Investor Flows and Fragility in Corporate Bond Funds

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June 25, 2015

Preliminary

* We are grateful for helpful comments and suggestions from Byoung-Hyoun Hwang, Pamela Moulton, David Musto, Stefan Nagel, Hyun Song Shin, Yongxiang Wang and seminar participants at Cornell University brownbag workshop. Goldstein is at the Wharton School of Business (phone: (215)746-0499; email: itayg@wharton.upenn.edu); Jiang is at the Eli Broad College of Business at Michigan State University (phone: (517)353-2920; email: jiangh@broad.msu.edu); and Ng is at the Dyson Scool of Applied Economics and Management at Cornell University (phone: (607)255-0145; email: dtn4@cornell.edu).

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Abstract

Investment in bond mutual funds has grown rapidly in recent years. With it, there is a growing concern that they are a new source of potential fragility. While there is a vast literature on flows in equity mutual funds, relatively little research has been done on bond mutual funds. In this paper, we explore flow patterns in corporate-bond mutual funds. We show that their flows behave quite differently than those of equity mutual funds. While we confirm the well-known convex shape for equity funds' flow-to-performance over the period of our study (1992-2014), we show that during the same time, corporate bond funds exhibit no convexity. Under some performance benchmarks, corporate bond funds even exhibit a concave shape: their outflows are sensitive to bad performance more than their inflows are sensitive to good performance. Moreover, corporate bond funds tend to have more concave flow-performance relationships when they have more illiquid assets and when the overall market illiquidity is high. These results point to the possibility of fragility: The illiquidity of corporate bonds may generate a first mover advantage (or strategic complementarities) among investors in corporate-bond funds, amplifying their response to bad performance or other bad news.

I. Introduction

The landscape of the financial industry is constantly changing, as new financial innovation and regulation shift activities across different financial institutions and vehicles. One of the dominant trends of recent years is the growth of assets under management by fixed income mutual funds, i.e., mutual funds investing in corporate or government bonds. Data reported by Feroli, Kashyap, Schoenholtz, and Shin (2014) show that from January 2008 to April 2013, fixed income funds have attracted multiple times more inflows compared to equity, money market, allocation and other funds combined. Data reported by the Investment Company Institute (ICI 2014) show bond-fund assets roughly doubling over this period.[1]

Observing this trend, several commentators have argued that bond funds pose a new threat to financial stability. What will happen when the current trend of loose monetary policy changes? Will massive flows out of bond funds and massive sales of assets by these funds destabilize debt markets with potential adverse consequences for the real economy? Feroli, Kashyap, Schoenholtz, and Shin (2014) use evidence from the dynamics of bond funds to show that flows into and out of funds seem to aggravate and be aggravated by changes in bond prices. They conclude that this suggests the potential for instability to come out of this industry. They analyze the market "tantrum" around the announcement of the possible tightening of monetary policy in 2013, and suggest that events like this can put the bond market under stress due to amplification coming from bond mutual funds.

In order to get a better understanding of the potential threats to stability posed by bond mutual funds, we need more research on the flows into and out of these funds. By now, there is a vast literature on flows in equity mutual funds. This literature has been reviewed recently by Christoffersen, Musto, and Wermers (2014). However, as these authors note, there is almost no research on flows in bond mutual funds. In this paper, we try to fill the gap and provide a first step in the analysis of the flows in bond funds. We focus on actively managed corporate bond funds in the period between January 1992 and December 2014. Our analysis shows that flows in corporate bond funds exhibit different patterns than what has been the common observation in the vast literature on equity-fund flows.

[1] See Section II.A for details on the developments in the bond fund industry.

A pervasive result in the empirical literature on equity mutual funds is that the flow-to-performance relation tends to have a convex shape, that is, inflows to equity funds tend to be very sensitive to good past performance, but outflows are overall not that sensitive to bad past performance. Papers documenting this pattern, discussing its origins and consequences include: Ippolito (1992), Brown, Harlow, and Starks (1996), Chevalier and Ellison (1997), Sirri and Tufano (1998), Lynch and Musto (2003), Huang, Wei and Yan (2007), among others. Considering the context of fragility, a convex flow-to-performance curve suggests that fragility is not a pressing concern. If investors do not rush to take their money out of funds following negative developments, then one should not worry so much about outflows depressing prices and leading to negative consequences for the real economy.

Our evidence, however, shows that corporate bond funds exhibit quite a different pattern from equity funds when it comes to the sensitivity of flow to performance. While we confirm a convex shape for equity funds' flow-to-performance over the period of our study (1992-2014), we show that during the same time, corporate bond funds exhibit no convexity. Under some performance benchmarks, corporate bond funds even exhibit a concave shape: Their outflows are sensitive to bad performance more than their inflows are sensitive to good performance. Moreover, the sensitivity of flows in corporate bond funds in the negative (positive) region is greater (smaller) than that in equity funds.

