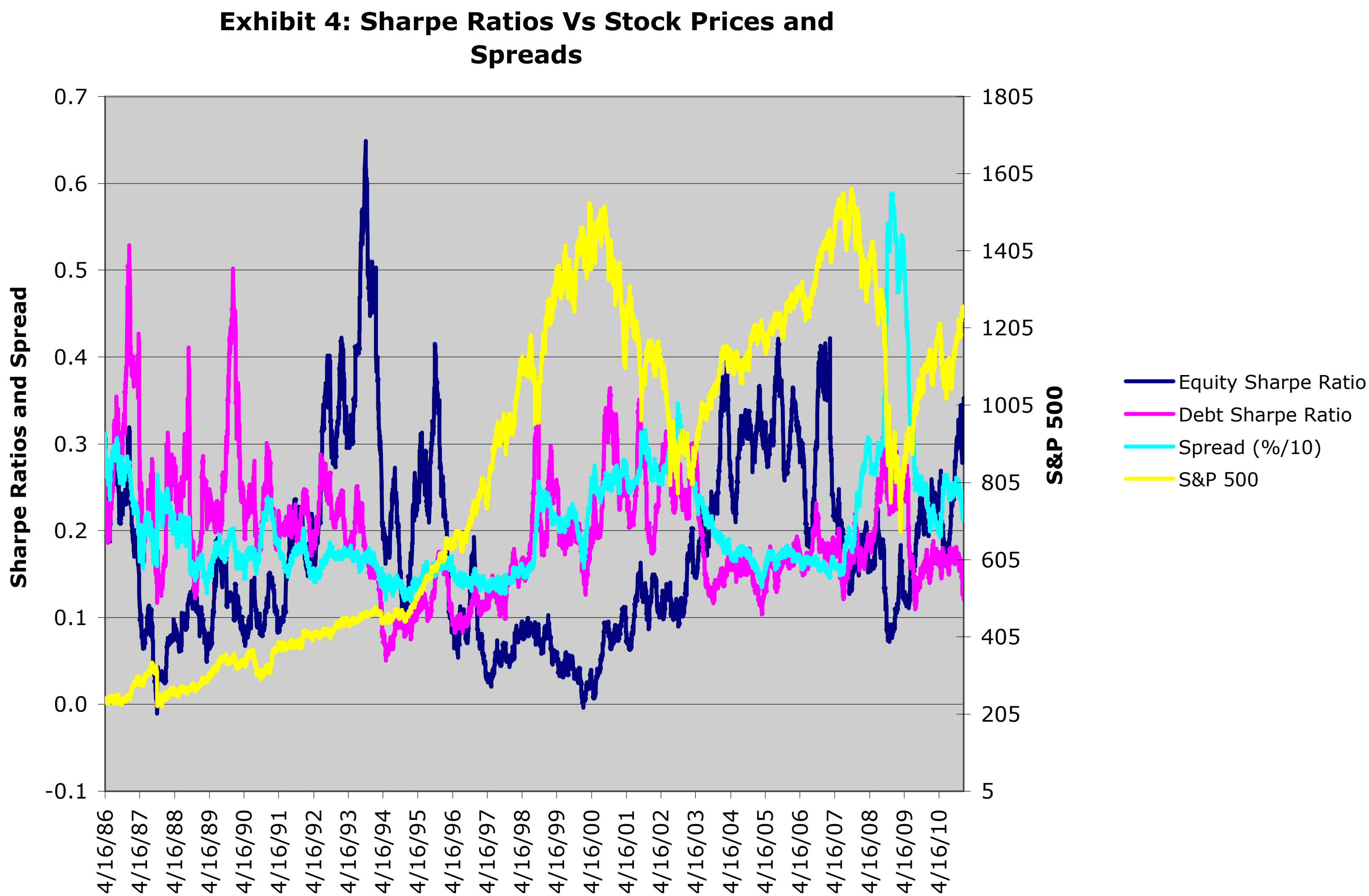


Exhibit 4: Sharpe Ratios Vs Stock Prices and Spreads
Sharpe Ratios and Spread
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
S&P 500
1805
1605
1405
1205
1005
805
605
405
205
5
4/16/86
4/16/87
4/16/88
4/16/89
4/16/90
4/16/91
4/16/92
4/16/93
