



Danger Ahead: The Reach-for-Yield Behavioral Transmission Mechanism Across Risky Assets

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Abstract

This paper argues for the existence of a reach-for-yield behavioral transmission mechanism which, during low-interest rate periods, drives a higher willingness to pay for dividend yield in various yield assets like high-yield bonds, high yield closed-end funds, yield companies and real estate investment trusts. We argue this effect is particularly notable for investors who have not correctly updated their priors for reasonable market returns given the macroeconomic outlook or for those investors who have fixed nominal return mandates i.e. pension funds. We present an uninformed/informer trader model that illustrates how in a low-interest rate environment, assets migrate to uninformed traders who do not correctly price the risk of the assets they are buying. This model also illustrates how macroeconomics shocks may arise from yield instruments whereby the owners of assets, realizing they did not fully understand the risks of what they own, seek to liquidate their positions at distressed prices. This can cause systemic risk in a similar manner to the market unraveling of mortgage-backed securities (MBS) sales during the 2008 Great Recession. We then empirically test a variety of yield assets in time-series to evaluate if a reach-for-yield phenomena exists during low-interest rate periods. We conclude that there exists a statistically significant reach-for-yield effect in which investors consistently pay a higher premium for yield in a low-interest rate world across a variety of yield assets.

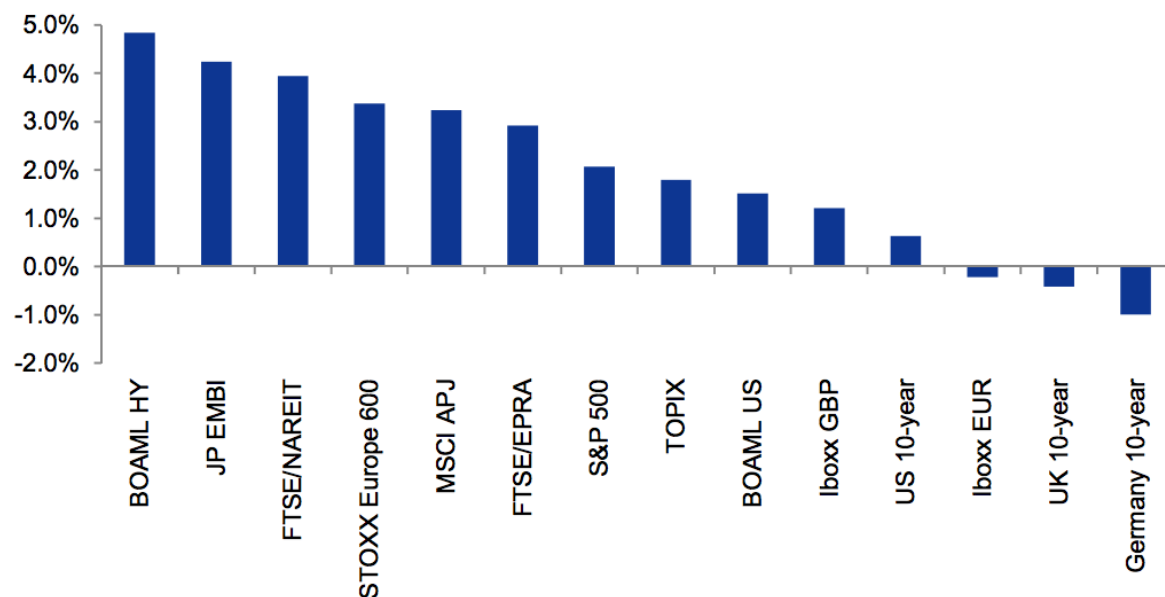
1 Introduction

Reach-for-yield is a behavioral phenomenon in which investors buy assets to achieve heightened nominal returns without sufficient consideration for the risk profile of their investment. We define sufficient consideration as the marginal increase in willingness to pay for an asset over and above the price a rational expected return optimizing investor, with full understanding of the risk profile of the asset, would be willing to pay. Goldman Sachs (2015) noted in a Global Markets Release the low-interest rate environment of the past several years reduced expected long-term returns across asset classes and boosted valuations for most risky assets. (Figure 1). They additionally noted risky assets have been supported by low yields as investors have been pushed up the risk curve, in particular, post European Central Bank Quantitative Easing. When the risk-free rate is low, the potential risk of the reach-for-yield mechanism driving market instability is elevated. One of several reasons for this instability risk is that investors do not fully understand the risk profile of the assets they are involved in. During a draw down in asset value they are more likely to want to liquidate these assets quickly. This desire, combined by the lack of liquidity in many yield-orientated instruments like high yields bonds can lead to rapid reductions in price.

A related phenomenon was seen in 2008 when investors held Mortgage-Backed Securities (MBS) despite not fully appreciating their risk profile. Once the MBS started under performing, the asset class was liquidated aggressively and the capacity to trade was severely undermined, leading to a variety of run-on consequences like margin calls and fire sales in other illiquid assets. Understanding the reach-for-yield channel is critical to being able to understand the real impact of low interest rate monetary policy. It facilitates better policy decision making to avoid unintended

Exhibit 1: Only riskier credit or equities still offer attractive real yields

Real yields for different asset classes (fixed income yields adjusted for 5-year average inflation)



Source: Datastream, Haver, Goldman Sachs Global Investment Research.

Figure 1. A research publication from Goldman Sachs marketing the attractiveness of real yields in risky assets during 2015, a period with zero fed rate in the US.

consequences of portfolio bench-marking and uninformed investor participation.

Throughout our analysis, we use the phrase "yield assets". We define "yield assets" as asset classes that pay a dividend yield or distribution of income that is higher than the standard dividend yield in equities (yield-orientated) and have a non-zero probability of defaulting or incurring capital loss (i.e. not riskless). The "yield assets" we consider comprise of yield companies, real estate investment trusts, high yield bonds, closed-end funds and master limited partnerships.

We hypothesize that this reach-for-yield effect may be transmitted by a behavioral bias in which investors seek to beat a particular fixed nominal return profile. The return target of the individual investor may not be sufficiently Bayesian-updated to the risk profile of the market for various reasons including incorrect extrapolation

of prior period returns, poor information or a lack of understanding as to downside risk leading to a willingness to bid up pricing. The behavioral bias can also be transmitted through a principal-agent conflict in an institutional fund management capacity in which an entity like a bank, pension or insurance company may have to hit specific nominal return targets which have not been adjusted to the risk profile of the market. This could lead to an investor having to optimize a portfolio for an excessively high return target fully aware of the heightened risks.

Market practitioners have criticized the extensive use of quantitative easing and low-interest rate policy post financial crisis for its persistent distortionary effect. Market practitioners often argue that a low interest rate environment can stimulate movements of unsophisticated investors from higher-grade bonds to lower-grade bonds and other yield assets with higher variance risk profiles. For example, Carl Icahn, a well-respected investment practitioner, notes in his video entitled 'Danger Ahead', "This market [high yield] keeps going up and up with zero interest rates and that is what is really driving it" (Transcript attached in Appendix). A mass migration of retail investors to higher yield asset classes, supported by new innovations in financial markets like the wide spread availability of exchange-traded funds in previously illiquid areas (high yield bonds), could lead to systematic risk if there is widespread misunderstanding of the risk profile of yield investments.

Although the reach-for-yield mechanism has been studied for investment grade bonds, most notably by Becker and Ivashina (2013), there has been limited analysis of other yield vehicles like high yield bonds, closed-end funds, real estate investment trusts, Master Limited Partnerships (MLPs) and Yield Companies (YieldCos) (Becker and Ivashina, 2013). With investors being unable to achieve their desired returns in conventional portfolio mixes, they have to seek high yield bonds and other

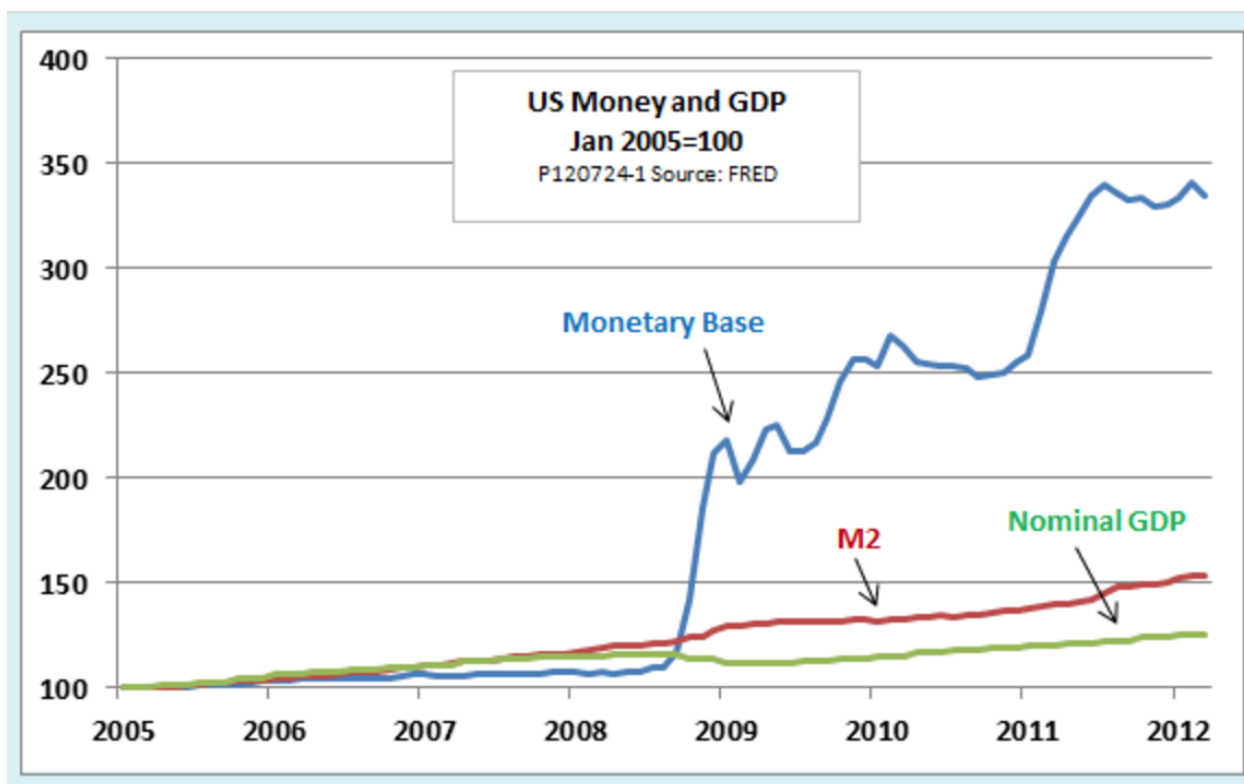


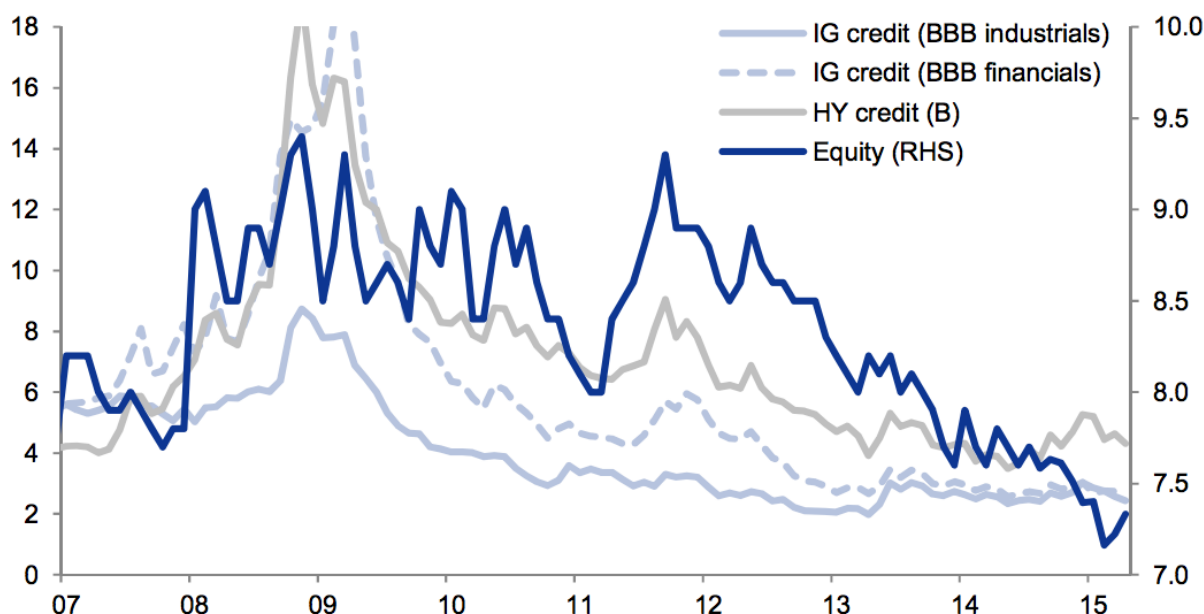
Figure 2. With extensive use of quantitative easing in response to the financial crisis, the monetary base has reached heightened levels and federal interest rates have been at multi-year lows from 2009 to 2015.

yield instruments in an attempt to improve returns. These desired returns may exist either from behavioral bias discussed previously around insufficient Bayesian updating to the market environment or an agency conflict in a structure such as a pension fund where there are fixed annual liabilities and correspondingly, pressure is placed on the manager to achieve a fixed annual return.

We will firstly explore the existing work in the structured credit space relevant to high yield bonds and other yield-orientated asset classes as well as pieces of the informed/uninformed trading literature. We will then introduce our trading dynamics model. We examine a model in which there are two classes of investors: a sophisticated class with a conventional expected return optimizing objective function and an unsophisticated class of investor with a bench marked nominal return

Exhibit 3: Required returns have declined across asset classes

Required returns for US asset classes (Equity = S&P 500 equity risk premium + 10-year yields, Credit = US credit risk premia + 5-year yields)



Source: Datastream, Haver, Goldman Sachs Global Investment Research.

Figure 3. This graph illustrates the decline in expected returns during the persistent low-interest rate period since 2008. As expected returns decrease across all assets, investors have to take incrementally more risk to achieve the same return profile.

target. Uninformed investors (traders) target a particular nominal yield, which is not updated for variant market conditions. Their utility function is such that they are particularly sensitive to under performing their benchmark (which may be a psychological target) but do not experience large relative utility gains from beating this benchmark. This results in a transfer of ownership of risky assets in low-yield environments to uninformed investors as uninformed investors subsequently have an incentive to gamble on these yield assets disproportionately in low-yield environments so as not to miss their benchmarks.

Following this, we will consider a series of regressions of scaled price factors (price/book for REITs, price/NAV for Closed-End Funds). We will test the willing-

ness to pay for yield in time-series using a fixed effects methodology or through a direct consideration of the interest rate. Time-series regressions can illustrate how scaled price ratios have evolved with dividend yields over time. We will seek to deduce whether the willingness to pay for yield increases during low-interest rate periods. In this paper, we address, using our underlying theory explored in our literature review, model and empirical work, whether reach-for-yield, specifically within yield assets, poses systemic risks for the economy as well as potential public policy implications. Finally, we draw implications and conclusions from the results and make recommendations for future research.

A key limitation of our analysis is the availability of accurate, historical data-sets across various assets under consideration. For certain assets, like yield companies, this is because the asset class is relatively new so such data does not exist. For other assets such as high-yield bonds, it is difficult to obtain accurate historical data for all the necessary variables we consider (although, in general, we were able to find sufficient data to obtain statistically significant results). Additionally, the extended period of Quantitative Easing (QE) witnessed post the 2008 recession is unprecedented and still relatively recent and so concrete policy recommendations with clear empirical robustness are inherently challenging to produce in lieu of the absence of more data points. Next, our empirical analysis focuses on validating one of the three core pillars of our model: the implication of being in a low-interest rate world on reach-for-yield behavior. The two other pillars: (i) bounded perceived downside by uninformed investors and (ii) a migration of risky assets to uninformed investors in a low-interest rate world, are supported through components of our literature review and intuition but need future empirical work to prove with the same rigor as our reach-for-yield analysis. Migration of risky assets to uninformed investors has been addressed in the literature substantially more than bounded perceived down-

side by uninformed investors. A final note is that the title "uninformed investors (traders)", used in our model, refers to both i) uninformed retail investors who have less knowledge than institutional investors like hedge fund analysts and ii) agents who have misaligned incentives (such as pension-fund managers with fixed nominal return targets) in different parts of our analysis.

2 Literature Review

We explore the existing work in the informed/uninformed trading literature. We also investigate the structured credit space, relevant to reach-for-yield, in yield-orientated asset classes like high yield bonds and closed-end funds. We also review relevant components of the reach-for-yield literature within the context of corporate bonds. Finally, we address some of the key behavioral economics literature on retail investor/uninformed trader biases.