This result is consistent with Chen, Goldstein, and Jiang (2010) who compare the sensitivity of outflows to bad performance between equity funds that hold illiquid assets and equity funds that hold liquid assets. They show that outflows are more sensitive to bad performance in illiquid funds and relate the result to strategic complementarities and financial fragility. In illiquid funds, outflows impose greater liquidation costs on the fund when readjusting the portfolio. Since portfolio readjustments typically happen in the days after the actual redemption and investors get the net asset value as of the day of redemption, withdrawing money out of the fund leads to negative externalities on other investors who keep their money in the fund. This creates a first-mover advantage in the redemption decision, amplifying the flows out of illiquid funds following bad performance.[2]

[2] Chen, Goldstein, and Jiang (2010) develop a model of runs in the tradition of the global-games literature – e.g., Morris and Shin (1998) and Goldstein and Pauzner (2005) – and show how complementarities will generate this

Indeed, corporate bond funds tend to hold quite illiquid assets. Unlike equity, which typically trades many times throughout the day, corporate bonds may not trade for weeks and trading costs in them can be very large. Despite the illiquidity of their holdings, corporate bond funds quote their net asset values and prices to investors on a daily basis. As a result, there is a mismatch between the illiquidity of the fund's holdings and the liquidity that investors holding the fund get: they are able to redeem their shares at any day and get the quoted net asset value. This implies that investors' outflows may lead to costly liquidation by the funds, where the costs would be borne to a large extent by remaining investors. This creates a first-mover advantage in redemptions which amplifies the reaction of outflows to bad performance.

We find additional evidence in support of the idea that asset illiquidity creates strategic complementarities among corporate bond-fund investors in their redemption decisions. First, the liquidation costs imposed on funds due to massive outflows are expected to be more severe during periods of higher illiquidity, when bonds trade even less, when trading is more costly, and when there is more uncertainty about bond valuation. We use several measures to proxy for aggregate uncertainty and illiquidity. These include the VIX index, measuring implied volatility, the TED spread, measuring the difference between the interest rates on interbank loans and on treasury bills, and the Federal Funds rates, measuring the rates at which banks trade federal funds with each other. Consistent with our hypothesis, we find that flow-performance relationships for corporate bond funds are more concave during periods when these measures are high.

Second, we show some evidence that among corporate bond funds, those with lower asset liquidity tend to experience greater sensitivity of outflows to bad performance, i.e., their flow-performance relationship is more concave. In order to measure liquidity at the fund level, we use the level of cash holdings, since funds with more cash suffer lower liquidation costs in case of massive outflows, and so expose their investors to weaker strategic complementarities.

Third, following the model and empirical results in Chen, Goldstein, and Jiang (2010), we expect that strategic complementarities will be less important in determining fund outflows if the fund ownership is mostly composed of institutional investors. This is because institutional investors are large and so are more likely to internalize the negative externalities generated by

amplification of outflows following bad performance. Such complementarities are in the spirit of the bank-run literature going back to Diamond and Dybvig (1983); albeit they are not as strong as in banks.

their outflows. Indeed, consistent with this hypothesis, we find that the effect of illiquidity on the sensitivity of outflow to bad performance diminishes when the fund is held mostly by institutional investors.

As a case study, we examine the outflows from PIMCO's Total Return funds in October 2014, shortly after the announcement of Bill Gross' departure on September 26, 2014. Dubbed as the "Bond King" by *Fortune* magazine in 2002, Bill Gross clearly had an enormous effect on these funds, being the manager and the one that many investors identified these funds with. Hence, one would expect significant flows out of these funds following his resignation. Moreover, following the main theme of our paper, one would expect outflows to be amplified by illiquidity of the funds' assets. An interesting case study is offered by the fact that three of the funds – Total Return Fund, Total Return Fund II, and Total Return Fund III – were very different in nature than the fourth one – Total Return Fund IV. This last one had significantly higher amounts of cash and other liquid assets. Indeed, consistent with our hypothesis, it is the only one out of the four funds that did not see sharp withdrawals following Gross' resignation, despite the fact that up until then it had returns that were very highly correlated with those of the other three funds.