4/16/94
4/16/95
4/16/96
4/16/97
4/16/98
4/16/99
4/16/00
4/16/01
4/16/02
4/16/03
4/16/04
4/16/05
4/16/06
4/16/07
4/16/08
4/16/09
4/16/10
Equity Sharpe Ratio
Debt Sharpe Ratio
Spread (%/10)
S&P 500

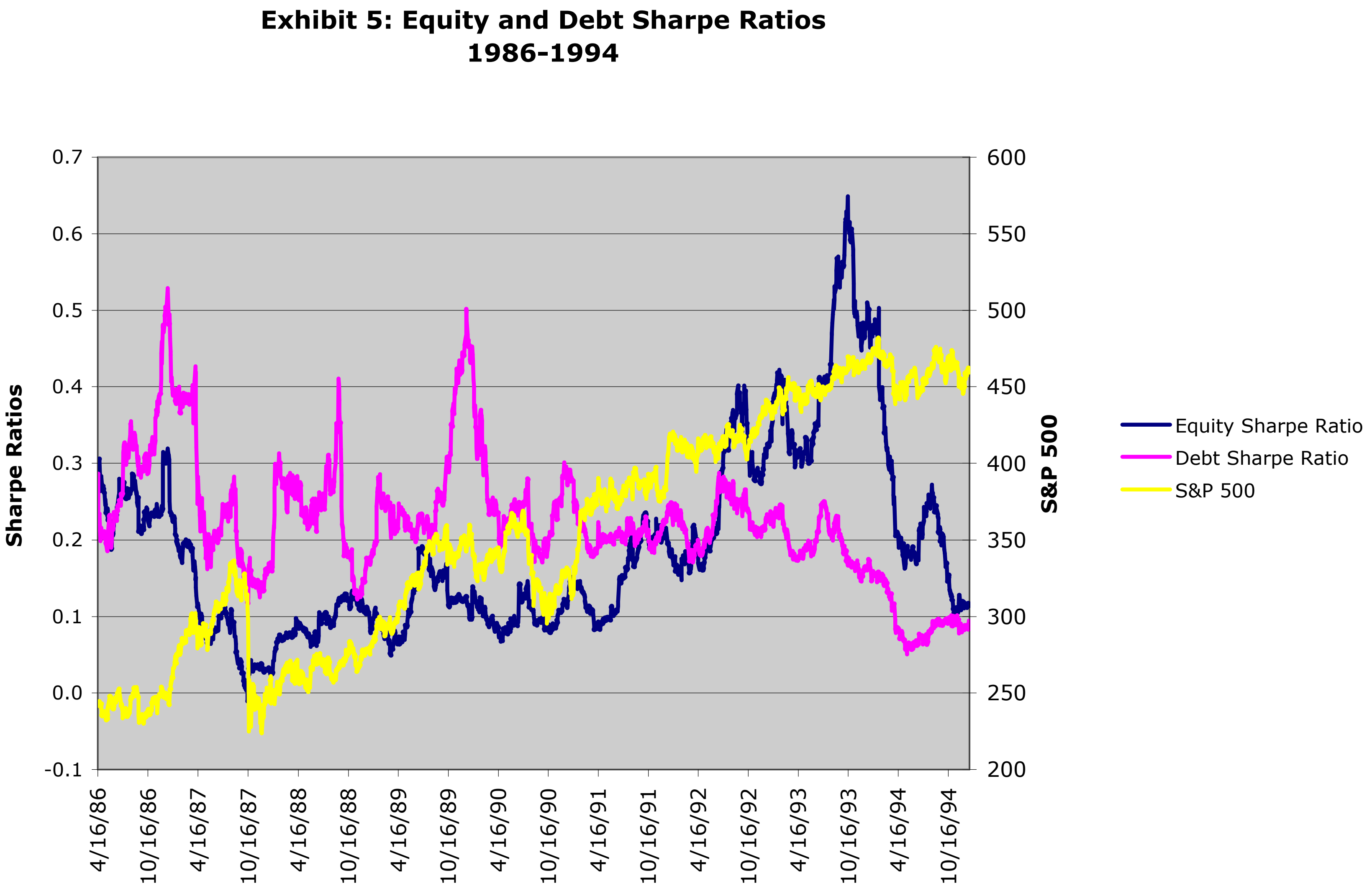


Exhibit 5: Equity and Debt Sharpe Ratios
1986-1994