Various models have been constructed to illustrate the potential consequences of market interactions between informed traders and unsophisticated traders with varying objective functions. This work started with that of Kyle (1985) and Back (1992) and has continued to evolve in complexity. Hanson and Stein (2014) consider the case of a mean-variance optimizing trader investing based on conventional portfolio allocation theory and a yield-orientated trader with reduced sensitivity to variance. Such models typically result in yield-orientated assets being bid up in price by the yield-orientated investor. As these assets are bid up, they become relatively less attractive to the informed traders who see a declining risk/reward ratio. Ownership of these assets subsequently progressively shifts to the yield-orientated investors. Such a scenario is not particularly worrying if both parties are informed as the risk of their investments and one party rationally chooses to underweight risk and focus on return. Foster and Viswanathan (1994) consider two asymmetrically informed traders where one informed trader is aware of the information seen by both traders and the other uninformed trader only knows his private information. This leads to an interesting dynamic game where the informed trader is tactical with her/his initial trading so as not to leak too much to the uninformed trader who guesses at what the informed trader knows by his/her trading activity. Near the end

of the game, the informed trader is much more aggressive in trading as the remaining value of being deceptive about the incremental information becomes lesser. The example used is less informed traders competing with wealthy, well-informed traders in the commodities future markets where the level of information asymmetry can be high. Brody et al (2008) model a scenario which has an informed trader, leveraging incremental information sources to seek arbitrage opportunities, while at the same time accommodating the additional risk of the news flow. On the other hand, the information available to the uninformed trader can be exclusively measured by the asset price and the associated cash flow. The model shows explicit trading strategies which show how excess information can be translated into profit (or relative loss for the uninformed trader).

Recent investigation by Bloomfield et al (2009) into the consequences of uninformed traders on momentum yields are of particular relevance to our investigation. The results of three experiments using a laboratory market, based on Hong and Stein's methodology (1999), highlighted that when informed traders cannot observe prices, uninformed traders can drive long-term price reversals through trend-following i.e. momentum trading. When informed traders also can observe prices, uninformed traders generate reversals through speculative contrarian trading. These results contribute specifically to the debate on individual investors and noise traders, dubbed to be uninformed (Barber, Odean and Zhu (2009)). Our model provides an alternative mechanism for price reversals as uninformed traders receive new information and subsequently seek to liquidate assets sub-optimally to informed traders who are willing to be market makers for their distressed counterparts.

We also consider the literature surrounding yield assets, specifically high yield bonds and closed-end funds. Altman (1992) describes the three broad categories of

high-yield bonds. 25% of the market comprises of "fallen angels". These companies typically issue investment-grade securities but see their credit rating deteriorate. The next broad category is corporate bonds that have been issued with below-investment-grade credit for standard business purposes. This comprises another 25% approximately. The remaining 50% comprises of issuance to finance major corporate restructuring such as acquisitions. Ma et al (1989) argue that the high-yield bond market exhibits surprisingly strong resiliency. Implied default probabilities are considered and the results suggest that while these rates spike after prominent bankruptcies, they tend to normalize within six months.

Platt et al (1992) demonstrate the lack of congruence between standard Moody's company bond ratings and estimation of company failure rates through early warning models. This work argues that the scope for information asymmetry is particularly high in the high yield bond market and subsequently, the potential downside for uninformed traders is higher. This paper demonstrates the difficulty in investing for uninformed traders. It is difficult for them to succeed in the high-yield bond space while competing with hedge funds and other informed traders that have substantially more experience in assessing the probability and consequences of default. Fridson et al (1990) highlight the lack of market efficiency in the pricing of high-yield bond issuance. They find that the 1985 new issue credit spreads on the highest credit risk offerings were not sufficiently wide to compensate for the credit-related losses. This emphasizes the weakness of a strategy of reaching for maximum yield and instead calls for investors to a focus on secondary-market opportunities, availability of historically large risk premiums or equity kickers that may make conditions more attractive. We argue that this reach-for-yield phenomena, despite the low historical expected returns, still exists and is particularly prominent throughout high-yield bonds, buoyed by enhanced access in recent years, during low-interest rate periods.

As a testing ground for reach-for-yield behavior, closed-end funds have particular relevance given the high proportion of the ownership base which is retail-based. Uninformed traders could potentially be excited by optically high yields and aggressive distribution policies. Closed-end funds are characterized by often-persistent discounts to net asset value. It may be the case that dividend yield is one of the contributors to the wide variance in discounts to net asset values. A number of well-known foundational papers have analyzed the evolution of the closed end fund discount. Malkiel (1977) noted early in the analysis of closed end funds the potential for departure from prices that the efficient market hypothesis would suggest. This is not simply for the reasons that underlie market inefficiency in common stock but additionally because the net asset value (henceforth NAV) can deviate substantially from the price a closed end fund trades for, based on supply and demand for shares. This alone, however, is not a sufficient criticism for inefficiency to exist because one can say that rational investors should be able to assess the NAV of the underlying holdings alongside other factors like liquidity. Through supply and demand, an efficient price should theoretically be obtained reached (Lee, Shleifer, Thaler, 1991). Malkiel (1977) notes that some portion of the observed discounts seen in funds can be attributed to unrealized appreciation, distribution policy and institutional policies governing investment in foreign securities or types of stocks (Malkiel, 1977). His paper is critical to the evolution of the literature in signaling the failings of traditional rational analysis to explain the discount and calling for an appeal to market psychology (Malkiel, 1977). A reach-for-yield mechanism could add further clarity to this early understanding of distribution policy.

Stimulated through deficiencies in early academic analysis from individuals such as Malkiel, closed-end funds have become a rich source of investigation for behavioral

economists. Shleifer and Thaler (1991) suggest that closed-end funds are primarily held by retail investors with a wide scope of risk tolerance that can rapidly shift based on market movements (Shleifer, Thaler, 1991). They propose that the size effect detailed by Fama and French (1993) in small stocks in which smaller stocks have higher fundamental risk-adjusted returns is related to why closed-end funds experience discounts. Essentially, because shifting investor sentiments can make a closed-end fund riskier than the underlying assets because of the ownership base, the funds have an inbuilt risk-premium, which makes them on average under priced compared to what the fundamentals would dictate. This closed-end fund discount is consequently partially explained by the ownership demographic of the funds. A challenge going forward of this type of analysis which is noted by Shleifer and Thaler (1991) as well as Malkiel (1977) is the difficulty in ascertaining exactly how much of the discount can be explained by these effects. Regardless, the behavioral insight provided by Thaler and Shleifer (1991) was instrumental in acknowledging the avenue for market irrationality to partially explain the premium/discounts in closed end funds. In the context of international closed-end fund premiums, this behavioral analysis lays the foundation for justifying how specific country funds can trade at more than 100% premiums; results that efficient markets based models struggle to generate (Pontiff, 1996). The existence of evidence suggesting inefficiency in pricing of closed-end funds, largely driven by uninformed traders, makes them an ideal target for our analysis.

Wang and Nanda (2011) provide a relevant explanation for closed-end fund discount variation through variance in dividend policies. They argue that closed-end funds have a wide variance in discounts, which can be explained by the signaling effect built into dividend policies. Firms that commit to paying out a fixed proportion of capital per year to reduce the chance of trading at a persistent discount signal to

the market that the manager is actively avoiding a discount. It also signals to the market that the manager has confidence in their trading abilities. A payout policy has a first order effect of decreasing assets under management, which decreases compensation for the manager. Managers would theoretically do it as a means of demonstrating their belief in their ability to generate returns to attract more capital to offset the capital paid out and have a higher proportion of compensation tied to performance as opposed to assets under management (AUM).

Wang and Nanda (2011) note that institutional investors tend to shy away from closed-end funds with aggressive distribution policies and find that funds with policies like this tend to be dominated by retail investors. They argue that the lack of interest from institutional investors is because after taking out the distribution of capital from the total distribution, yields can be less than 1%. They cite a lack of interest from institutional investors in worrying about reinvesting their capital in a low interest rate environment. We will consider an alternative explanation where institutional investors (presumably informed traders) recognize that the high nominal yields of these funds are not real yields and subsequently are not willing to pay a premium price for them. Retail investors (presumably uninformed traders), on the other hand bid up the prices of these assets, motivated by a reach for yield mechanism. This can explain why the holders of closed-end funds with aggressive dividend policies are nearly entirely retail investors. On top of our interest in the alternate channel of reaching for yield, it is enriching to consider how the robustness of these results evolves through low-interest rate periods specifically.

Finally, we consider the relatively sparse reach-for-yield literature. Becker et al (2013) examine investors' appetite to buy assets which offer high nominal yields. This paper targets the corporate bond market, primarily focusing on investment

grade bonds. They show that insurance companies, the largest single owner of corporate bonds, reach-for-yield in choosing their investments. In general, insurance companies prefer higher rated bonds with subsequently lower capital requirements. Interestingly, by conditioning on credit rating, they find insurance portfolios are systematically biased toward higher yield and higher CDS bonds. Their findings remain consistent in both primary and secondary markets and are robust to a variety of controls including bond liquidity, duration and issuer fixed effects. This behavior is pro-cyclical and becomes even stronger during economic expansion. Additionally, the effects are more pronounced for firms with weaker corporate governance and stricter regulatory capital. In general, bonds acquired by insurance companies show higher systematic risk and volatility than standard bonds holding credit rating constant. We view a low-interest rate environment for investors in a similar light to a binding capital base, (scarce capital access forces more risky allocations to generate certain absolute returns). Investors and insurance companies alike have less flexibility over what they can buy to hit their hurdle returns and are driven into selecting more risky assets.

Becker et al's (2013) observation of an increase in reach-for-yield behavior during times of economic expansion is relevant to our model. During an economic expansion, we expect uninformed traders to extrapolate prior period returns and subsequently have a higher psychological return target than is reasonable if they were to purely consider current market conditions. This makes uninformed traders more willing to hold risky assets like high-yield bonds that have performed well in prior periods. They may underestimate the risk of default as they are less able to price the risk of a shift in the macro environment.

Chodorow-Reich (2014) provides further insight into the effects of unconventional

monetary policy on financial institutions. This paper argues that the low nominal interest rates combined with administrative costs drove money market funds to reach-for-yield in 2009-2011. It also argues that private defined-benefit pension funds saw an increase in risk taking from 2009. The conclusion was that unconventional monetary policy like quantitative easing drove additional risk-taking in some sectors, like insurance, but not in others.

We consider components of the behavioral economics literature that engages with psychological biases, particularly those concerning retail investors. Daniel et al (2015) summarize the two broad categories of behavioral economics work: 1. the various evidence of psychological bias in individual agents and 2. a variety of market phenomena which rational expectations hypothesis fails to predict or explain. Daniel et al (2015) highlight that although liquid financial markets provide rapid pricing feedback, investors still exhibit substantial overconfidence and hold beliefs for too long. This overconfidence is seen among CFOs (Ben-David et al 2013) and among traders and investment bankers (Glaser et al 2013). They highlight a variety of biases stemming from overconfidence including "overplacement" which is exaggerating one's relative ranking in society, "overprecision" which is exaggerating one's accuracy and "self-attribution bias" which is claiming responsibility for past successes but dismissing failure as bad luck. Overconfidence could be a strong driver for why retail investors are willing to invest in risky assets understating the probability of default and extrapolating prior period returns. Given the positive relationship between economic expansion and magnitude of reach-for-yield behavior discussed above (Becker et al 2013), this tendency to underestimate negative events such as defaults is particularly relevant to our model.

Barber et al (2009) highlight the degree of under-performance of retail traders.

Using trading history of investors in Taiwan, the aggregate portfolio of investors suffers a 3.8% loss in asset value. Virtually all of these losses can be attributed to aggressive orders made by investors in new equities. Institutions, on the other hand, outperform by 1.5% and both the aggressive and passive trading (such as re-balancing) are profitable. This paper provides further behavioral evidence for the tendency of uninformed investors to under-perform, concentrated on unusual portfolio allocation decisions. In our case, new allocation to yield products like high-yield bonds that are not previously commonplace components of an individual investors' portfolio, seems to be a reasonable example of aggressive behavior under the definition of Barber et al.

Weld et al (2009) highlight the nominal share price puzzle. This puzzle is why companies do share splits even though they should have no effect on fundamental value. They argue that it can cost a large size corporation \$800,000 to do a share split but it is still done with high frequency over time. In fact, it can actually lead to heightened trading costs because a lot of brokers charge commission in the form of a few cents/share. Subsequently, the higher the nominal share price, the lower the commission. In recent history, Apple, Google, GE have all done share splits. The argument given is that retail investors perceive a very low share price to be risky (for example, stocks under \$10 a share) and perceive a very high nominal share price to be expensive. Trying to avoid flighty retail investors is one of the reasons why Berkshire Hathaway doesn't do share splits, despite having class A shares trading at close to \$200,000 share as of 02/18/2016. This psychological phenomena has become so ingrained that companies actively manage their share price to stay within a broad range over time. The equally weighted share price of the NYSE has remained around \$25 from 1933 to 2007. This psychological bias to a "reasonably" priced nominal share can help build intuition for why retail investors could be biased to

buying assets with a high nominal yield. Efficient markets would prevent investors achieving heightened expected returns by buying higher nominal yields, just like it should prevent investors achieving higher expected returns by buying companies within a nominal share price band they deem to be comfortable.

3 Background

We provide some context on high yield bonds, closed-end funds, real estate investment trusts, Master Limited Partnerships (MLPs) and Yield Companies (YieldCos).

High yield bonds typically are classified as bonds with a credit rating below BBB i.e. below investment grade. Investment grade refers to the quality of a company's credit. The BBB specification is a threshold decided by Standard and Poor's and/or Moodys by considering the historical default rate of this tranche. High yield bonds are substantially more risky than investment grade bonds in terms of default risk and credit-default premiums. An additional risk is economic risk, which refers to how during weak macroeconomic environments, a flight-to-quality can ensue in which investors want to hold safer assets and subsequently the yield spread compresses. Traditionally, high yield bonds are held by highly informed market participants with expertise in structured credit and due diligence. Since 2009, high yield bond issuance has continued to increase as investor appetite for these products has intensified (Exhibit 3). High yield bonds are attractive as financing tools for private equity companies and distressed business, in particular, that would face substantial dilution risk if they attempted to equity finance.

We are interested in high yield bonds and the systematic risk they present in a low-yield environment because of the dramatically heightened access that retail

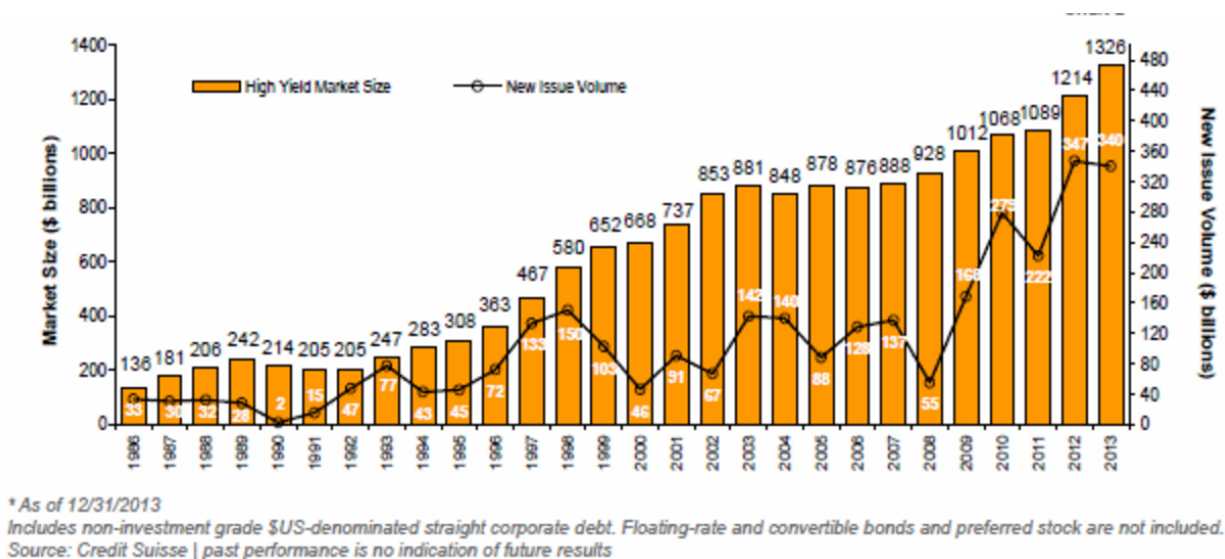


Figure 4. High-Yield Bond Issuance and Market Size (Credit Suisse).

investors have to these assets. Only 10 years ago, it was relatively difficult to access high yield bonds except at issuance auctions. With firms like BlackRock producing exchange-traded funds in an abundance for investors and collecting lucrative management fees for doing so, retail investors can invest in these assets with unprecedented access. The two biggest exchange-traded funds (iShares iBoxx High Yield Corporate Bond ETF (HYG) issued by BlackRock and SPDR Barclays High Yield Bond ETF (JNK) issued by StateStreet) for high yield bonds have around \$24 billion in assets under management.

We are particularly interested in high yield bonds because these assets often combine an attractively high return compared to other yield instruments with substantial risk and historically have had weak Sharpe ratios compared to other asset classes with substantial default risks, correlation to macroeconomic shocks and procyclical issuance trends (William Sharpe, 1966).

A closed-end fund is a publicly traded investment company that raises a fixed

amount of capital during its initial public offering. The fund is then listed and traded on a stock exchange like a stock (Investopedia, 2016). Unlike a mutual fund, shares cannot be redeemed but must be bought or sold on the exchange. The rough metric of underlying value is NAV which is defined as the total market value of all of the assets in the fund including cash. One problem that is particularly challenging for closed-end funds holding illiquid assets like high-yield bonds is that they are hard to price accurately and subsequently net asset values can be stale. Closed-end funds also have a market price driven through the intersection of supply and demand, as is the case for a stock. While it is not uncommon to see companies trading at large premiums to their book value, it is often puzzling to explain discounts in closed-end funds because the underlying assets are the major driver of value. Typically, we see closed-end funds trading at discounts of around 10% of Net Asset Value although funds are typically issued at a premium to Net Asset Value. In recent years, closed-end fund issuance has declined as exchange-traded funds have risen in prominence offering enhanced liquidity, visibility and fee structures more akin to passive management rather than active management.