While we present evidence supporting the presence of strategic complementarities and a first-mover advantage in corporate bond funds, other hypotheses may also explain why corporate bond funds have more concave flow-performance relationship than equity funds. For instance, corporate bond investors may feel they are more exposed to the downside than to the upside compared to stock investors, which can explain the difference in the flow-performance relationship. However, we find evidence that is not consistent with such an explanation. First, we examine the flow-performance relationship for Treasury bond funds. Treasury bonds also have limited upsides, but are much more liquid than corporate bonds. We find that Treasury bond funds clearly exhibit a convex flow-performance relationship. Second, we allow for the asymmetric payoffs of corporate bonds by explicitly considering downside betas in the calculation of fund performance. The concave flow-performance relationship for corporate bond funds still holds, which suggests that asymmetric payoffs may not be the main reason.

The strategic complementarities and first-mover advantage we discuss here are very familiar from the banking context, and recently were on display in the run on money market mutual funds following the collapse of Lehmann Brothers.[3] One thing that distinguishes banks and money market funds from other mutual funds (including bond funds) is that the latter have a floating net asset value, such that investors are not guaranteed to get a fixed amount when they withdraw. Indeed, this feature is often thought to prevent the emergence of strategic complementarities in mutual funds. However, this argument is incomplete. Even with a floating net asset value, the structure of funds gives rise to complementarities and fragility, since investors can take their money out at any given day based on the most recently updated net asset value, and the consequences of their redemptions will be reflected to a large extent in future net asset values. Hence, investors impose a negative externality on others when they redeem their shares, creating the first-mover advantage. This problem arises mostly when the assets held by the fund are illiquid, which is the case for corporate bond funds.

The potential fragility from fund flows does not necessarily call for regulatory intervention. Funds can take measures to reduce the extent of the first mover advantage and so reduce the amplification of outflows in illiquid funds. Indeed, we show here that the amplification is reduced when funds hold more cash. Other measures funds can take include putting restrictions on redemptions or calculating the net asset value that investors can take out of the fund to factor in the future liquidation costs. The practice of swing pricing, whereby the net asset value investors can redeem depends on aggregate flows, is based on similar logic.[4] Still, regulators should be aware of the behavior of flows in the mutual fund industry. First, attempts to regulate other players in the financial system are likely to push more activity into mutual funds (as happened in the last few years for bond funds), potentially increasing their fragility. Second, if the effect of flows goes beyond the fund itself and is not internalized by the fund, then mutual funds will not fully implement the desired measures.

Our paper does not attempt to answer the question of whether outflows in bond funds have significant implications on market prices and/or the real economy. We only conduct some exploratory tests in this direction. The mechanism that could be at work is that massive outflows from corporate bond funds force the funds to sell large amounts of bonds, putting downward pressure on corporate bond prices. Even though these bonds are traded in secondary markets, one

[3] For an empirical study of the run on money market funds, see Schmidt, Timmerman, and Wermers (2014).

[4] Hanson, Scharfstein, and Sunderam (2014) discuss some solutions for money-market funds, noting that a floating net asset value will not completely solve the problem.

would expect that lower bond prices will make it more difficult for firms to raise new debt and so the real effect on their operations and investments will follow. Gilchrist and Zakrajsek (2012) study the relationship between corporate bond credit spreads and economic activity. Following Gilchrist and Zakrajsek (2012), we examine how corporate bond outflows are associated with future credit spreads and macroeconomic outcomes based on a vector autogression (VAR) framework. We find that shocks to the corporate bond fund outflow lead to economically and statistically significant increase in credit spread. Such shocks to the corporate bond fund outflow that are orthogonal to the current state of the economy lead to economically and statistically significant declines in consumption, investment and GDP. Our evidence complements existing evidence on the price pressure imposed by mutual-fund outflows (e.g., Coval and Stafford (2007), Manconi, Massa, and Yasuda (2012), and Ellul, Jotikasthira, and Lundblad (2012)) and on the real effect of these outflows (e.g., Edmans, Goldstein, and Jiang (2012) and Hau and Lai (2013)).

The remainder of the paper is organized as follows. Section II presents the institutional background and hypothesis development. Section III presents the data and methodology. Section IV shows the empirical results. Section V explores some implications of outflows from bond funds on prices and the real economy. Section VI describes the case study based on Bill Gross' departure from PIMCO funds. Section VII concludes.