Sharpe Ratios
S&P 500
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
600
550
500
450
400
350
300
250
200
4/16/86
10/16/86
4/16/87
10/16/87
4/16/88
10/16/88
4/16/89
10/16/89
4/16/90
10/16/90
4/16/91
10/16/91
4/16/92
10/16/92
4/16/93
10/16/93
4/16/94
10/16/94
Equity Sharpe Ratio
Debt Sharpe Ratio
S&P 500

Exhibit 6: Equity and Debt Sharpe Ratios 1996-2007

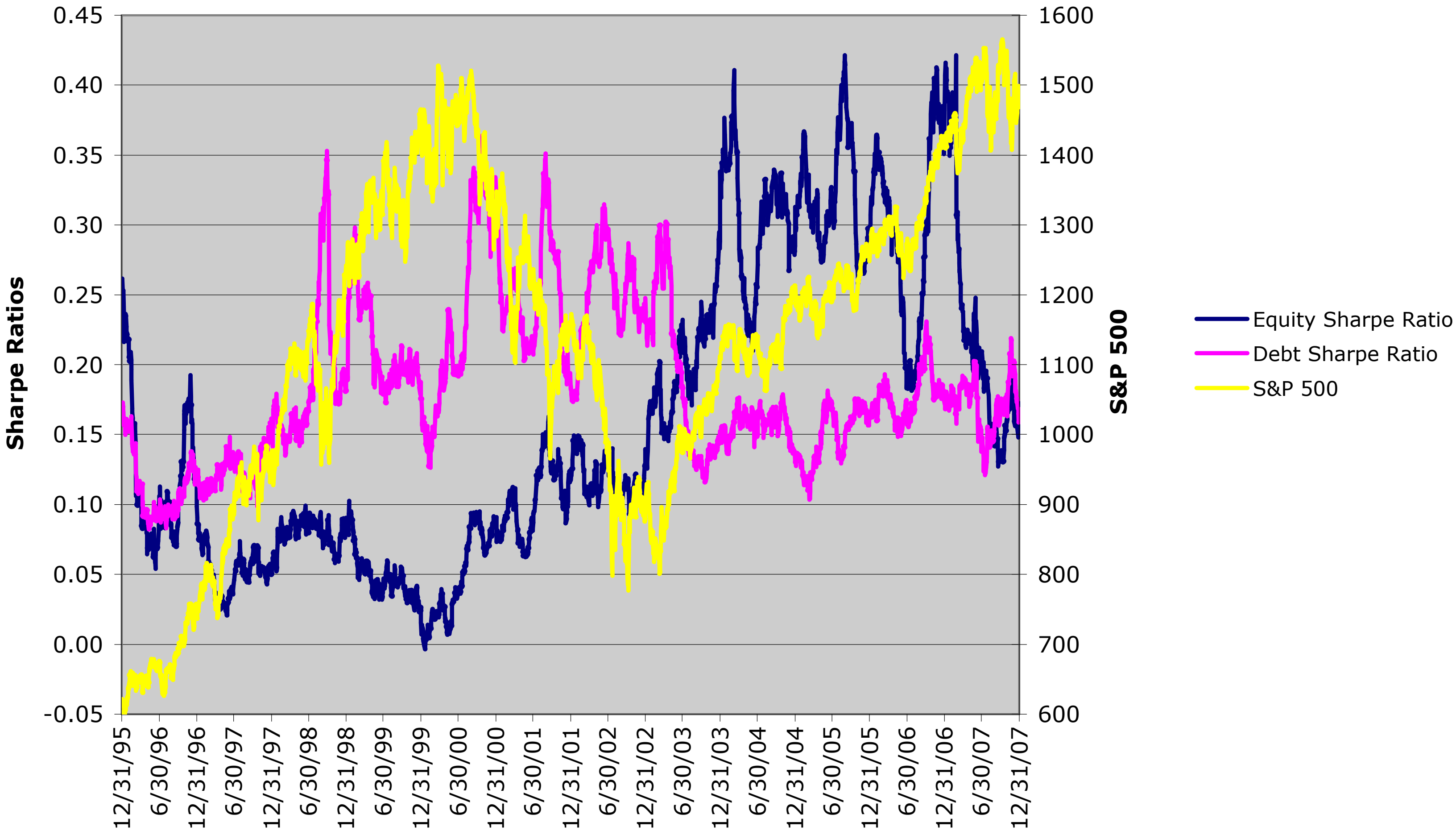
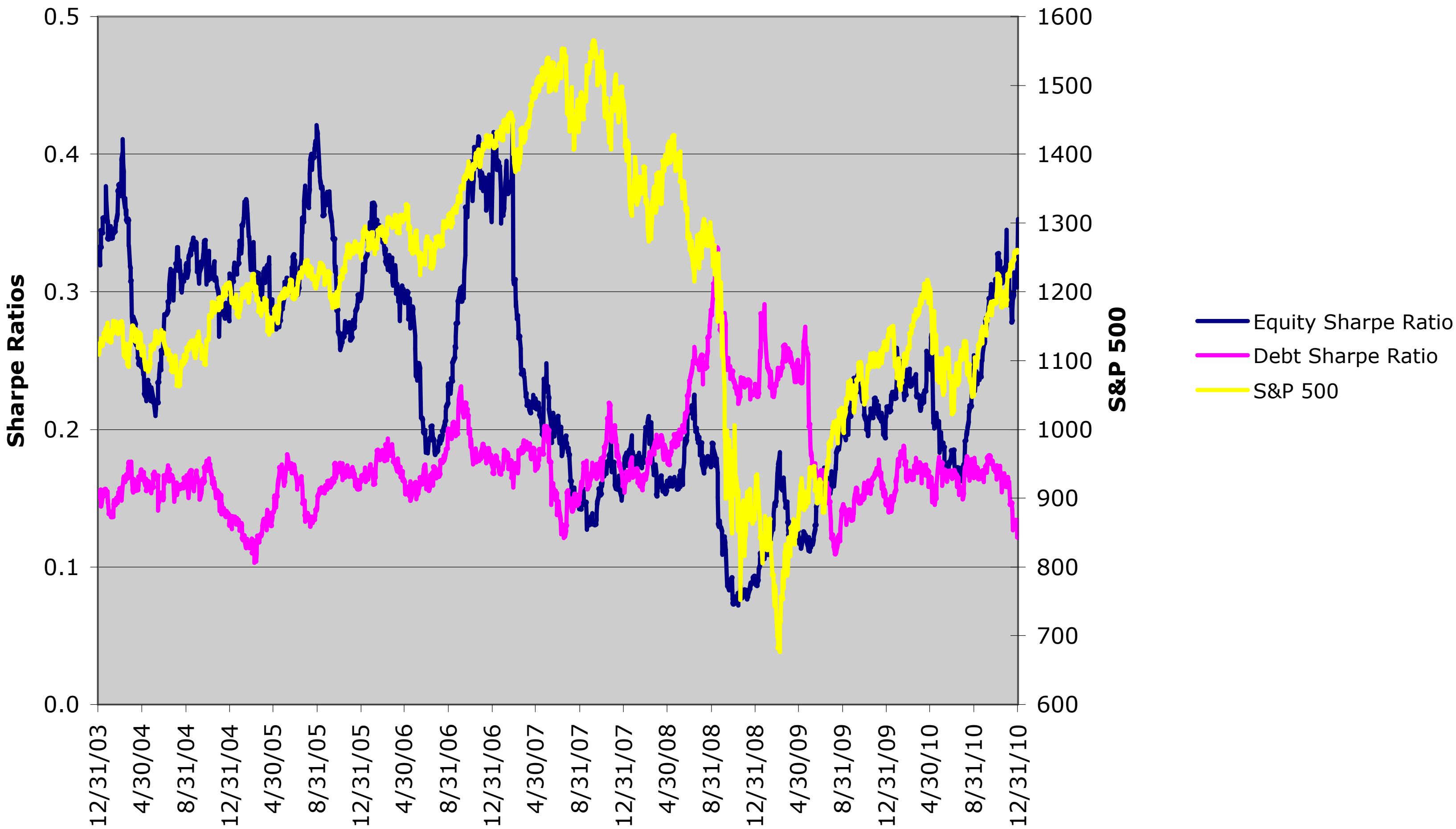


Exhibit 7: Equity and Debt Sharpe Ratios
2004-2010



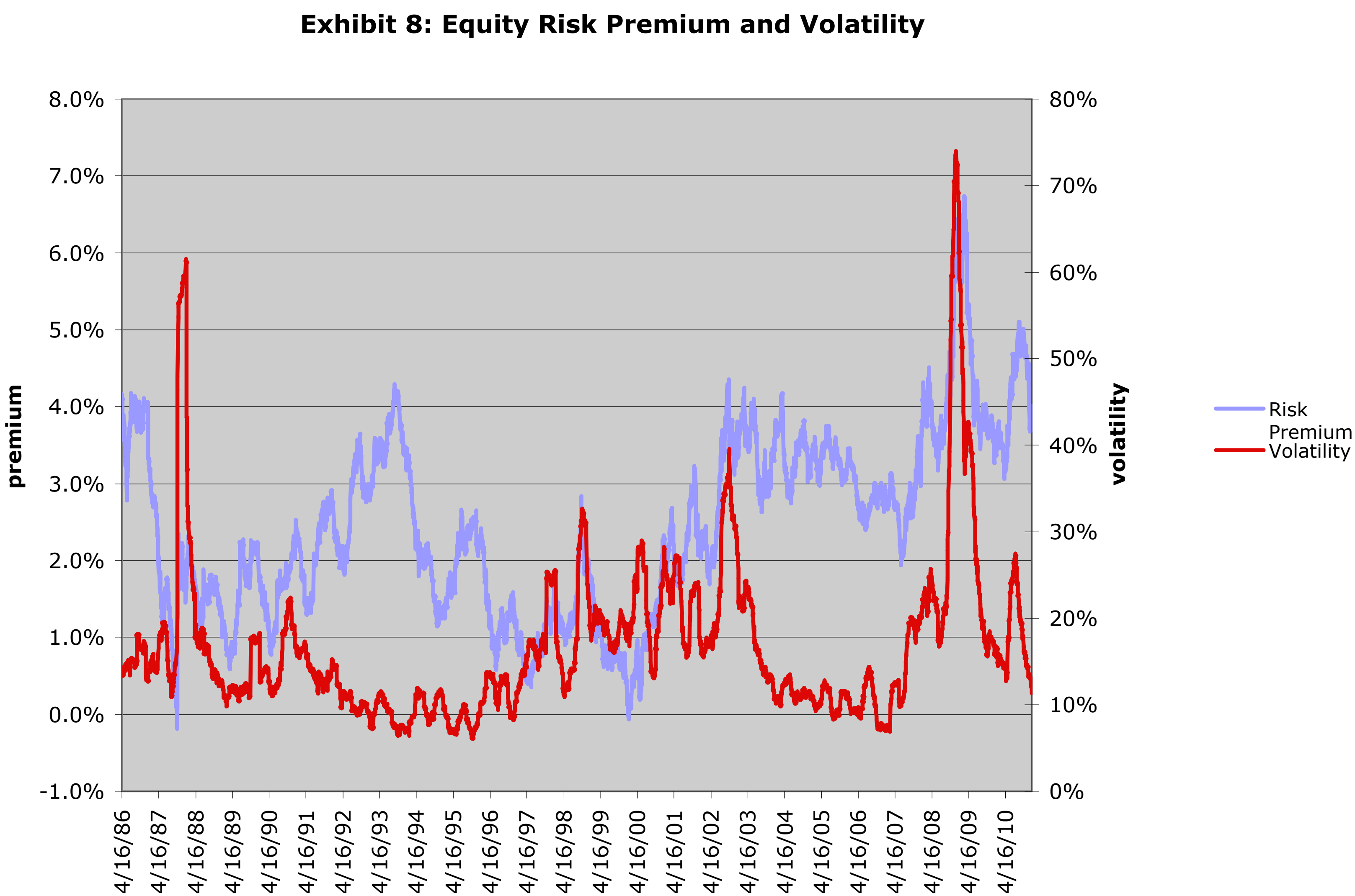
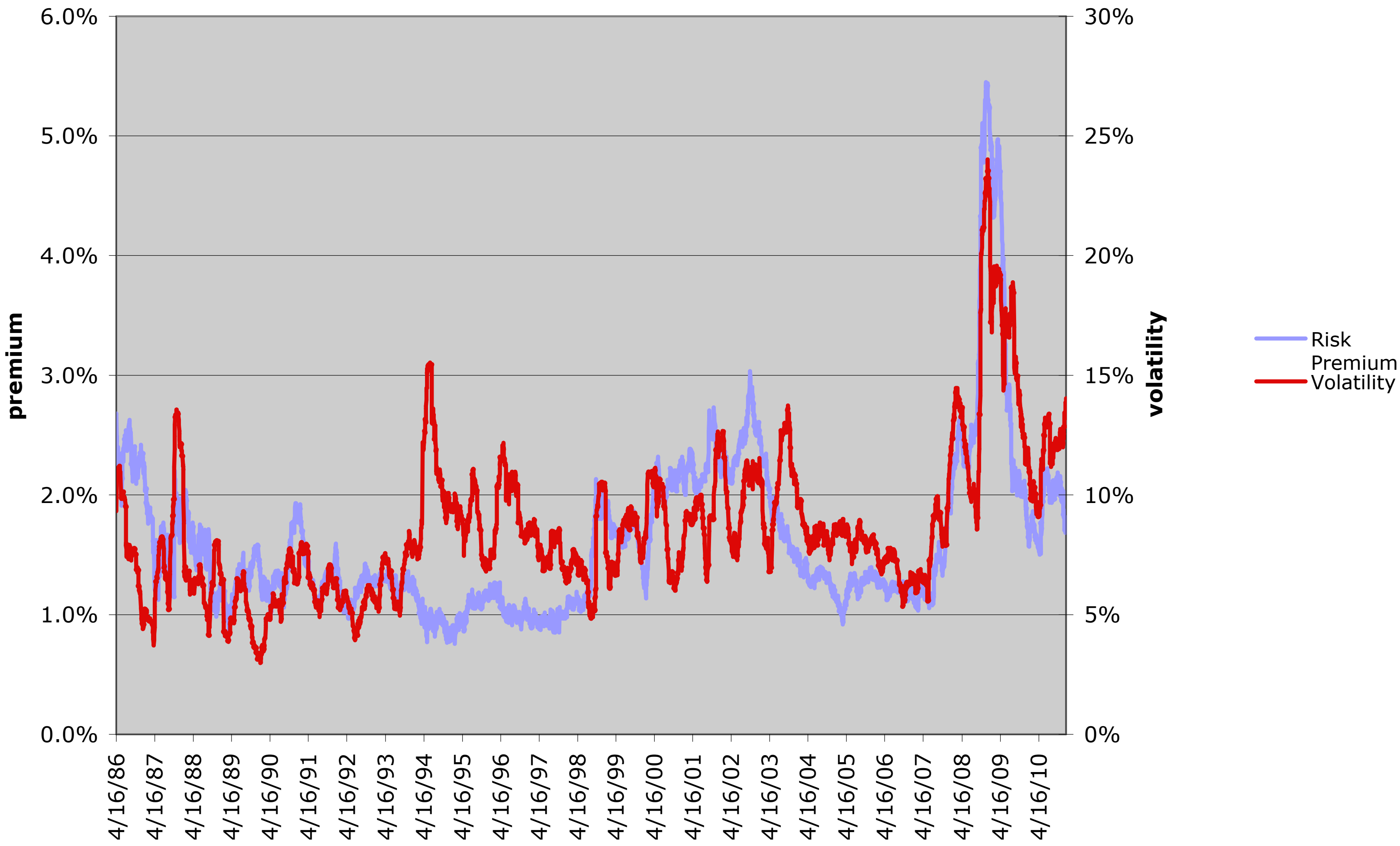