Real estate investment trusts (REITs) are another important yield asset to consider. Typically, real estate is highly illiquid as the market-place requires brokers to buy or sell that take large commissions. Additionally, to buy real estate, one must commit a large amount of capital compared to buying a stake in the equity of a company. A REIT is attractive because it solves some of these issues. REITs invest in property or mortgages and then trade on exchanges facilitating a substantially more liquid asset. REITs have tax benefits and typically have to pay out a very high proportion of their income as a distribution. Subsequently, REITs are known to pay high dividend yields and are attractive to yield-orientated investors. REITs often trade on a multiple of their yield and therefore, have strong incentives to

maximize their nominal yield. A lot of retail market newsletters like MarketWatch and Jim Cramer rank REITs by dividend yield. REITs are known to buy stakes in apartment complexes, hospitals, office buildings, timber land, warehouses, hotels and shopping malls. There are multiple protections, for example, REITs must have at least 100 shareholders and no more than five of them can hold more than 50% of shares between them. At least 75% of REIT assets must be invested in cash, real estate or US treasuries. At least 75% of gross income must be derived from the real estate holdings. REITs are required to have dividend payout ratios of at least 90%, REITs can deduct these dividends and meaningfully reduce tax liabilities (Investopedia, 2016). On average, 67 percent of the annual dividends paid by REITs qualify as ordinary taxable income, 17 percent qualify as return of capital and 16 percent qualify as long-term capital gains. Currently the total market capitalization of all REITs as of January 2016 is \$905 billion (NAREIT, 2016). 198 REITs trade on the New York Stock Exchange (NAREIT, 2016). The average yield of the FTSE NAREIT ALL REITs index is 4.47% compared to the S&P500's average of 2.34%. Stock exchange-listed REITs paid out approximately \$42 billion in distributions during 2014.

The next yield asset we consider is Master Limited Partnerships (MLP). MLPs are similar to REITs in that they require 90% of their revenue to be generated by Natural Resources or Real Estate. Figure 5 shows a break-down of MLPs by sector. The theme park company, Cedar Fair (Ticker: FUN), for example, is an MLP because income is derived from the theme park assets and the land they operate on. MLPs are limited partnerships which trade on a public stock exchange. Traditionally, they consist of a general partner who manages the business and limited partners who provide the capital. Partners receive income distributions from the cash-flow generated by the MLP. Traditionally, MLPs, particularly those with real

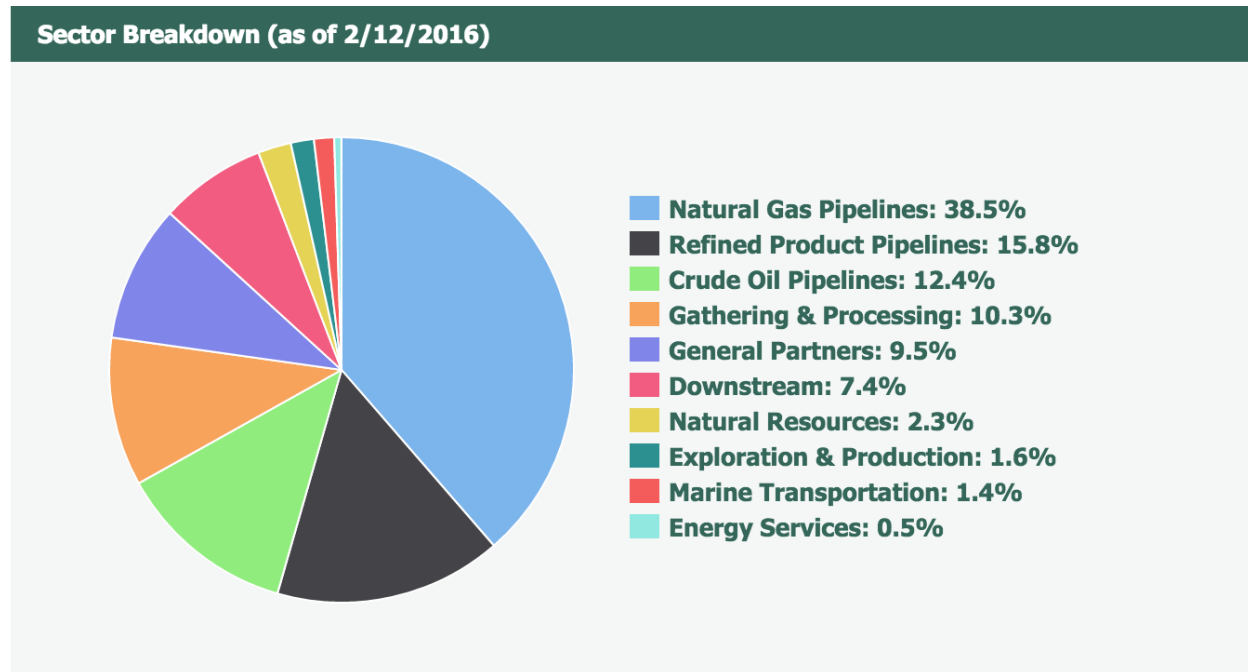


Figure 5. MLP Issuance by Sector (Yorkville Capital).

estate assets, pay substantial dividends although unlike REITs there are no high required distribution rates to qualify. MLPs, unlike corporations, do not pay income taxes although it does retain limited liability. Partners pay taxes on MLP income personally and can also claim MLP depreciation on their personal taxes. As of 2/12/2016, the total market cap of the 122 publicly traded Master Limited Partnerships was \$253 billion (Yorkville Capital, 2016).

A new instrument has been used with increasing prevalence in recent years called a yield company (YieldCo). These instruments have become especially popular in the renewable energy financing sector for companies like SunEdison (Ticker: SUNE). A YieldCo is a dividend-growth focused public company created by a parent company which packages long-term contracted operating assets like solar panels in order to generate predictable cash flows. Figure 6 shows the major YieldCos issued to date. These YieldCos have rapidly gained prominence in the current low-interest rate en-

vironment because they offer perceived safe yields which are supposed to grow over time.

	Portfolio	Renewable Assets (MW-electric)	Total Assets (MW)	Total Capital Raised	Market Cap	Yield (Annual)
NRG Yield, Inc.	Conventional, solar, wind, thermal	1401	2984	\$840 million	\$3.9 billion	5.45%
Pattern Energy Group, Inc.	Wind	1932	1932	\$938 million	\$1.9 billion	6.25 %
Abengoa Yield Plc.	Solar, wind, conventional, electric transmission	710	1010; 1018 mi	\$829 million	\$3.0 billion	3.6 %
TransAlta Renewables, Inc.	Wind,hydro	1378	1378	C\$346million (US\$323)	\$1.3 billion	7.5 %
NextEra Energy Partners, LP	Wind, Solar	989	989	\$406 million	\$3.1 billion	6.25%
TerraForm Power, Inc.	Solar	523	523	\$500 million	\$3.0 billion	4.5% (expected)

Figure 6. Key YieldCo issuance as of August 2014.

As of 07/28/2015, the total market cap of YieldCos was approximately \$84 billion, however, this market cap has fallen significantly since then. YieldCos are very relevant for our consideration because they opportunistically target yield-hungry investors. Additionally, because the parent companies need to finance new acquisitions through these structures which in turn provide the cash-flow to help pay the dividends, the willingness to pay for yield and conviction in the market-place in the trajectory for yield growth is crucial. This sets up a vicious cycle which can drive precipitous price declines if investors lose faith in the sustainability of the dividend.

This transmission mechanism is very relevant to our informed-uninformed trader model we will explore. We can observe the consequences of this "run-for-the-door" type behavior as investors did, through 2015, lost confidence in the sustainability of the dividends and this asset class, more generally, in a in Figure 7. YieldCos are very complex instruments to understand because of the various claims to cash-flow and the subsequent risk associated with these in the future. YieldCos offer a pow-



Figure 7. 1 year trailing price chart of 3 major YieldCos (02/18/2016).

erful example of a scenario in which information asymmetry around the probability and magnitude of underlying risks can have very negative consequences for market stability. One of the major reasons why Bank of America Merrill Lynch, the key structuring bank for these products, was able to market them so successfully was because of their stable yields in a low-interest-rate world, somewhat analogous to the sale of MLPs at IPO. (Company Interview, 2016).

4 Model

Our model illustrates a mechanism by which reaching-for-yield leads to different behaviors in different interest rate environments. We utilize the model to highlight some specific behavioral biases (lack of sensitivity to downside, unreasonable return expectations often extrapolated from past returns) and how they ultimately can drive instability. The model is an extension of the Hanson and Stein (2014) uninformed/informed trader model with one mean-variance optimizing investor and one yield-seeking investor.

We specify two types of traders: informed traders and uninformed traders. All traders are given an initial endowment of 1 safe asset and 1 yield asset. Agents are able to freely trade 1 yield asset for 1 safe asset between each other. We specify two different scenarios: a high interest rate world and a low interest rate world. Our safe asset has an exogenous return of r_h in a high interest rate world and an exogenous return of r_l in a low interest rate world where $r_h > r_l$. Our yield asset, in a high interest rate world, has an exogenous return of $r_h + \alpha_h$ with probability p and an exogenous return of r_d with probability $1 - p$. Our yield asset, in a low interest rate world, has an exogenous return of $r_l + \alpha_l$ with probability p and an exogenous return of r_d with probability $1 - p$. d stands for default and is independent of the interest rate environment. Let r_i be the portfolio return of the informed trader and let r_{ui} be the portfolio return of the uninformed trader. We assume that there is only one type of yield asset available and if a default occurs, all yield assets default. Different units of yield assets could be interpreted as identical fractional ownership shares in a closed-end fund, high-yield bond or other yield asset as discussed earlier. We assume that the yield assets are perfectly correlated.

We specify the following conditions:

$$\alpha_h, \alpha_l > 0 \tag{1}$$

$$p(r_l + \alpha_l) + (1 - p)(r_d) < r_l \tag{2}$$

$$p(r_h + \alpha_h) + (1 - p)(r_d) = r_h \tag{3}$$

Condition 1 ensures investors are obtaining strictly more absolute return in the yield asset than the safe asset in the state of the world where the yield asset does not default. This condition is necessary because otherwise the safe asset would be strictly preferred.

Condition 2 makes buying the yield asset sub-optimal for an expected return maximizing investor as the expectation return of the safe asset is higher than the yield asset. This leads to the bifurcation between our two types of investors' propensity to hold the yield asset. In a risk-neutral world, where investors are not compensated for holding risky assets combined with low-beta phenomena (Campbell et al, 2003), this specification is reasonable.

Condition 3 is an indifference condition such that expected return maximizing investors are indifferent between risky assets and safe assets. This condition is an extension of the efficient markets hypothesis in a risk-neutral world (Fama, 1970) in which there is no "free lunch". If there is an absence of any market disruptions (market segmentation, behavioral effects or mispricing), investors should not be able to achieve heightened expected returns by changing their asset allocation.

We specify a portfolio benchmark return R and some other conditions:

$$r_h > \frac{R}{2} \tag{4}$$

$$r_l < \frac{R}{2} \tag{5}$$

$$r_l + \alpha_l > \frac{R}{2} \tag{6}$$

$$r_d < \frac{R}{2} \tag{7}$$

Condition 4 means that investors who own two safe assets will be able to outperform the portfolio benchmark return in the high interest rate world.

Condition 5 means that investors who own two safe assets will not be able to beat the portfolio benchmark return in the low interest rate world.

Condition 6 means that investors who own two yield assets will be able to beat the portfolio benchmark return in the low interest rate world provided the yield assets do not default.

Condition 7 means that investors will not be able to beat the portfolio benchmark return if their yield assets' default.

$$r_h + r_d < R \tag{8}$$

$$r_d < 0 \tag{9}$$

$$a > 0 \tag{10}$$

Condition 8 means that investors who hold both a safe asset and a yield asset that defaults will not be able to beat the portfolio benchmark returns.

Condition 9 means that the yield asset has a negative return if a default occurs.

Condition 10 means that investors always suffer negative utility if their returns are below the portfolio benchmark return. The portfolio benchmark return only features in the utility function of the uninformed trader.

Our informed trader has a utility function:

$$U = E(r_i) \tag{11}$$

Our uninformed trader has a utility function (with $0 \leq \alpha < 1$)

For $r_{ui} \geq R$

$$U = (r_{ui} - R)^\alpha \tag{12}$$

For $r_{ui} < R$

$$U = -a \tag{13}$$

Our informed trader has a standard expected return maximizing utility function. This utility function, by design, ensures the trader adapts return expectations continuously because she/he is optimizing over expected return so will own whatever assets will perform the best on average. We define this trader as the informed trader because the utility function enables pricing of all the potential payouts with the importance of such payouts scaled in a reasonable manner (in this case, by the real probability of the payout occurring).

Our specification for the uninformed trader's utility emphasizes the focus on hitting a particular return threshold R . This utility function is reasonable for the typical uninformed retail investor for a few reasons.

Firstly, it is reasonable to conceive retail investors having a particular return target in their mind that is psychologically anchored through their understanding of "conventional wisdom" or prior period results that are not necessarily tied to current market conditions. For example, many investment products have warnings that feature disclaimers like "past performance does not guarantee future results" yet there is widespread extrapolation of prior period returns, particularly by less informed traders. This is demonstrated by Lamont and Frazzini in their paper aptly titled "Dumb money: mutual fund flows and the cross section of stock returns" (Lamont et Frazzini, 2005).

Secondly, retail investors are known to trade more regularly and invest more heavily in growth stocks. This drives flatness in the capital asset pricing model and under compensates individuals for holding high beta stocks (Campbell et al, 2003). Successful investing in varying market conditions requires patience and an acknowledgment that expected returns are lower in risky assets during certain periods than others (Shiller, 2010).

Thirdly, the retail investors may be highly sensitive to a particular return profile because they need a specific amount of money in the future (i.e. to pay for college or retirement). An informed investor, like a hedge fund, would be less likely to have a specific liquidity constraint than a retail trader. If a hedge fund, for example, had a pressing liquidity constraint, it would likely have been shut down in advance because limited partners would be concerned about solvency or financial obligations.

These three behavioral characteristics of retail investors point to a lack of willingness to accept lower expected returns during less favorable macro-conditions. We

have specified with the return profile of our safe asset that it is easy to beat the return threshold R in the high yield world to mimic the idea that the aggressive return expectations of retail investors is sustainable during times where assets have high yields. The construction of our safe asset to under perform the return threshold R mimics the idea that retail investors are less likely to be able to hit their target returns in an environment where expected returns are compressed.

In our model, retail investors are also unable to properly price the potential risk of default. The yield asset could represent a high yield bond in which the uninformed trader, ex-ante, doesn't have a clear understanding of how bad the situation could get in the bad state of the world. The agent optimizes around a dis-utility of $-a$ in the bad state of the world, unable to appreciate the full spectrum of potential capital loss or risk being taken. The agent subsequently oversimplifies the portfolio allocation decision. The retail investor is aware bad things can happen but his/her characterization of "bad" is not very granular. For a retail investor, with a lack of understanding of default probabilities and potential scale of losses in a default scenario, investing in high yield bonds is problematic given the substantial information asymmetry between them and more informed counter-parties. Platt et al (1992) emphasized the lack of congruence between Moody's company bond ratings and failure rates. Fridson et al (1990) highlighted the lack of efficiency in the pricing of high-yield bonds. Our literature review substantiates our model of certain yield assets as complex, illiquid and challenging to price which provides strong evidence for why an uninformed trader may oversimplify their calculus of potential downside (represented by $-a$ in our model).

We believe it is reasonable to classify this second category of trader as "uninformed". If our uninformed trader is modeling a retail investor, an R which is not

being updated or risk-adjusted can be interpreted as not accurately pricing market risk or reasonable return expectations. Additionally, the flat downside penalty of $-a$ reduces the sensitivity of this trader to downside risk in comparison to the informed trader (with an expected return optimizing utility function). Intuitively, a retail investor is less able to fully price and comprehend the full spectrum of downside risk scenarios and properly evaluate these whereas an informed investor is more capable of accurately assessing these risks.

Key Propositions:

1. Uninformed investors are unable to accurately ex-ante price downside risk and we represent this with a flat $-a$ penalty
2. Uninformed investors have distorted views of reasonable market return thresholds which we represent with R .
3. Market instability (systemic risk) can be caused by shocking either the market return threshold (R) of the uninformed investors or by shocking the downside penalty ($-a$)
4. Different return profiles exist for yield assets in high and low interest rate environments.

We first consider the case of the high interest rate world and solve our model under these circumstances.

Given the expected return on the yield asset is the same as the safe asset, the informed trader is indifferent between holding either asset so is indifferent between trying to trade one of the assets or keeping her/his initial endowment.

An uninformed agent, given our return threshold R , always prefers holding 2

yield assets to 1 yield asset and 1 safe asset.

Consider the expected utility of the uninformed trader who holds two yield assets:

$$U(ui) = p(2(r_h + \alpha_h) - R)^\alpha + (1 - p)(-a) \quad (14)$$

Consider the expected utility of the uninformed trader who holds one yield asset and one safe asset:

$$U(ui) = p(2r_h + \alpha_h - R)^\alpha + (1 - p)(-a) \quad (15)$$

Because of the constant in the uninformed trader's utility function in the bad state of the world (in which the yield asset defaults), the agent strictly prefers holding two yield assets to a yield asset and a safe asset assuming $\alpha > 0$. The agent suffers the same penalty for under performing R irrespective of the magnitude by which the realized returns deviate below the threshold.

We also have to consider the utility of the uninformed trader in holding two safe assets relative to two risky assets. The utility of the uninformed trader in holding two safe assets is as follows:

$$U(ui) = (2r_h - R)^\alpha \quad (16)$$

If $(2r_h - R)^\alpha > p(2(r_h + \alpha_h) - R)^\alpha + (1 - p)(-a)$, the uninformed trader strictly prefers holding two safe assets to two risky assets. In this case, the uninformed trader will trade with the informed trader to obtain the safe assets. The informed trader is risk-neutral and subsequently is indifferent between the assets so will hold the risky assets.

If $(2r_h - R)^\alpha < p(2(r_h + \alpha_h) - R)^\alpha + (1 - p)(-a)$, the uninformed trader strictly prefers holding two risky assets to two safe assets. In this case, the uninformed trader will trade with the informed trader to obtain the risky assets. The informed trader is risk-neutral and subsequently is indifferent between the two assets so will hold the safe assets.

If $(2r_h - R)^\alpha = p(2(r_h + \alpha_h) - R)^\alpha + (1 - p)(-a)$, the uninformed trader is indifferent between holding two safe assets and two risky assets. Subsequently, we can solve for a which is as follows:

$$a = \frac{p(2(r_h + \alpha_h) - R)^\alpha - (2r_h - R)^\alpha}{1 - p} \quad (17)$$

In this case, the uninformed trader is indifferent between either holding two risky assets or two safe assets. It is interesting to note that given the specification for utility of the uninformed trader in the bad state of the world that both options are strictly preferred to holding one safe asset and one risky asset. Two equilibria exist, one in which the uninformed trader trades her/his initial endowment of safe asset for another risky asset and one in which the uninformed trader trades her/his initial endowment of the risky asset for another safe asset.

If we relax condition 3) and the expected return of the two assets is left to vary without changing the 1:1 exchange rate between yield assets and safe assets then an equilibrium can be created where the yield assets are preferred by both traders. Subsequently, no one wants to trade their one yield asset in their initial endowment for a safe asset. This occurs if the expected return from the yield asset is higher than that of the safe asset and the utility function of the uninformed trader

makes one yield asset and one safe asset more attractive than two safe assets i.e.

$$p(2r_h + \alpha_h - R)^\alpha + (1 - p)(-a) > (2r_h - R)^\alpha$$

We next consider what happens in the low interest rate world. Informed traders realize that safe assets have a higher expected return than yield assets and so wish to own both safe assets and have utility:

$$U_i = (2r_l) \tag{18}$$

If an uninformed trader buys safe assets, she/he will miss the benchmark return R and subsequently will have utility of $-a$. This is because the total return of two safe assets does not surpass the return threshold of the benchmark return R subsequently triggering the uninformed trader's disutility of $-a$. By a similar argument to above, the uninformed trader strictly prefers two yield assets to one yield asset and one risk asset. Therefore, regardless of the magnitude of a , the uninformed trader can't get enough return in the safe asset and needs to buy the yield asset. The ex-ante utility of the uninformed trader is optimized by owning both the yield assets. In this equilibrium, the uninformed trader strictly prefers owning two yield assets while the informed trader strictly prefers owning two safe assets. It is important to note that the expected return of the informed trader's portfolio is higher than that of the uninformed trader.

The utility of the uninformed trader is as follows:

$$U_{ui} = p(2(r_l + \alpha_l) - R)^\alpha + (1 - p)(-a) \tag{19}$$

In this equilibrium, all the risky yield assets are bought by the the uninformed

trader regardless of the magnitude of r_d (assuming r_d is bound by our negative constraint), the return of the yield asset in the bad state of the world. All of the safe assets are bought by the informed trader who realizes the expected return is not favorable by retaining ownership of the yield assets. If all investors were expected return optimizing informed traders, nobody would want to trade a safe asset for a yield asset with inferior returns and the default risk would be spread over all the investor's portfolios. Investors would have some guaranteed returns from their safe assets. The worst-case outcome for the portfolio under default of the yield asset is not as unfavorable as under the case where an investor's portfolio has two yield assets (with perfect correlation). The existence of uninformed traders leads to a transfer of ownership of yield assets away from informed traders, who now have a counter-party willing to take away the unattractive assets from them. The uninformed traders, trying to chase a return threshold R , that is relatively more difficult to reach in this low-interest rate environment, are driven to own all the yield assets. This model illustrates the enhanced impact of the reach-for-yield phenomena in a low-interest rate environment in the presence of uninformed traders.

One can argue that an economy in which investors maintain different but consistent objective functions is not particularly worrisome because assets migrate to those investors who desire them most and then they hold them. In reality, it is more likely that unsophisticated investors (and often sophisticated investors as well) are happy to enjoy the benefits of risk-taking when things are going well but "run for the door" (Stein, 2015) when the potential losses in their investment allocations materialize. Unsophisticated investors, realized they are holding assets in a risky environment, are likely to want to liquidate these assets rapidly, further depressing their price. We can model this "run for the door" behavior in the low-interest rate world by introducing a shock to the equilibrium where uninformed traders have their hurdle rate R

reduced. This could occur as uninformed traders realize that their return targets are unsustainable and they become more pessimistic about the outlook for the economy.

Assume R gets reset to 0. The key inequality to consider is if:

$$p(2(r_l + \alpha_l))^\alpha + (1 - p)(-a) < (2(r_l))^\alpha \quad (20)$$

This occurs if

$$\frac{p(2(r_l + \alpha_l))^\alpha - (2(r_l))^\alpha}{1 - p} < a \quad (21)$$

In this case, uninformed traders after updating their hurdle return expectations R for the current market climate find themselves realizing that the yield assets are no longer more attractive than the safe assets. However, the informed traders are unwilling to trade any safe assets for yield assets (at the 1:1 exchange rate). The liquidity in the marketplace at the 1:1 rate which previously was robust (as uninformed traders wanted yield assets and informed traders wanted safe assets) vanishes. Now both informed and uninformed traders prefer the safe assets. In order for any trading to occur, the exchange price for the yield assets need to fall in order to stimulate the informed traders to want to trade. We assume the unit asset is divisible to illustrate this mechanism

The informed trader in this scenario will be willing to trade when they can obtain x yield assets for 1 safe asset. x is defined by

$$x(p((r_l + \alpha_l)) + (1 - p)(r_d)) > r_l \quad (22)$$

$$x > \frac{r_l}{p((r_l + \alpha_l)) + (1 - p)(r_d)} \quad (23)$$

We know that x must be greater than 1 given that the expected return of the

safe asset is higher than that of the yield asset. This shock mechanism in which uninformed traders have to update their return expectations R and want to liquidate their risk assets can lead to a decline in prices which is decreasing in p , increasing in r_d and decreasing in R . The lower R becomes the higher the willingness uninformed investors have to trade the yield assets. Uninformed investors may have return hurdle expectations R which are meaningfully out of sync from reasonable market expectations based on macroeconomic factors.

We still need to consider whether at the new market clearing price x the uninformed trader wishes to trade. The uninformed trader considers the below function. The first component represents maintaining her/his existing portfolio, the second component represents trading all her/his yield assets for safe assets and the third component represents trading some portion of his yield assets for 1 safe asset then keeping the remaining yield assets. The third component is only a consideration if the market rate $x < 2$.

$$\text{Max}[p(2(r_l + \alpha_l))^\alpha + (1-p)(-a), (\frac{2}{x}(r_l))^\alpha, p(r_l(3-x) + \alpha_l(2-x))^\alpha + (1-p)(-a)] \quad (24)$$

If the Max function returns the second or third component, the uninformed trader and informed trader will now trade.

Figure 8 shows the utility of an uninformed trader holding a portfolio of two yield assets, two safe assets or one yield and one safe asset. We plot utility on the y axis against the return threshold on the x axis. In this simulation we set $p = 0.7, r_l = 5\%$, $a_l = 4\%, \alpha = 0.9$ and $a = 10$. We consider a wide range of R values encompassing

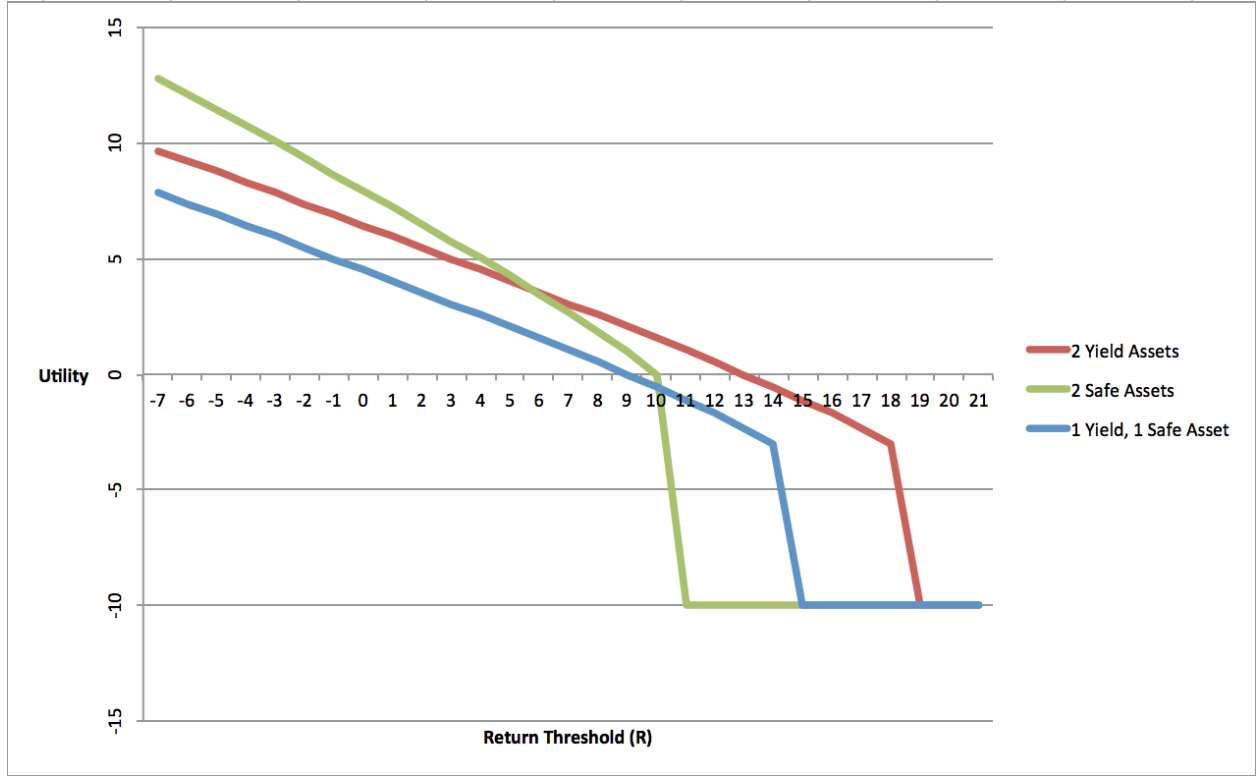


Figure 8. Utility of the uninformed trader under various portfolio combinations as the Return Threshold changes. $p = 0.7$, $r_l = 5\%$, $a_l = 4\%$, $\alpha = 0.9$, $a = 10$.

the major shifts in asset allocation an uninformed trader would be incentivized to attempt to make (although in our standard model, portions of these R ranges would be restricted by our initial assumptions). For return thresholds that are very low all the way up to close to 5.5, it is optimal to hold two safe assets as the return threshold is so low that it is not worth taking the risk and potentially taking the penalty of $-a$. After this threshold, it becomes more attractive to hold two yield assets because they enable the uninformed trader to beat the return threshold R sufficiently to offset the probability of disutility in the case of default. After the return threshold in this example of 10, the uninformed trader cannot possibly beat the yield target with 2 safe assets so is driven to hold the yield assets so as to have an opportunity to beat the return threshold with some probability. Beyond 18, neither the yield asset or the safe asset offers sufficient return potential to hit the return

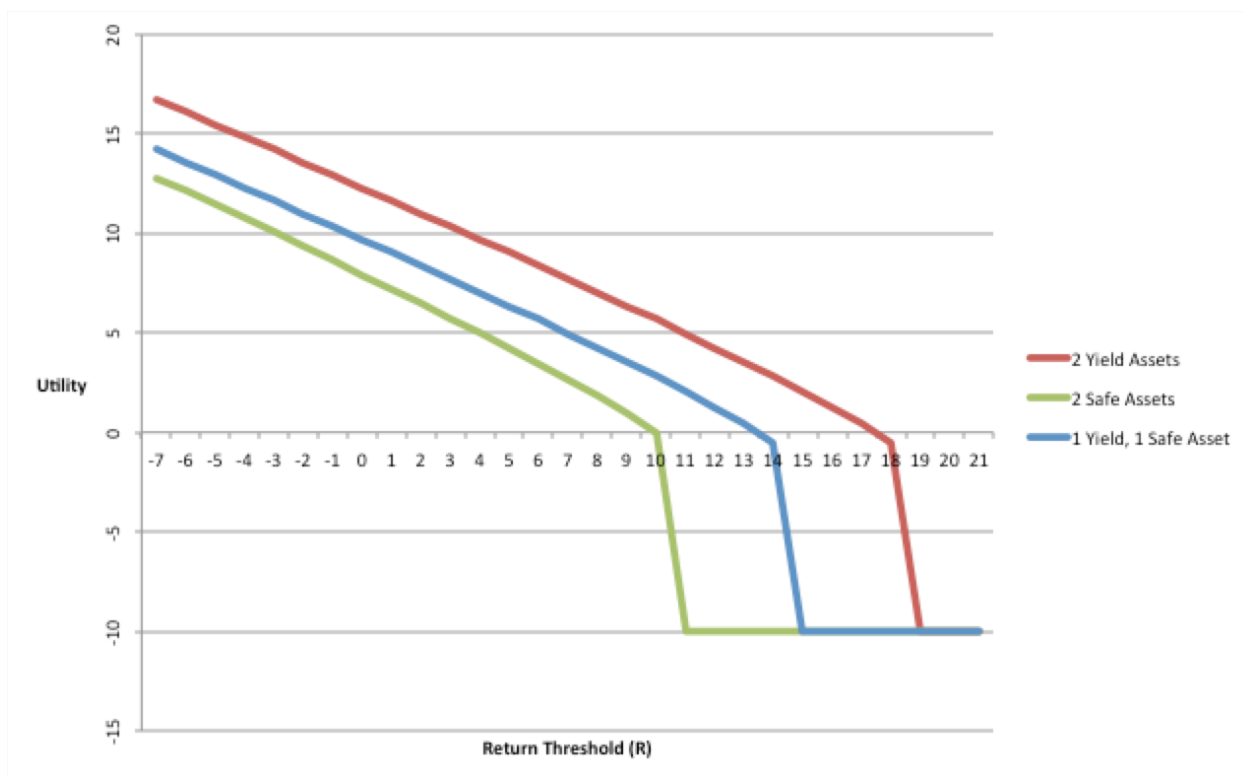


Figure 9. Utility of the uninformed trader under various portfolio combinations as the Return Threshold changes. $p = 0.95$, $r_l = 5\%$, $a_l = 4\%$, $\alpha = 0.9$, $a = 10$.

threshold and the uninformed trader becomes indifferent between the two portfolios. It is never optimal for the uninformed trader to hold a mix of yield and safe assets as this portfolio is always strictly dominated by one of the two other options.