Exhibit 8: Equity Risk Premium and Volatility
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
-1.0%
premium
80%
70%
60%
50%
40%
30%
20%
10%
0%
volatility
4/16/86
4/16/87
4/16/88
4/16/89
4/16/90
4/16/91
4/16/92
4/16/93
4/16/94
4/16/95
4/16/96
4/16/97
4/16/98
4/16/99
4/16/00
4/16/01
4/16/02
4/16/03
4/16/04
4/16/05
4/16/06
4/16/07
4/16/08
4/16/09
4/16/10
Risk Premium
Volatility

Exhibit 9: Debt Risk Premium and Volatility



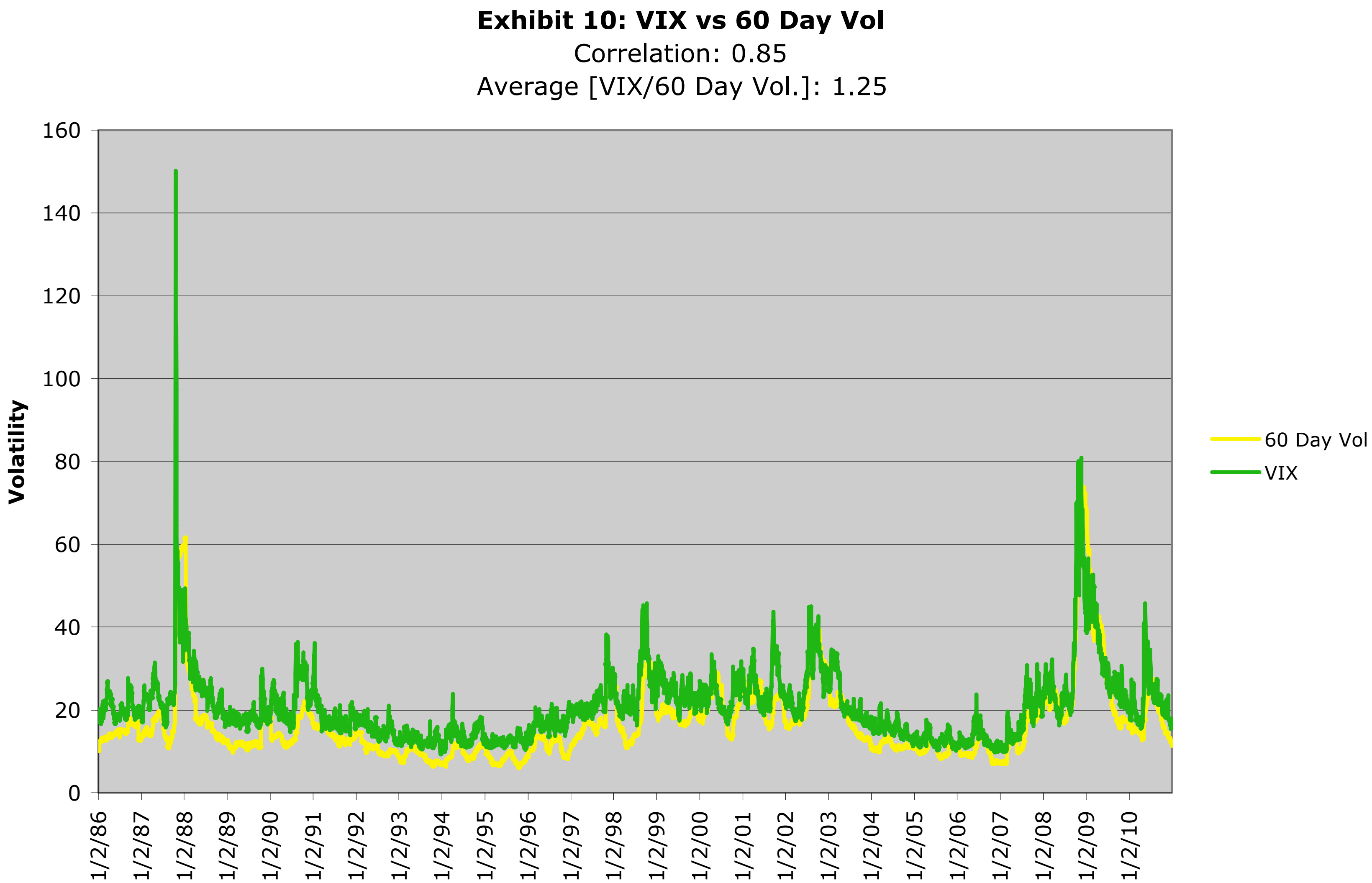


Exhibit 10: VIX vs 60 Day Vol
Correlation: 0.85
Average [VIX/60 Day Vol.]: 1.25
Volatility
160