We can see in Figure 9, as the probability of default $1 - p$ becomes less likely (here it is set at 0.05) the yield asset becomes strictly more optimal than the safe asset. This is because, the upside in the case the return threshold is beaten by a meaningful component more than offsets the probability of default. We assume the probability p is accurate but one could also consider that for an uninformed trader, not only may the downside ($-a$) be misinformed but the perceived probability of default could be lower than reality. This would further accentuate the reach-for-yield mechanism and drive uninformed traders to choose yield asset portfolios over

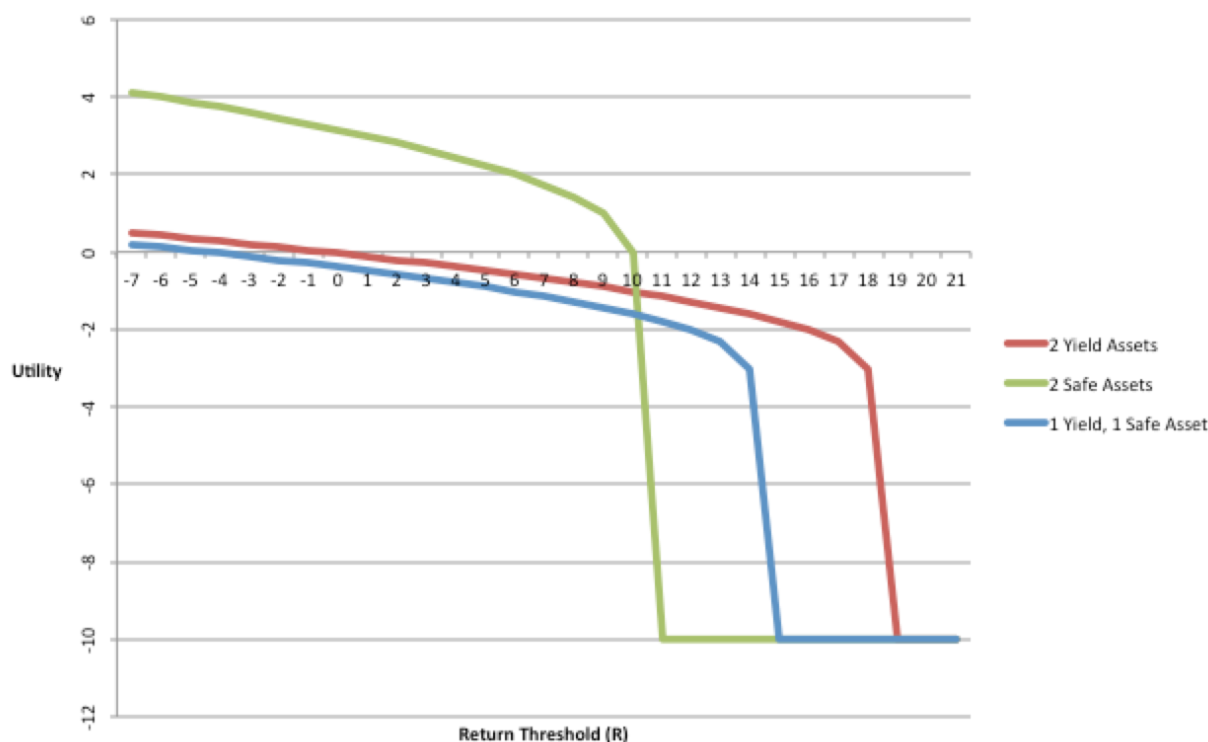


Figure 10. Utility of the uninformed trader under various portfolio combinations as the Return Threshold changes. $p = 0.7$, $r_l = 5\%$, $a_l = 4\%$, $\alpha = 0.5$, $a = 10$.

safe assets on the margin. We can note that 2 yield assets is strictly optimal to 1 safe and 1 yield asset. Owning two safe assets is, therefore, inferior to both of the other portfolio allocation options, given the relatively low probability of default compared to the incremental yield.

Figure 10 demonstrates the effect of decreasing α to 0.5. This increases the concavity of the utility function and subsequently makes incremental returns marginally less attractive than in the conditions specified in Exhibit 7 above the hurdle threshold return R . We can see this makes the yield asset less optimal for a wider range of return thresholds up until a R value of 10.

Figure 11 demonstrates the effect of increasing a_l . a_l represents the low-interest

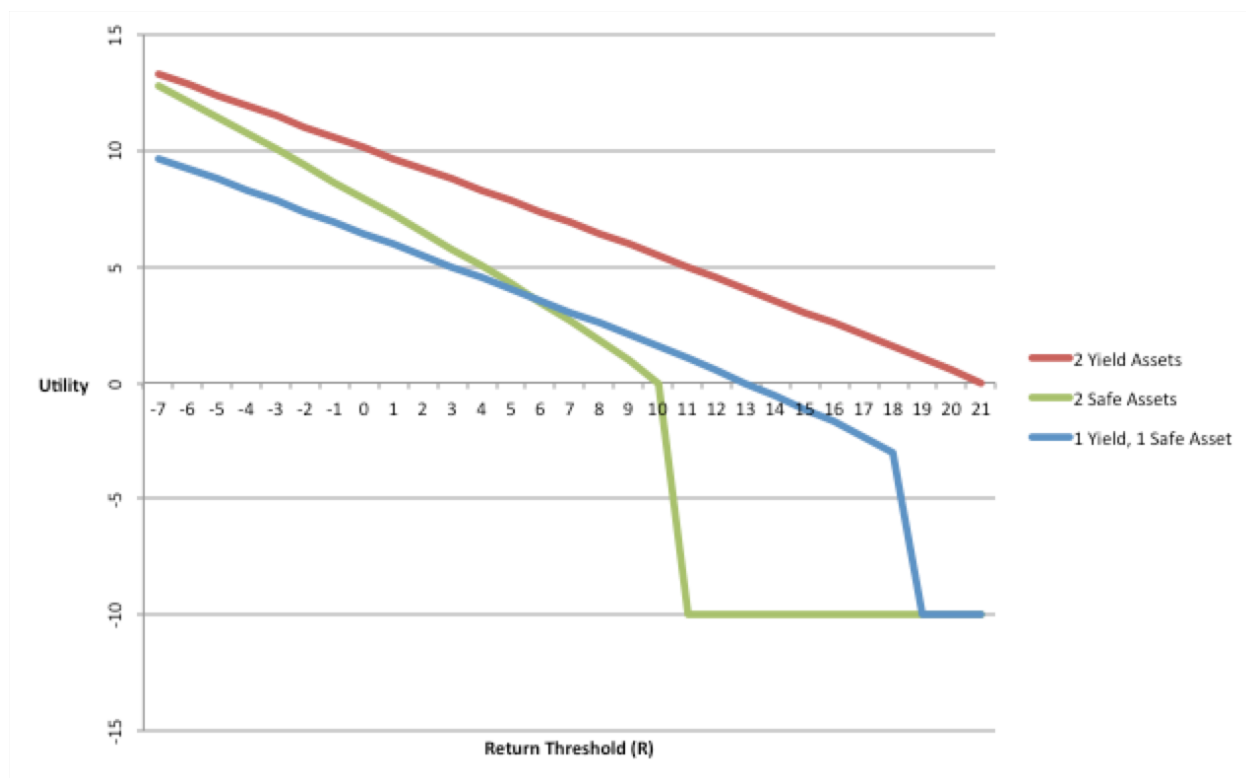


Figure 11. Utility of the uninformed trader under various portfolio combinations as the Return Threshold changes. $p = 0.7$, $r_l = 5\%$, $a_l = 8\%$, $\alpha = 0.9$, $a = 10$.

rate environment yield spread above and beyond the safe asset. As this increases, the yield asset becomes marginally more attractive. In our model, a_l remains fixed, however, in reality as more investors buy yield assets a_l would compress as the price gets bid up and subsequently continue to make the yield asset incrementally more attractive. At an a_l value of 8, the yield asset pays a sufficient premium which means that it is strictly optimal to the safe assets for the uninformed trader above a return threshold of -7 . It important to note, that investors and asset managers would rarely maintain a negative return target as they typically have the opportunity to buy safe assets that have small but non-zero returns or can hold cash "in their mattress" which provides a nominal return of 0. Eventually, as the return threshold gets larger the utility of holding the yield asset will eventually converge to $-a$ as no combination of assets facilitates hitting R .

This threshold return updating transmission mechanism illustrates how systemic risk (defined as the possibility of a rapid decline in assets prices) can build in the presence of uninformed traders in low-interest rate environments if R is not continuously re-calibrated for the environment. Uninformed traders can accumulate a portfolio of yield assets potentially including assets discussed above like YieldCos or high-yield bonds expecting a particular return. After realizing the return expectations are not reasonable, they will attempt to trade their portfolio for safe assets but will need to do so at a discounted market price.

Key Conclusions:

1. The higher the expectations of market return thresholds (R), the greater the propensity for uninformed traders to hold yield assets and exhibit reach-for-yield characteristics. This transfer of ownership of yield assets towards uninformed traders is a key characteristic of the model of Hanson and Stein (2014).
2. A decline in market return thresholds (R) can disrupt the equilibrium asset allocation between informed and uninformed traders and cause the clearing price for yield assets to fall.
3. A change in the interest rate environment can affect the relative attractiveness of yield assets and generate reach-for-yield behaviour given the specification of utility for the uninformed trader.
4. Bounded perceived downside risk ($-a$) increases the willingness for uninformed traders to buy yield assets which have some non-zero probability of defaulting. This can lead to excessive risk-taking from the perspective of a social planner who wishes all assets to be priced based on their expected returns (in a risk-neutral world).
5. The existence of uninformed traders with unrealistic market return thresholds (R) leads to the heightened likelihood of market instability (defined as a sudden

change in asset prices) provided that there is some probability that the unrealistic market return threshold will be updated.

6. Uninformed traders prefer to own two yield assets or two safe assets over one yield asset and one safe asset. This result is driven by the utility function of the uninformed trader (specifically target return thresholds and bounded downside risk) combined with perfectly correlated default risk across yield assets.

4.1 Model Extensions

We can also use our model described above to help describe how misaligned agency incentives can also lead to the creation of greater systemic risks. In the context of agency conflict incentives, imagine a pension fund manager who has to make a particular nominal return target (in our model, this is R). One could assume, for example, the agent's boss has fixed liabilities and so subsequently decides to set the agent's compensation (and job security) to beating a specific threshold. $-a$ represents getting fired for under-performing. We would be imagine a to be very large in this type of context. In this scenario, the uninformed trader could be more aptly described as an informed trader with incentive misalignment through the fault of a principal. This problem could be reduced by adjusting R downwards during low-return environments so the agent does not need to take on substantial risk to hit the target. You could also adapt the $-a$ to be a function of the magnitude of losses. Additionally, one could construct a compensation scheme in which the agent has to pay back money in the bad state of the world in a sliding scale tied to the set of downside losses would help to reduce the agency incentive to do whatever it takes to hit R . The agent, under this modification, would be more sensitive to the scale of downside losses.

Another valid consideration for modeling agency conflicts with pension funds would be to examine the pay-off structure in the scenario where they outperform their return threshold. We can temper the sensitivity of utility to out-performance by modifying our concavity parameter α . This is relatively crude and could be improved by modifying the function inside the brackets to reflect the compensation structure, then use α to model diminishing marginal utility over dollars. As an approximation, however, the flexibility of α here is useful.

The introduction of a could also be viewed as a simplification of a salience model (Shleifer, 2012) whereby the investor's utility function can be modified by altering the magnitude of a to either be highly sensitive to under-performing the nominal benchmark (i.e. salient to under-performing) in the case of large a or hardly sensitive at all to losses (i.e salient to magnitude of returns above and beyond a threshold) in the case of small a . You could imagine being very sensitive to magnitude of returns above a threshold in the case of a fund manager with a carry fee built into the compensation structure where she/he must outperform a particular target before receiving a hike in fees. This structure is common in areas such as high-yield bond funds, private equity and distressed debt.

5 Data

We use Bloomberg as a source of issuance and scaled price factor data across closed-end funds, real estate investment trusts and high yield bond ETFs and yield companies. Bloomberg, the leading provider of financial data for investment professionals, has comprehensive coverage of a wide variety of asset classes.

Firstly, we consider our data-set of US Real Estate Investment Trusts. We use the FTSE NAREIT All Equity REITs Index. This is a free-float adjusted market capitalization-weighted index that includes all tax qualified REITs listed in the NYSE, AMEX, and NASDAQ National Market. The condition for inclusion in this index is to have more than 50 percent of total assets in qualifying real estate assets other than mortgages secured by real property. Our data-set spans 2513 trading days between 5/31/2006 and 2/10/2016. We specifically consider tax qualified REITs because we want to use only those that are distributing large portions of their income as yield. The average dividend yield is 4.28% and standard deviation is 1.34%. The average Price to Book ratio is 2.29 and standard deviation is 0.45. Over this time period, the federal funds rate has an average yield of 1.13% and a standard deviation of 1.87%. The US Generic Government 5 Year Yield has an average yield of 2.15% and a standard deviation of 1.25%.

Secondly, we consider our data-set of high-yield bonds. We use two indexes for our analysis, the first being HYG US Equity. This is the iShares iBoxx High Yield Corporate Bond ETF issued by BlackRock. This has 997 constituent holdings as of 02/19/2016. As of 02/19/2016, it has a market capitalization of 13.7 billion making it the largest high-yield bond ETF by market capitalization. The second being JNK US Equity. This is the SPDR Barclays High Yield Bond ETF. This has 763

constituent holdings as of 02/19/2016. As of 02/19/2016, it has a market capitalization of 9.35 billion making it the second largest high-yield bond ETF by market capitalization. HYG US Equity spans 106 monthly data-points between 05/07/2007 and 02/05/2016. The average monthly yield is 0.61% and the standard deviation is 0.16%. The average Price to Net Asset Value is 100.80% with a standard deviation of 1.37%. JNK US Equity spans 98 monthly data-points between 12/04/2007 and 02/09/2016. The average monthly yield is 0.69% with a standard deviation of 0.24%. The average Price to Net Asset Value is 100.487% with a standard deviation of 0.719%.

Thirdly, we consider our data-set of closed-end funds. For our analysis, we screen the world of closed-end funds by the following criteria: 1) US domiciled 2) Inception Date before 1/1/1995 3) High Yield Fund Focus 4) Still Currently Active. This produces a sample size of 18 closed-end funds (after dropping 1 closed-end fund for missing data). Our sample includes 43,200 individual complete data points with 2400 complete data points per closed-end fund. The data spans from 1/1/1995 to 3/14/2016. We consider US domiciled funds as we are considering the US interest rate environment. The average dividend yield of the close-end funds in our sample size is 8.77%. The average price/NAV is 96.60%. Although the implications for US federal reserve policy has global effects through the market transmission mechanism, US domiciled funds is the most relevant sub-set of world closed-end funds. We consider funds with an inception date before 1/1/1995 in order to capture at least two different low-interest rate environments.

We consider high-yields funds for a few reasons: (i) Our previous analysis of high-yield funds was constrained to exchange-traded funds which have substantially tighter price to net asset value variance because of the easy redemption process

which facilitates arbitrage trading. By considering closed-end funds, which have substantially wider variance in price to net asset value, we provide further clarity into the consistency of the reach-for-yield asset classes. (ii) High-yield funds, given their focus on yield and lower credit quality, is a fruitful area for consideration because of the potential for information asymmetry and skewed perceptions of downside risk. In the earlier literature analysis, we noted a number of examples of this prominent information asymmetry manifesting itself in high-yield funds and subsequently concluded its particular importance. (iii) Market practitioners such as Carl Icahn, perceive high yield bonds to be one of the largest sources of risk in the discussion of reach-for-yield.

Fourthly, we consider our data-set of yield companies. We consider 5 of the largest YieldCos by market capitalization. These are NYLD US Equity, PEGI US Equity, ABY US Equity, NEP US Equity, TERP US Equity. These YieldCos were all relatively recent initial public offerings. NYLD US Equity spans 193 data-points between 05/15/2015 and 02/19/2016. The average dividend yield is 5.32% and the standard deviation is 1.31%. The average Price to Book is 0.911 and the standard deviation is 0.179. PEGI US Equity spans 358 data-points between 09/18/2014 and 02/19/2016. The average dividend yield is 5.82% and the standard deviation is 1.35%. The average Price to Book is 1.09 and the standard deviation is 0.49. ABY US Equity spans 358 data-points between 11/14/2014 and 02/19/2016. The average dividend yield is 5.82% and the standard deviation is 1.35%. The average Price to Book is 1.51 and the standard deviation is 1.02. NEP US Equity spans 60 data-points between 12/31/2014 and 03/27/2015. The average dividend yield is 0.50% and the standard deviation is 0.03%. The average Price to Book is 1.33 and the standard deviation is 0.07. TERP US Equity spans 285 data-points between 01/02/2015 and 02/19/2016. The average dividend yield is 4.38% and the standard

deviation is 4.34%. The average Price to Book is 2.37 and the standard deviation is 1.32.

There are a number of empirical tests which we perform. We conduct a number of time-series regressions on the real estate investment trusts, high-yield bonds, yield-companies and closed-end funds under considerations. In a number of these regressions, we specify an indicator variable for the low-interest rate environment. We set our cut-off value at a fed funds rate of 2%. While we acknowledge assigning any one specific cut-off value which defines entrance into a low-interest rate environment is simplistic, Taylor (1993) argues convincingly that 2% is approximately the stable long-term equilibrium interest rate in "Discretion versus Policy Rules in Practice". We also note that a 2% cut-off encompasses both the low-interest rate environment from 2001 to 2005 and 2009 to 2016. Finally, we discussed with various industry practitioners across both the sell-side and buy-side community to ascertain the appropriateness of this cut-off from this alternative perspective. We set our 5Y Government Yield rate at 3%. This cut-off value is obtained by taking the average fed rate over the 1995 to 2016 period which is 1.44% and the average 5 year government yield rate of 2.55% and finding the average magnitude of the difference 1.1%. We round this to 1 significant figure to obtain 1% to bring the accuracy in-line with our fed rate cut-off and then add this value to our fed rate cut-off to obtain 3%. We recognize the inherent limitation in using a binary cut-off but given that we seek to demonstrate the effect of low-interest rates does not necessarily have a linear effects on the attractiveness of assets in our model, we see this as reasonable.

For our real estate investment trust analysis, we run a time-series regression with price/book value as the dependent variable. For the independent variables, we use the annual dividend yield, an indicator variable for low interest rate environment

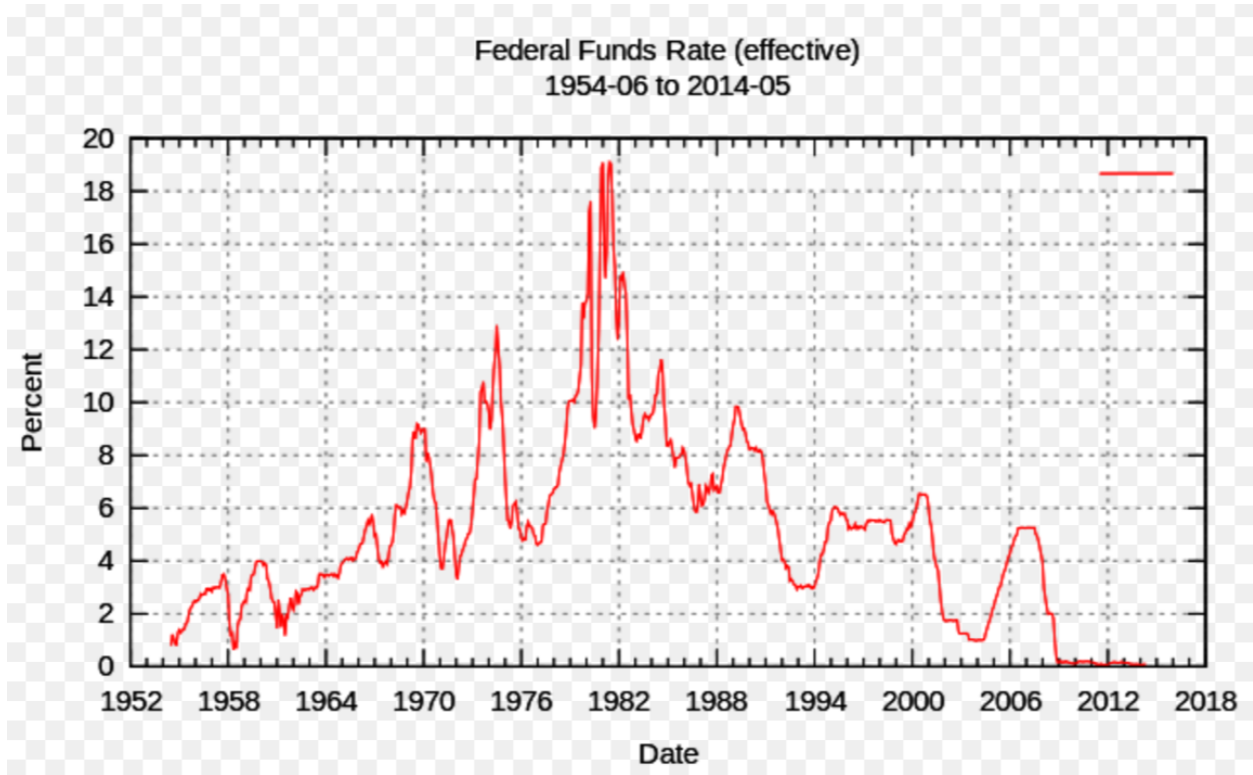


Figure 12. Effective Fed Funds Rate Chart

and an interaction term between our indicator variable and the dividend yield. A positive coefficient on the interaction term would imply that in a low-interest rate environment, the willingness to pay for each incremental unit of dividend yield is higher as measured by an elevated price/book ratio.

The regression we run for real estate investment trusts in time-series is:

$$\frac{Price_t}{BookValue_t} = \beta_0 + \beta_1 DivYield_t + \beta_2 1LIR(FedRate)_t + \beta_3 1LIR(FedRate)_t \cdot DivYield_t + \epsilon_t \quad (25)$$

$$\frac{Price_t}{BookValue_t} = \beta_0 + \beta_1 DivYield_t + \beta_2 1LIR(5Year)_t + \beta_3 1LIR(5Year)_t \cdot DivYield_t + \epsilon_t \quad (26)$$

We describe the various inputs we use in our regressions below:

Regression Inputs		
Abbreviation	Name	Definition
LIR	Low Interest Rate	An indicator variable which switches on in a low-interest rate world, defined as below 2% for the Federal Reserve Rate or below 3% for the 5 Year Generic Government Yield
5Year	5 Year Generic Government Yield	The interest rate paid on the United States 5 Year Generic Government Bond
FedRate	Federal Reserve Rate	The interest rate at which depository institutions (banks and credit unions) lend reserve balances to other depository institutions overnight, on an uncollateralized basis.

For our high yield bond analysis, we run a time-series regression with price/net asset value as the dependent variable. For the independent variables, we use the monthly dividend yield, an indicator variable for low interest rate environment and an interaction term between our indicator variable and the dividend yield. We run this regression twice, once for HYG US EQUITY and once for JNK US EQUITY. We test our measure of the low interest rate environment for both the fed rate and the 5 year generic government yield. We test both of these rate inputs to see if there is any material difference. A positive coefficient on the interaction term would imply that in a low-interest rate environment, the willingness to pay for each incremental unit of dividend yield is higher as measured by an elevated price/NAV ratio.

The regression we run for high yield bonds in time-series is:

$$\frac{Price_t}{NAV_t} = \beta_0 + \beta_1 DivYield_t + \beta_2 1LIR(FedRate)_t + \beta_3 1LIR(FedRate)_t.DivYield_t + \epsilon_t \quad (27)$$

$$\frac{Price_t}{NAV_t} = \beta_0 + \beta_1 DivYield_t + \beta_2 1LIR(5Year)_t + \beta_3 1LIR(5Year)_t.DivYield_t + \epsilon_t \quad (28)$$

For our closed-end high yield fund analysis, we run a time-series regression with price/net asset value as the dependent variable. For the independent variables, we use the annual dividend yield, an indicator variable for low interest rate environment and an interaction term between our indicator variable and the dividend yield. We run 36 regressions. We have 18 closed-end funds in our sample set (Tickers: PHF, PPR, VLT, MUA, PCF, MFM, MHY, AWF, CIF, CIK, CMU, GDF, GHI, HIO, HTR, LBF, KHI). For each closed-end fund, we run a regression for each of our low interest rate environment indicator inputs (fed rate and 5 year generic government yield).

$$\frac{Price_t}{NAV_t} = \beta_0 + \beta_1 DivYield_t + \beta_2 1LIR(FedRate)_t + \beta_3 1LIR(FedRate)_t.DivYield_t + \epsilon_t \quad (29)$$

$$\frac{Price_t}{NAV_t} = \beta_0 + \beta_1 DivYield_t + \beta_2 1LIR(5Year)_t + \beta_3 1LIR(5Year)_t.DivYield_t + \epsilon_t \quad (30)$$

For our yield company analysis, we run a time-series regression with a price/book value as the dependent variable. we use the annual dividend yield and the 5 Year Generic Government Yield. We are unable to use a fixed effects methodology for this regression because all the companies had their IPOs during the low-interest

rate period between 2009 and 2016 and subsequently, an indicator variable would not be informative. A negative coefficient on the 5 Year Generic Government Yield term would imply that the lower the interest rate, the higher the willingness to pay as measured by elevated price/book ratio. While this would be loosely supportive of our reach-for-yield thesis, we do note that a lower interest rate can also lead to an elevated price/book ratio because it lowers the discount rate of future cash flows. While our yield company analysis lacks specificity in isolating the impact of reach-for-yield and more generally suffers because there is likely endogeneity in the decision to issue yield company during a low-interest rate environment, we still see value in confirming our assumption of a negative coefficient. We use the 5 Year Generic Government Yield rather than the federal funds rate because during this extended low-interest rate period, variance in the path of the yield curve provides a more informative representation of interest rate expectations and provides a wider range of data-points. We run this regression five times, for each of NYLD US EQUITY, PEGI US EQUITY, ABY US EQUITY, NEP US EQUITY and TERP US EQUITY.

The regression we run for yield company in time-series is:

$$\frac{Price_t}{BookValue_t} = \beta_0 + \beta_1 DivYield_t + \beta_2 US5YGG + \epsilon_t \quad (31)$$

For our core empirical test that we utilize for high yield bonds, closed-end funds and Real Estate Investment Trusts, we can calculate the magnitude of the impact of being in low interest rate world on valuation (either price to book or price to net asset value) by taking the expected value of our valuation metric in a normal interest rate world and then in a low-interest rate world and observing the difference. This

demonstrates the impact of the indicator variable.

$$E\left(\frac{Price_t}{NAV_t} \middle| LIR(FedRate) = 1\right) - E\left(\frac{Price_t}{NAV_t} \middle| LIR(FedRate) = 0\right) = \beta_2 + \beta_3 DivYield_t \quad (32)$$

$$E\left(\frac{Price_t}{NAV_t} \middle| LIR(5Year) = 1\right) - E\left(\frac{Price_t}{NAV_t} \middle| LIR(5Year) = 0\right) = \beta_2 + \beta_3 DivYield_t \quad (33)$$

While the total magnitude of the effect of being in a low-interest rate world is given by $\beta_2 + \beta_3 DivYield_t$, the reach-for-yield mechanism we are measuring is determined by $\beta_3 DivYield_t$. We are specifically interested in the sign and statistical significance of β_3 although the size of the coefficient is also relevant.

Standard economic theory does not predict a robust coefficient in either direction for β_3 as the marginal willingness to pay for each incremental unit of dividend yield should not change in a predictable way as the interest rate varies. If one had to make an argument that the coefficient had to be a particular sign, it would be more intuitive to expect a negative coefficient in an efficient market environment. One could argue that distributing income, as a dividend, in the present period, rather than re-investing becomes incrementally less attractive in a low-interest rate environment because future earnings have a lower discount rate applied to them. As a result, you would expect the marginal willingness to pay for an incremental unit of dividend yield in a low-interest rate world as compared to a normal-interest rate world to be negative. Our reach-for-yield mechanism predicts a positive sign on this coefficient. This disparity from standard efficient market theory (predicting a positive coefficient over an ambiguous or negative coefficient) forms the basis for our key empirical test.

6 Analysis

We first discuss the most important coefficients under examination. The coefficient of our interaction term (β_2) measures the first order impact of being in a low-interest rate environment on valuation (either price to book or price to net asset value). The sign we would expect to see here is ambiguous. Economic theory defines an assets value as the NPV of all future cash flow. This is the total sum of all future cash flows discounted by the appropriate discount rate. The discount rate is typically a function of the interest rate. Higher discount rates are applied when interest rates are higher and lower discount rates are applied when interest rates are lower. Subsequently, when in a low-interest rate environment, cash flows are mechanically discounted by a lower interest rate and subsequently will generate a higher net-present value.

Additionally, we must recognize that the decision to be in a low-interest rate environment is endogenous to the state of the economy. Typically, the Federal Reserve will lower the interest rate to stimulate growth through monetary policy during times of weaker economic performance. This was seen during the 2008 recession and additionally during the period following the tech-stock burst (2001) and subsequent market weakness. Subsequently, we can interpret lower-interest rates as carrying some information as to the state of the broader economy. The basic dividend discount model, which is defined below illustrates these two competing effects. A reduction in discount rates drives asset valuation higher but a reduction in dividend growth rate (a related variable to general macroeconomic growth) drives asset valuation lower.

$$\frac{DPS}{DR - DGR} = V \quad (34)$$

DPS = Dividend Per Share

DR = Discount Rate

DGR = Dividend Growth Rate

V = Value of Stock

The most relevant coefficient in our analysis, which is the strongest indicator for our reach-for-yield behavioral mechanism, is our interaction term, typically measured by (β_3) . Our interaction term measures the marginal effect of an incremental unit of dividend yield on valuation (price to book or price to net asset value) in a low-interest rate environment. Reach-for-yield can be interpreted as a higher willingness to pay for yield in a certain state of the world, most typically being that of low interest rates. If the reach-for-yield mechanism were present, we would expect to see (β_3) being positive. This would imply that for a given asset, there is a positive correlation between willingness to pay for yield and being in a low-interest rate world.

Another coefficient we consider is (β_1) , which measures the effect of dividend yield on valuation directly. While there are asset class specific drivers of the sign of this coefficient, we generally would expect a negative relationship in the sign of (β_1) . A company or fund typically has the opportunity to reinvest income for future growth and subsequently drive future dividend distributions higher or pay out income in the current period. As a result, it is standard to see high growth companies like technology companies (SalesForce, Amazon, Netflix) opting to not pay out income and continue to reinvest in the business. We see lower growth industries like

industrials, real estate and theme parks opting to pay out substantial portions of income because the opportunity to obtain attractive return on investment through reinvesting is reduced. We usually see, as a result of these variances in growth rates, higher valuation multiples being paid for companies who are not distributing earnings compared to those paying sizeable distributions. We acknowledge that given our specific focus is in asset classes that focus on paying dividends, there may be idiosyncratic preferences or additional factors relevant that make this analysis more difficult than simply comparing the valuations of common equities. Regardless, we still see this first order assumption of a negative relationship between dividend yield and valuation as reasonable.

6.1 Regression Results

Firstly, we examine our regression results for REITs (Table 1). Our first regression uses the fed rate as the interest rate proxy and the second regression used the 5-year generic government yield as the interest rate proxy. We see that our first interaction term has a positive coefficient of 0.136, which is significant at the 1% significance level. Our first regression has an R^2 value of 0.748. Our second interaction term has a positive coefficient of 0.262, which is significant at the 1% significance level. Our second regression has an R^2 value of 0.785. These results are confirmatory with our model that argues for a reach-for-yield channel making incremental units of dividend yield more attractive in a low-interest rate environment. In a low-interest rate environment, we argued in our model that investors who have particular return targets (either psychologically or contractually) are willing to pay a higher premium for yield.

We additionally note a negative coefficient of -0.369 in our first regression and

VARIABLES	(1) REIT(Fed)	(2) REIT(5Y)
DividendYield	-0.369*** (0.0128)	-0.494*** (0.0161)
IndicatorFed	-1.028*** (0.0574)	
InteractionFedDiv	0.136*** (0.0132)	
Indicator5Y		-1.617*** (0.0701)
Interaction5YDiv		0.262*** (0.0164)
Constant	4.204*** (0.0554)	4.787*** (0.0687)
Observations	2,513	2,513
R-squared	0.748	0.785

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 1. REIT Regression Results

-0.494 in our second regression on DividendYield, which are both significant at the 1% significance level. Above and beyond the standard rationale argued previously for why this coefficient may be negative, we note the potential relevance of the fund manager of a REIT in driving this relationship. In the case of a fund manager, the market may place a higher premium on some managers (based on reasons such as past period performance, qualifications, trust or other factors) and subsequently may bid up funds, which have a lower distribution because the talented manager is able to generate future incremental returns.

Our regressions also have statistically significant negative coefficients for the indicator variables. We suspect the negativity of this relationship lends support for the theory that the low-interest rate environment signals weaker macroeconomic strength and subsequently a first-order compression in valuation. The statistical robustness within our REIT analysis is promising. For further analysis, it would be insightful to consider the strength of the negative coefficient on the interaction terms across more historical low-interest rate periods. One could also consider the strength of this coefficient for REITs domiciled in the United States compared to overseas REITs with less direct exposure to the US interest rate environment to see if the reach-for-yield phenomena was stronger for US funds. This would make intuitive sense as there is more exposure to the low-interest rate environment.

Secondly, we consider our high-yield bond regression results (Table 2). In our regressions with HYG US Equity, we do not obtain conclusive results. The sample size is 106 restricted by the historical data available, which is a contributing factor to the wide confidence intervals. The interaction terms have positive coefficients of 0.654 and 1.197 respectively but these are not statistically significant with a wide confidence interval of $[-5.327, 6.635]$. A positive coefficient is supportive of

our reach-for-yield mechanism but we would need less variance to be able to extract any conclusive results. We obtain a relatively low R^2 value of 0.1045 for FedRate and 0.094 for 5 Year Generic Government Yield.

In the second regression with JNK US Equity, we do obtain statistically significant results for both our interest rate proxy. Our interaction term for fed rates has a positive coefficient, which is statistically significant at the 1% significance level. The coefficient on our interaction term is 10.885 with a confidence interval of [3.550,18.219]. We also note the R^2 value of 0.50 is relatively high. We see the strength of the positive interaction term coefficient as being particularly notable given the relatively low number of observations. Our interaction term for 5 year government yields is positive (37.68) with statistical significance at the 1% significance level. This result also has a relatively high R^2 value of 0.49.

We note a few limitations of our high-yield bond analysis through the lens of exchange-traded funds.

Firstly, exchange traded funds can be easily redeemed and issued and subsequently they typically trade with a market price very close to the underlying net asset value. One consolation for high-yield bonds is that the underlying asset is reasonably illiquid so the ease of redemption and subsequently arbitrage is lower than for an ETF like the SPDR SP500 ETF, which has minimal variance of price from underlying asset value. The reduced variance of price from underlying net asset value may constrain the accuracy of our analysis.

Despite this potential criticism, there are a number of promising characteristics of this analysis. We use exchange-traded funds because they provide daily pricing

VARIABLES	(1) AWF(Fed)	(2) AWF(5Y)	(3) CIF(Fed)	(4) CIF(5Y)
DividendYield	-0.709*** (0.111)	-1.298*** (0.0343)	-1.347*** (0.172)	-1.233*** (0.136)
IndicatorFed	-0.250*** (0.0202)			
InteractionFedDiv	1.740*** (0.148)			
Indicator5Y		-0.321*** (0.0147)		
Interaction5YDiv		2.372*** (0.104)		
IndicatorFed1			-0.158*** (0.0239)	
InteractionFedDiv1			1.896*** (0.248)	
Indicator5Y1				-0.174*** (0.0216)
Interaction5YDiv1				2.013*** (0.226)
Constant	1.028*** (0.0140)	1.100*** (0.00407)	1.168*** (0.0169)	1.163*** (0.0133)
Observations	4,531	4,531	2,393	2,393
R-squared	0.183	0.267	0.090	0.104

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2. HYG High Yield Bond Regression Results

information for the high-yield bonds and there exists Net Asset Value data for them. A further reason why we used exchange-traded funds is because they are one of the most recent innovations in financial markets, which have dramatically increased the access of retail investors to products like high yield bonds. Typically, the majority of high yield bonds were acquired upon public offering and held by institutions without much opportunity for retail investors to access them. With the emergence of ETFs from companies such as Vanguard and BlackRock this lack of access has notably changed. Additionally, ETFs are important to consider because many market practitioners such as Carl Icahn note them as being one of the single most risky drivers of reach-for-yield because they provide, at least optically, liquidity within risky, opaque asset classes. Larry Fink, CEO of BlackRock and Carl Icahn held a public debate on this topic at the 2015 CNBC Delivering Alpha Conference in which Icahn argued that BlackRock was aggressively fueling a reach-for-yield bubble while enjoying the profitability of the fees collected on assets under management sitting in high yield bond ETFs.