140
120
100
80
60
40
20
0
1/2/86
1/2/87
1/2/88
1/2/89
1/2/90
1/2/91
1/2/92
1/2/93
1/2/94
1/2/95
1/2/96
1/2/97
1/2/98
1/2/99
1/2/00
1/2/01
1/2/02
1/2/03
1/2/04
1/2/05
1/2/06
1/2/07
1/2/08
1/2/09
1/2/10
60 Day Vol
VIX

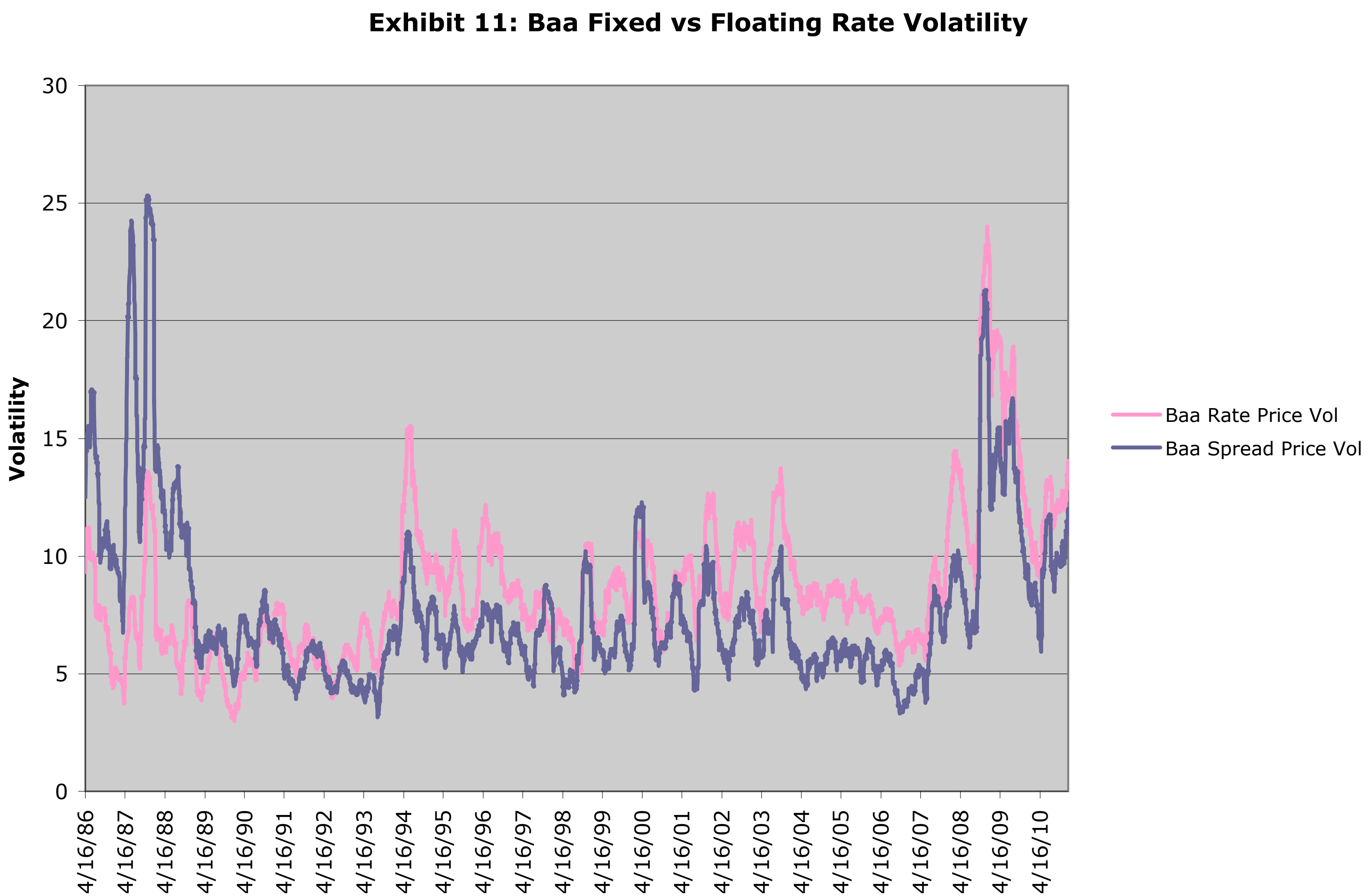


Exhibit 11: Baa Fixed vs Floating Rate Volatility
Volatility
30
25
20
15
10
5
0
4/16/86
4/16/87
4/16/88
4/16/89
4/16/90
4/16/91
4/16/92
4/16/93
4/16/94
4/16/95
4/16/96
4/16/97
4/16/98
4/16/99
4/16/00
4/16/01
4/16/02
4/16/03
4/16/04
4/16/05
4/16/06
4/16/07
4/16/08
4/16/09
4/16/10
Baa Rate Price Vol
Baa Spread Price Vol