Secondly, high-yield bond ETFs with the largest two encompassing about 25 billion in assets under management, are still only a small portion of the overall market and subsequently may not be a fair proxy for more general yield behavior. We argue that high-yield bond ETFs are specifically relevant for our models validation because they combined i) optically high liquidity, ii) a high proportion of retail investors iii) offer a high nominal yield and iv) historically have seen dramatic swings in downside risk, making them difficult to price by uninformed investors (and informed investors alike). This difficulty in pricing is compounded because exchange-traded funds bundle large portfolios of high yield bonds so one has to do substantial due diligence on often hundreds or thousands of companies to be informed about potential downside risk. This may be particularly problematic if uninformed traders place substantial

trust in institutions like Vanguard and BlackRock and subsequently perform less due diligence, further exposing themselves to information asymmetry. This likely occurs to some extent.

A third general weakness of analyzing high-yield bonds is that the underlying value reported (net asset value) may be stale, intermittent or not reflective of the underlying default risk. Compared to assets with greater stability like real estate investment trusts, the extent of information asymmetry can give rise to systematic issues in reporting quality. While the market driven price may be a function of buyers and sellers interacting and transmitting information, if the underlying net asset value is biased, the accuracy of an analysis that tests Price/Net Asset Value, could be challenged. We have selected the two largest and most carefully studied exchange-traded funds to help combat some of these concerns, relying partially (and somewhat ironically) on the care of the issuers of these institutional-grade ETFs to select their constituent holdings carefully.

We next consider our closed-end fund high yield regressions (Table 3a - 3g). We begin by considering the coefficient of the interaction terms. For the 18 time-series regressions run using FedRates, all coefficients are positive with varying levels of statistical significance. 2 coefficients are positive but without sufficient statistical significance, even at the 10% level, 1 coefficient is positive at the 5% significance level and 15 coefficients are positive at the 1% significance level. For the 18 time-series regression run using the 5 Year Government Generic Yield, 17 coefficients were positive with varying levels of statistical significance and 1 coefficient was negative at the 10% significance level. Of the 17 positive coefficients, 14 were positive at the 1% significance level, 2 were positive at the 10% significance level and 1% was positive but without statistical significance. The significance of these interac-

tion terms demonstrates that the sensitivity of valuation of a closed-end fund on a price/net asset value basis to each incremental unit of dividend yield increases in a low interest rate world with a positive correlation. This is supportive of our core reach-for-yield behavioral mechanism. We draw additional comfort in the consistency of the positive correlation of the interaction term across 35 out of 36 of the time-series regressions.

VARIABLES	(1) CIK(Fed)	(2) CIK(5Y)	(3) CMU(Fed)	(4) CMU(5Y)
DividendYield	0.376** (0.180)	0.742** (0.329)	2.298*** (0.603)	1.920*** (0.390)
IndicatorFed	0.265** (0.103)		-0.197 (0.140)	
InteractionFedDiv	2.631*** (1.016)		2.644 (1.982)	
Indicator5Y		-0.0274* (0.0152)		-0.252** (0.122)
Interaction5YDiv		-0.198* (0.116)		3.342* (1.713)
Constant	0.672*** (0.102)	0.924*** (0.0434)	0.822*** (0.0430)	0.851*** (0.0273)
Observations	2,400	2,400	2,400	2,400
R-squared	0.084	0.042	0.142	0.160

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3a. HYG High Yield Bond Regression Results

Next we consider the coefficient of the dividend yield terms. For the 18 time-series regressions run using FedRates, 1 was positive with no statistical significance, 2 were positive at the 5% significance level, 4 were positive at the 1% significance level, 9 were negative at the 1% significance level and 2 were negative with no statistical significance. For the 18 time-series regression run using the 5 Year Government Generic Yield, 1 was positive at the 5% significance level, 3 were positive at the 1%

VARIABLES	(3) CXE(Fed)	(4) CXE(5Y)
DividendYield	2.200*** (0.226)	1.705*** (0.235)
IndicatorFed	-0.295*** (0.0284)	
InteractionFedDiv	4.019*** (0.399)	
Indicator5Y		-0.345*** (0.0270)
Interaction5YDiv		4.704*** (0.377)
Constant	0.817*** (0.0163)	0.852*** (0.0168)
Observations	2,374	2,374
R-squared	0.166	0.184
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table 3b. HYG High Yield Bond Regression Results

significance level, 2 were negative at the 5% significance level, 11 were negative at the 1% significance level and 1 was negative with no statistical significance. Overall, the results have a negative skew with 22 statistically significant negative coefficients at the 5% level compared to 10 statistically positive coefficients at the 5% level. The results, despite this negative bias, are still ambiguous. We highlighted in our literature review that closed-end funds may pay higher distributions to signal confidence in return generation, given a distribution lowers the asset base for a manager to collect fees on (Wang and Nanda, 2011). Such a relationship would yield a positive correlation between dividend yield and the price/net asset value. On the contrary, one could argue that higher dividend yields, specifically for high yield bond funds, likely bring higher default risk with greater uncertainty. This may lead to discounting by the market place and a negative correlation between dividend yield and the price/net asset value. The ambiguity of this sign is expected.

VARIABLES	(1) GDF(Fed)	(2) GDF(5Y)	(3) GHI(Fed)	(4) GHI(5Y)
DividendYield	-0.796*** (0.192)	-2.477*** (0.206)		
IndicatorFed	-0.210*** (0.0242)		-0.287*** (0.0175)	
InteractionFedDiv	1.671*** (0.230)			
Indicator5Y		-0.288*** (0.0244)		-0.227*** (0.0168)
Interaction5YDiv		3.178*** (0.238)		
DividendYield1			0.593*** (0.0870)	-0.211** (0.105)
InteractionFedDiv1			1.774*** (0.128)	
Interaction5YDiv1				1.983*** (0.137)
Constant	1.084*** (0.0188)	1.226*** (0.0200)	0.887*** (0.00857)	0.950*** (0.00979)
Observations	2,400	2,400	2,400	2,400
R-squared	0.042	0.083	0.231	0.206

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3c. HYG High Yield Bond Regression Results

VARIABLES	(1) HIO(Fed)	(2) HIO(5Y)	(3) HTR(Fed)	(4) HTR(5Y)
DividendYield	0.284** (0.123)	-0.152 (0.139)		
IndicatorFed	-0.428*** (0.0211)		-0.308*** (0.0432)	
InteractionFedDiv	4.066*** (0.225)			
Indicator5Y		-0.431*** (0.0195)		-0.322*** (0.0360)
Interaction5YDiv		4.170*** (0.211)		
DividendYield1			-1.021*** (0.269)	-0.675*** (0.259)
InteractionFedDiv1			1.894*** (0.452)	
Interaction5YDiv1				1.739*** (0.383)
Constant	0.935*** (0.0109)	0.974*** (0.0121)	1.108*** (0.0244)	1.094*** (0.0232)
Observations	2,400	2,400	2,391	2,391
R-squared	0.226	0.244	0.246	0.400

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3d. HYG High Yield Bond Regression Results

Lastly, we consider the coefficient of the indicator terms. For the 18 time-series regressions run using FedRates, 17 coefficients were negative and 1 coefficient was positive at the 1% significance level. For the coefficients that were negative, 3 were negative with no statistical significance, 12 were negative with statistical significance at the 1% level and 2 were negative with statistical significance at the 5% level. For the 18 time-series regression run using the 5 Year Government Generic Yield, 17 coefficients were negative and 1 coefficient was positive at the 1% significance level.

VARIABLES	(1) LBF(Fed)	(2) LBF(5Y)	(3) KHI(Fed)	(4) KHI(5Y)
DividendYield	0.115 (0.103)	-0.293** (0.141)		
IndicatorFed	-0.0701*** (0.00875)		0.0217*** (0.00482)	
InteractionFedDiv	0.681*** (0.114)			
Indicator5Y		-0.0882*** (0.0106)		0.0567*** (0.00668)
Interaction5YDiv		1.068*** (0.150)		
DividendYield1			-1.035*** (0.155)	-1.308*** (0.133)
InteractionFedDiv1			0.435*** (0.0392)	
Interaction5YDiv1				0.439*** (0.0398)
Constant	0.894*** (0.00694)	0.920*** (0.00930)	1.070*** (0.0172)	1.067*** (0.0141)
Observations	2,389	2,389	1,070	1,070
R-squared	0.391	0.401	0.185	0.278

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3e. HYG High Yield Bond Regression Results

VARIABLES	(1) MUA(Fed)	(2) MUA(5Y)	(3) PCF(Fed)	(4) PCF(5Y)
DividendYield	-1.509 (0.935)	-2.289*** (0.186)		
IndicatorFed	-0.360** (0.173)			
InteractionFedDiv	5.745** (2.712)			
Indicator5Y		-0.426*** (0.148)		
Interaction5YDiv		6.640*** (2.287)		
DividendYield1			-2.316*** (0.177)	-2.356*** (0.168)
IndicatorFed1			-0.0707*** (0.0205)	
InteractionFedDiv1			0.625** (0.304)	
Indicator5Y1				-0.0555** (0.0253)
Interaction5YDiv1				0.282 (0.403)
Constant	1.054*** (0.0577)	1.103*** (0.0109)	1.253*** (0.0139)	1.257*** (0.0129)
Observations	2,398	2,398	2,392	2,392
R-squared	0.085	0.119	0.190	0.204

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3f. HYG High Yield Bond Regression Results

For the coefficients that were negative, 1 was negative with no statistical significance, 12 were negative with statistical significance at the 1% level, 3 were negative with statistical significance at the 5% level and 1 was negative with statistical significance at the 10% level. We initially expected an ambiguous sign for this coefficient but these results suggest that the coefficient is negative with statistical significance, in general. One interpretation of this is that the state of being in a low-interest rate world carries valuable information about the state of the macro-economy. This means that conditional on being in a low-interest rate world, the economy is likely to be doing worse and subsequently valuations are compressed. This would be a useful analysis to consider in future work. This interpretation is especially compelling for high-yield bonds because they are particularly leveraged to the state of the broader economy, and subsequently it makes sense that the first order effect of the low interest rate world is to compress valuation (while the second order effect demonstrates our reach-for-yield mechanism).

While closed-end high yield funds have some of the similar reporting challenges as exchange-traded funds that hold high yield bonds, there is substantially less involvement from quantitative arbitrageurs like JaneStreet because the price/net asset value of these assets can vary wildly for sustained amounts of time. The only fail safe way to close the discount gap is to liquidate the closed-end fund and the incumbent management often has very strong incentives to not let this happen so they can continue to capture fees. While certain hedge funds such as Weiss Asset Management target closed-end fund arbitrage specifically, closed-end funds, in general, have a much higher proportion of retail ownership with substantially wider discounts (with heightened variance) and so are a more fruitful natural laboratory for our empirical examination of the interaction term.

VARIABLES	(1) MFM(Fed)	(2) MFM(5Y)	(3) MHY(Fed)	(4) MHY(5Y)
DividendYield	-1.680*** (0.418)	-1.788*** (0.434)		
IndicatorFed	-0.446*** (0.0543)		-0.298*** (0.0882)	
InteractionFedDiv	5.828*** (0.828)			
Indicator5Y		-0.526*** (0.0459)		-0.305*** (0.0750)
Interaction5YDiv		7.056*** (0.689)		
DividendYield1			1.179*** (0.364)	0.938*** (0.284)
InteractionFedDiv1			2.636*** (0.922)	
Interaction5YDiv1				2.760*** (0.778)
Constant	1.146*** (0.0284)	1.155*** (0.0293)	0.861*** (0.0326)	0.885*** (0.0247)
Observations	2,393	2,393	2,400	2,400
R-squared	0.125	0.134	0.195	0.202

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3g. HYG High Yield Bond Regression Results

VARIABLES	(1) PHF(Fed)	(2) PHF(5Y)
DividendYield	-0.936 (0.734)	-0.907*** (0.305)
IndicatorFed	-0.0451 (0.0820)	
InteractionFedDiv	0.640 (0.828)	
Indicator5Y		-0.0531 (0.0501)
Interaction5YDiv		0.886* (0.510)
Constant	1.082*** (0.0729)	1.069*** (0.0305)
Observations	476	476
R-squared	0.019	0.054

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3h. HYG High Yield Bond Regression Results

VARIABLES	(1) PPR(Fed)	(2) PPR(5Y)	(3) VLT(Fed)	(4) VLT(5Y)
DividendYield	-2.272*** (0.156)	-1.520*** (0.154)		
IndicatorFed	-0.338*** (0.0630)			
InteractionFedDiv	4.754*** (0.772)			
Indicator5Y		-0.122** (0.0500)		
Interaction5YDiv		2.098*** (0.636)		
DividendYield1			-0.768*** (0.239)	-0.860*** (0.190)
IndicatorFed1			-0.0584 (0.0367)	
InteractionFedDiv1			1.389*** (0.379)	
Indicator5Y1				-0.150*** (0.0290)
Interaction5YDiv1				2.610*** (0.303)
Constant	1.119*** (0.00998)	1.064*** (0.00983)	1.030*** (0.0258)	1.034*** (0.0204)
Observations	2,397	2,397	2,392	2,392
R-squared	0.169	0.053	0.130	0.272

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3i. HYG High Yield Bond Regression Results

Fourthly, we consider our yield company regression results (Table 4). As discussed earlier, all of our yield companies were issued during a period we define as a low-interest rate period so in order to garner some insight into the implications of interest rates on these instruments we altered our methodology. We added the interest rate proxy directly as the dependent variable and removed indicator variables. We see for the first regression on NYLD US Equity there is a statistically significant negative coefficient on the 5 year Generic Government Yield term at the 1% significance level. The coefficient on the 5 year Generic Government Yield term is -0.138 with a confidence interval of [-0.190,-0.871]. We also note the particularly high R^2 value of 0.94. We would expect this high explanatory power given YieldCo products are intentionally constructed, distributed and marketed as a yield product. Subsequently, they are likely to be highly sensitive to both interest rates and dividend yield. Our next YieldCo regression PEGI US Equity does not produce a statistically significant coefficient on our interest rate term. Our 5 year Generic Government Yield term is 0.159 but lacks significance, even at the 10% significance level. The R^2 in this regression is 0.443, which is significantly lower than our NYLD equity.

Our next YieldCo Regression ABY US Equity also does not produce a statistically significant coefficient on our interest rate term. Our 5 year Generic Government Yield term is -0.338 with a confidence interval of [-0.703,0.027]. We do note this regression has an R^2 of 0.77 and is significant at the 7% level but this does not meet an acceptable threshold. Our next YieldCo regression NEP US Equity also does not produce a statistically significant coefficient on our interest rate term. Our 5 year Generic Government Yield term is 0.165 with a confidence interval of [-0.008,0.0211]. The R^2 in this regression is 0.991. Our coefficient of interest is statistically insignificant from 0 so we cannot extract much insight from this observation. We see for the last regression on TERP US Equity there is a statistically significant negative

VARIABLES	(1) NYLD	(2) PEGI	(3) ABY	(4) NEP	(5) TERP
DividendYield	-0.128*** (0.00257)				
USGG5YRIndex	-0.138*** (0.0260)				
DividendYield1		-0.237*** (0.0144)			
USGG5YRIndex1		0.159 (0.131)			
DividendYield2			-0.246*** (0.00751)		
USGG5YRIndex2			-0.338* (0.186)		
DividendYield3				-2.602*** (0.0334)	
USGG5YRIndex3				0.00651 (0.00729)	
DividendYield4					-0.202*** (0.0130)
USGG5YRIndex4					-1.871*** (0.376)
Constant	1.799*** (0.0374)	2.223*** (0.227)	3.350*** (0.287)	2.613*** (0.0169)	6.076*** (0.572)
Observations	193	358	317	60	285
R-squared	0.939	0.443	0.773	0.991	0.488

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4. NYLD US Equity yield company Regression Results

coefficient on the 5 year Generic Government Yield term. The coefficient on the 5 year Generic Government Yield term is -1.870 with a confidence interval of [-2.611,-1.130]. Our R^2 value is 0.49 which is relatively low in our comparison set of yield companies but is still significant.

One interesting result of our analysis is the strong negative coefficient on dividend yield across all 5 of the yield companies we consider at the 1% significance level. This means that there is a negative correlation between the absolute value of the dividend yield and the price/book ratio. One factor to be aware of is that given yield companies are usually a derivative of another development company (for example, SunEdison is the development company of TERP US Equity), the cash flows, which are contractually secured by the parent, are supposed to have greater visibility than a stand-alone entity. All of the yield companies are exposed to the markets level of conviction in the future dividend growth and the credibility of this visibility. It could be the case that yield companies with lower dividend rates are perceived to have less future challenges with growing their dividend payout ratio and so subsequently, the market is willing to bid these assets up higher on a price/book basis than a yield company already paying a very large distribution. A company paying a very large distribution may be perceived as risky and unsustainable by the market and subsequently be penalized. It would be fruitful to examine how these assets trade through the rate hike environment in 2016 onward and to see whether the strength of the negative coefficient on dividend yield varies.

While the yield company results are directionally supportive of the thesis, it is difficult to disentangle the reach-for-yield component of the negative coefficient on the interest rate proxy from a number of other effects. One such effect we have highlighted is that reductions in interest rates mechanically drive valuations higher

because discount rates get reduced. It may be the case that a portion of the negative coefficient is being driven by reduced rates driving asset valuations higher through our reach-for-yield mechanism. It is inherently difficult to disentangle this effect to a sufficient extent that it would be useful for our model because of the embedded endogeneity problem (yield companies were issued during the low-interest rate world). While our analysis of yield companies is limited both by the number of companies and the operating life, it is important to acknowledge these assets because, by design, they are particularly attractive for yield sensitive investors. They are also very appealing to analyze because of their precipitous declines throughout 2015 and 2016 which has largely been attributed to a lack of familiarity with the asset classes and complex structures by which these yield companies are built upon, and a rising rate environment.

In summary, three of our four yield assets we consider were statistically supportive of our core reach-for-yield behavioral mechanism and proposed model. Our analysis of real estate investment trusts was insightful given the length of the dataset across multiple periods of low-interest rates and compelling statistical significance in the interaction terms. Our analysis of yield companies was directionally supportive but our simplified empirical test of this asset class, constrained by endogeneity concerns and data availability, reduces our conviction. Our analysis of high yield bonds through consideration of two of the major exchange-traded-funds was broadly confirmatory. One of the regressions (HYG) did not yield a statistically significant result. The second (JNK) did yield a statistically significant result with a confirmatory positive coefficient on our low-interest rate environment interaction term. Most notably, in our study of closed-end high yield funds, we saw the most compelling results with 29 out of 36 interaction term coefficients being negative at the 1% significance level. Additional conviction was established through using two

different interest rate proxies and seeing no substantial deviation in the strengths of coefficients.

While not our primary source of interest, our empirical analysis suggests that asset classes with more exposure to broader macroeconomic concerns like high yield bonds had a more negative coefficient on the indicator variable for being in a low-interest rate world than assets like REITs which are relatively less leveraged.

Overall, we find these results to be strong evidence of the reach-for-yield mechanism in yield assets. Multiple different yield assets are all demonstrative of the same directional trends and core-drivers in the low-interest rate environments. It is empirically evident that the willingness to pay for each incremental unit of dividend yield (reach-for-yield) increases during a low-interest rate environment in real estate investment trusts, closed-end funds and high-yield bond ETFs within the sample set we have considered. These results are generally supportive of the findings of Becker and Ivashina in their 2013 study of reach-for-yield within the context of corporate bonds. They additionally provide incremental support to the work of Chodorow-Reich (2014) who observed reach-for-yield within money market mutual funds.

Future analysis to gain heightened conviction around the structure of our uninformed/informed trader model could empirically test how the ownership base of the assets we have considered evolves over time. While it is somewhat difficult to measure the proportion of "uninformed traders", a proxy such as (1-% of hedge fund ownership) or (1-% of institutional owners) could be used to assess whether the ownership base of yield assets sees a reduction in informed traders during periods of low-interest rates. Bloomberg has two metrics of institutional ownership. One metric is number of institutional holders and the other is institutional holders as

a % of the ownership base. Bloomberg defines institutional holders as institutions including 13F filings (often hedge funds), US Mutual Funds, International Mutual Funds and insurance companies. This data was available historically from March 2010 for all of our closed-end fund high yield bonds and our high-yield bond ETFs and fleetingly for the yield companies in our sample size. Unfortunately, this number of data-points lacked sufficient statistical significance to be informative. In order to rigorously test this, we would seek historical data sufficiently backdated that it would encompass multiple low-interest rate periods like our price/book, price/NAV and dividend yield data typically did for various assets.

Our analysis does suggest stronger reach-for-yield effects through the interaction terms (with negative coefficients) for asset classes like closed-end funds compared to real estate investment trusts. These findings are supportive of our model which suggests that asset classes such as closed-end high yield funds should experience increased ownership by uninformed traders in a low-interest rate environment. This would imply the presence of the reach-for-yield phenomena should be stronger which is what we have seen in our scope of analysis. We are optimistic about the directional trends in our analysis but would seek to rigorously test this component of the model over a wider set of asset classes to enhance conviction.

7 Conclusion

This paper explores pieces of the informed trader/uninformed trader literature, various pieces of the closed-end fund literature, reach-for-yield in corporate bonds and behavioral economics literature in order to formulate the foundation for our reach-for-yield mechanism. We provide some background on developments in the high yield bond, master limited partnerships, yield companies, real estate investment trusts and closed-end funds space given their particular significance to our consideration of yield assets. Our paper presents a new uninformed-informed trader model that provides a mechanism by which systemic risk can build through uninformed investors' misunderstanding the market environment and holding unreasonably high return targets. The accumulation of yield assets by uninformed traders (or traders with misaligned agency incentives) can cause significant volatility when this misunderstanding becomes corrected. Our model emphasizes the distortionary impact of low-interest rates through the behavioral reach-for-yield mechanism. It also addresses the vagueness of many investors' understanding of downside risk in asset classes alluded to in the literature (for example, by Lamont and Shleifer). The model extends the work of Hanson and Stein (2014) with its consideration of two specific behavioral biases and two distinct interest rate environments.

After introducing our model, we consider various yield assets in different interest rate environments to test whether there indeed exists a clear interaction between the interest-rate environment and the marginal attractiveness of dividend yield. Subsequently, after considering multiple different asset classes, we obtain a set of empirical results that supports one of the core drivers of our model - a low-interest rate world makes yield assets more attractive and results in an elevated scaled price factor each incremental unit of dividend yield. Our empirical tests demonstrate a

strong positive coefficient with clear statistical significance on the interaction term between dividend yield and the interest rate (robust across 2 proxies). This result stands in contrast to conventional efficient markets theory which would predict an ambiguous or negative sign. This is supportive of the earlier work by Becker and Ivashina (2013), who demonstrated reach-for-yield in corporate bonds and Chodow-Reich (2014), who demonstrated reach-for-yield in money market funds.

Our findings have significant public policy implications. Firstly, our empirical work illustrates that a reach-for-yield phenomena becomes more significant in low-interest rate environments across a wide variety of yield assets. Secondly, our model illustrates that the risk of this reach-for-yield phenomena becomes increasingly severe as an increasing proportion of the market comprises of uninformed traders who:

- i) do not understand the downside risk of the assets they are holding properly and
- ii) do not have reasonable market return expectations.

There is a wide variety of implications for our findings: pension fund managers with fixed nominal return targets, uninformed traders who extrapolate past periods of strong returns (momentum trading) and opportunistic issues of yield instruments like yield companies during low interest rate periods all can contribute to a build up in systemic risk through the mechanisms we have discussed. Our work suggests there may be unintended consequences of quantitative easing through a migration of uninformed investors towards yield assets and a subsequent increase in systemic risk.

Public policy that seeks to increase disclosures around the downside scenarios in particular investment classes like yield companies could be valuable as, at present, they are often widely misunderstood by their owners. Additionally, regulatory bodies could make reasonable return targets for investors clear, particularly during

times of macroeconomic instability, so the marketplace more accurately allocates risky assets to those who are knowledgeable as to the full distribution of their risks. Another prudent policy measure would be to conduct liquidity tests for exchange-traded funds that hold illiquid underlying assets like high-yield bonds in order to ascertain what could happen during a rapid sell-off. To this day in 2016, the understanding of how exchange-traded funds which hold illiquid underlying assets is surprisingly scarce, even within firms like BlackRock. While exchange-traded funds have been marketed as a major innovation in financial markets, it has historically been rare that banks have packaged risky, complicated underlying assets in an easily accessible structure and created substantial value for sustained periods of time. It is evident that meaningful information asymmetry exists in security markets and further legal obligation by parties, like brokers, for example, through recognition of fiduciary obligations, may help to address the problem of excessive risk-taking in a low-interest rate environment.

Monetary policy is a powerful tool for macroeconomic stabilization but further analysis must be conducted to better understand the unintended consequences of certain techniques like quantitative easing on risky assets and their potential to enhance systemic risk through the reach-for-yield channel.

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9 Appendix

Carl Icahn, "Danger Close" transcript, 2015

I am concerned about the high-yield market. I think that's a major bubble. This market keeps going up and up with zero interest rates and that's what's really pushing it.

Sounds like you're saying this could be the beginning of something problematic?

- CNBC Reporter

I don't think the question is whether it will happen but when it will happen

There's one investor out there that a lot of CEOs just have to take the phone call from because when you get a call from this guy, Carl Icahn, he probably wants to shake things up a little bit. - CNBC Reporter

I believe the market is extremely overheated. If more respected investors warned about the market in 07, we might have avoided the crisis in 08.

Overall the US equity market - do you think it's in store for a dramatic pullback?

- CNBC Reporter

I've been worried for the last 5, 6 months about the market and the economy and the dangerous spot we are in. I've spoken four or five times about the problems we have. I want to speak out now because I know this may sound corny but I grew up in the streets of Queens, I love this country and I feel so strongly about the dys-

function that is going on both in Washington and in the boardrooms of corporate America.

Over the years at the risk of being modest I probably have one of the best records on Wall Street working on broken companies or companies that have great potential that just have problems in management or what management is doing and our countries in that position right now. Congress is currently in a nail biting 3 way tie for least popular branch of government. Just look at our record - 30 years no tax revolutions, 30 years no immigration reform. As a result you have this movement toward a guy like Donald Trump because you want someone who is not beholden to an establishment so we need a president that can move congress and I think Donald Trump can do it. I disagree with him on some issues and I'll talk to him more but this is what this country needs, somebody to wake it up. One obvious problem the government should've fixed a long time ago is the carried interest tax loophole, people on Wall Street are good friends of mine but not having to pay full taxes on what youre earning is absurd.

Teddy Roosevelt was great he stood up to JP Morgan where do we get a guy like that again? Donald of all of them, maybe he's brash but he's willing to say what he believes. The middle class guy who is making 50,000 a year is realizing I'm being taken an advantage of. You know in Czarist Russia they had to have a revolution then the Czar would bring out the machine guns and mow 'em down. All these guys have to do is vote. So we need government to get out of this gridlock, get out of this dysfunction. The quintessential example is repatriation, that means there's 2.2 trillion dollars in profit that American companies have earned in Asia, South America and Europe, companies that are domiciled in this country but make goods in another country, produce 'em and sell 'em there, nothing to do with the US, that

money is sitting there and the companies would bring it back but it's completely unfair that they would have to pay a double tax. They make the widgets and sell 'em there why should they pay a double tax when no other countries demand that except the United States. our country is shooting itself in the foot because these companies are saying we're not going to bring it back so they're punishing the little guy again because if that money came back it would make for jobs, that money doesn't go into that money is given to somebody who would invest in something else in this country and help to create more jobs as opposed to taking the money over to Europe and invest it in Ireland. It's absurd not to make a deal and agree to pay the tax and everybody agrees it should be done it's just having a food fight over who's going to get the credit for it, is it going to be the republicans put their foot down and say were not going to charge any tax or the democrats who want 15% and take the money back, or worse than that, through inversions a lot of companies are saying we are going to get out of this country we dont need to be here, they make most of their equipment in another country why should they be here at all. The same type of short-term thinking is happening with the government is happening in corporate America today.

The irony of low interest rates is that companies today instead of taking the money they can borrow and really investing in a lot of capital, new machinery, new equipment in their workers to make it more productive, what they do with the money is almost perverse. They just go and buy another company to show the analysts on Wall Street their numbers are going up so their stock will go up and its financially engineering at its height. The earnings that are being put out today I think they are very suspect, the guidance they give you doesn't talk about stock compensation, they ignore restructuring costs, they don't recognize intangible assets and costs of taking over another company. We say oh its synergy. It's like taking a

drug, borrowing money very cheaply, taking over another company, you feel good, it is like steroids. These companies can show a huge EBITDA number that we all know is not going to be there in 2-3 years.

Look I know this stuff, I've taken over companies I understand the way of it, so these earnings are fallacious. Another reason they are fallacious is a lot of companies that are doing buy backs, shouldn't be doing it. When you start doing those buybacks what it does is a short-term fix. But, it weakens the balance sheet. Now I've been a proponent for buy backs in companies like Apple when they're sitting in 200 billion in cash and not a lot of debt they should do buy backs especially in Apple where the stock is 9x earnings. But you have companies today selling at 28-30x earnings and have no net worth because they keep buying back stock and yet analysts look at it quarter to quarter if your earnings went up a quarter your stock jumps and now a lot of CEOs are just wanting to see quarter to quarter earnings up, seeing the stock up. And yet if you really do GAAP, which is a tougher metric, you haven't really increased earnings for 3 years GAAP earnings they've stayed flat for 3 years and even GAAP earnings are suspect, which means we're paying a huge multiple. Yet what's going to happen to that market who's going to buy your stock when those earnings start going down and that's with low interest rates which I think is another scary issue.

Yesterday, the Fed again decided not to raise interest rates. The question is why should they raise rates? And it's almost a rhetorical question, there's so many reasons they should raise rates. Because low rates, almost by definition build bubbles, builds real estate bubbles and even in the art market. Because the Fed balance sheet has mushroomed from less than a trillion dollars to over 4.5 trillion, which is a huge almost unbelievable move, and all that money crowds out the little guy.

The middle class investor has no where to go with their money but into the market or even more concerning high yield bonds that are very risky which are being sold en masse to the public, just as the mortgage backed securities. So companies issue these high yield bonds and buy other companies. And in fact the M and A business is pumping - M and A has doubled from 4-5 years ago up to 2 trillion dollars.

The irony of lower interest rates is, you think it will create more jobs and make workers more productive it's not happening. If you look at companies today the growth of productivity is at an all time low. Property, plant equipment is older than it has ever been. So we are not taking care of these companies we are making earnings with financial engineering: by taking over other companies, by low interest rates and what I say is, at what price? If low interest rates were that simple of a panacea, we would never have recessions, we would never have these crises; we would never have these panics. And look I'm not here to criticize the Fed because the Fed did save us in a way but you could say the Fed got us here in the first place in 02-03 with very low interest rates. It's like giving someone medicine and this medicine is being given and given and given and we don't know what's going to happen you don't know how bad the end of this is going to be. You do know though that when you did it a few years ago it caused a catastrophe, it caused 08. Where do you draw the line here?

Fink & Icahn Debate at Delivering Alpha Conference,

And I'll just say what I mean, I'm too old not to say what I mean. Blackrock is an extremely dangerous company. And and I mean this, not that Larry is dangerous

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I know I said in my debate with Larry Fink that I think Blackrock is a dangerous company, I don't mean to say this in a bad way I don't mean it to insult the company.

Blackrock is there to make money. That's what Larry does and he does a great job at it. Here's the major problem: Mrs Jones calls them or even an insurance company or even a pension plan and says look we can't make any income, we need income so the wealth management guy looks and says well you can buy high-yield they don't even know what you mean, high-yield what's that mean? what are the risks?. Well Blackrock has got a great name and we can buy one of their ETFs, OK well that sounds good, why not? They don't know the price, they don't understand what the price is, and they don't understand what the risk is.

And high yields really stand for junk bonds and people are buying these not really understanding what they're buying and if you just look at the numbers they are amazingly risky. You have 2.2 trillion of junk bonds up 5 years ago, up a trillion dollars. That's a hell of a lot when you think about the whole S&P is only 19 trillion. But Wall Street does what Wall Street does best. It sells securities. I used to laugh at some of the guys selling these bonds I used to say you know the mafia has a better code of ethics than you guys you know you're selling this crap and you keep selling them, and in fact you're shorting some of this. And that's what's really going on and it's just deja vu.

Blackrock is sort of a name on there. And this is one of the problems you had in '07 where you had brand names on a lot of these housing things and the wealth management guys believe there is liquidity here

But if and when there's a real problem in the economy people are going to rush

for exits like a movie theatre. And people want to sell those bonds and think they can sell them and there's no market for them.

We are going to a cliff. You get this party mobile and they're all on this party, they're all having a drink and having fun. And you know who's pushing that thing, it's Larry Fink and Janet Yellen pushing that and they're pushing the goddamn thing. They're pushing this thing, cause fair or not someone should've said this in '07 and I'm telling you in '07 I talked like this but I never really came out with this and I should have said it.

Every once in a while Janet wants to put the brakes on it and Larry says nah let it go and the people on the party bus are yelling no, no, don't touch those brakes, don't touch them, this is fun and they're moving towards this cliff. And this thing is going to go over this cliff and you know what's going to destroy it? They're going to hit a Black Rock.

You know I said it laughingly, but I will tell you this: I've seen it before, a number of times, I been around a long time I saw it '69, '74, '79, I could tell ya '87 and then 2000 wasn't pretty and I think a time is coming that would make some of those times look pretty good. You know I look back and I love this country but I sure as hell don't love a lot of politicians in it or the CEOs. I think they're taking advantage of the system and it's just *deja vu*. The public - they got screwed in 2008 and they're going to get screwed again. I think it was Santayana that said those that do not learn history are doomed to repeat it and I'm afraid we're going down that road.