II. Institutional Background and Hypothesis Development

A. Institutional Background: Valuations, Redemptions and Liquidity Management

Our paper focuses on actively managed corporate bond mutual funds. Compared with the voluminous research on the equity counterparts, relatively little academic research has been conducted on corporate bonds funds. This deficiency has to be addressed because of the large size of the corporate bond market as well as the increasingly important presence of mutual funds in this market segment. At the end of 2013, the amount of corporate bonds outstanding was \$7.46 trillion, almost half the size of the equity market. The corporate bond market is particularly important as a funding vehicle for U.S. companies. According to the Securities Industry and Financial Markets Association (SIFMA), corporate bond issuances in the U.S. reached \$1.4

trillion dollars in 2014. Many non-US firms also issue corporate bonds in the U.S., as documented by Bruno and Shin (2015). In the same year, the initial public offerings of equity in the U.S. raised only $92 billion dollars.[5]

Traditional players in the corporate bond market include long-horizon investors such as insurance companies, pension funds, and trusts.[6] In the recent decade, mutual funds have become increasingly important in corporate bond markets. According to ICI, the geometric average annual growth rate of assets under management by corporate bond funds is 14% from 2000 to 2013, which leads the aggregate size of corporate bond funds to more than quintuple. Combining data from ICI ($1.72 trillion holdings of corporate bonds by bond funds) and SIFMA ($7.46 trillion corporate bonds outstanding), we estimate that corporate bond funds owned about 23% of corporate bonds outstanding in 2013. As Moneta (2015) documents, the average turnover rate of corporate bond funds is much higher than that of equity funds. For instance, from 1996 to 2007 the average turnover rate of general corporate bond funds is approximately twice as large as that of equity funds, which suggests more active trading and relatively shorter investment horizons of corporate bond funds. Considering the relatively low liquidity in corporate bond markets, the high trading activities of corporate bond funds are likely to generate substantial market impact.

It should be noted that fixed income funds in general have expanded substantially during this period. For instance, the average annual growth rates for Treasury bond funds and Municipal bond funds from 2000 to 2013 are approximately 5%. Their growth, however, is dwarfed by that of corporate bond funds. As shown in Figure 1, the share of corporate bond fund assets in the universe of fixed income funds has trended up steadily. With a total net asset value reaching $1.86 trillion in 2013, corporate bond funds comprise 57% of entire bond fund assets. Due to their dominant position in bond funds, we choose to focus on corporate bond funds in our study. To make our analysis of flow-performance relation comparable with the literature on equity funds, we exclude passively managed corporate bond funds.

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[5] This is an estimate from Ernst and Young. See: http://www.ey.com/Publication/vwLUAssets/ey-q4-14-global-ipo-trends-report/$FILE/ey-q4-14-global-ipo-trends-report.pdf.

[6] As Bessembinder and Maxwell (2006) explain, most bond issues are often absorbed into stable "buy-and-hold" portfolios of insurance companies and pension funds soon after issuance. The reason is that corporate bonds are a favored investment for insurance companies and pension funds, since their long-horizon obligations can be matched reasonably well to the relatively predictable, long-term stream of coupon interest payments from bonds.

There are four features that make corporate bond funds prone to strategic complementarities and run risk: infrequent corporate bond trading; uncertain pricing of corporate bonds; high costs associated with investor outflows; and negative externality arising from costly outflows. We elaborate on these features below.

First, in contrast to equities which trade frequently on the exchange, corporate bonds trade in the over-the-counter dealer market relatively infrequently. Prior to 2002, the corporate bond market was particularly opaque, without readily available information on transaction prices. The introduction of the Transaction Reporting and Compliance Engine (TRACE) in July 2002 required bond dealers to report all trades in publicly issued corporate bonds to the National Association of Security Dealers (NASD) which in turn released these transaction data to the public. Using these data, Edwards, Harris, and Piwowar (2007) find that individual bond issues do not trade on 48 percent of days in their sample. They find that the average number of daily trades in an issue, conditional on trading, is only 2.4. Bessembinder and Maxwell (2008) note that corporate bonds trade infrequently even compared with other bonds. In their sample, corporate bonds comprise about 20 percent of outstanding U.S. bonds but account for only about 2.5 to 3.0 percent of trading activities in U.S. bonds. In contrast, U.S. Treasury securities comprise 16 percent of U.S. bonds outstanding, but account for 59 percent of total bond trading volume in 2006. Their results suggest that despite the improved ex-post transparency in the corporate bond market, it remains relatively illiquid.

Second, partially due to the fact that corporate bonds trade infrequently, accurate price information of corporate bonds may not be readily available, which leads to ambiguity in the pricing of corporate bonds. According to the Investment Company Act of 1940, bonds not traded should be priced at "fair value" made "in good faith." Cici, Gibson and Merrick (2009) find that in practice, bond fund managers usually comply with this mandate by marking their bond positions at the prices provided by one or more pricing service companies and/or securities dealers. However, different pricing services can mark the prices differently, and managers of bond funds have the discretion to override the third-party pricing using their own judgements. This creates room for large dispersions and uncertainty of bond valuations.

Indeed, Cici, Gibson and Merrick (2011) document substantial dispersions of month-end valuations placed on identical corporate bonds by different mutual funds. Their tests reveal that such dispersion of valuations is consistent with returns smoothing behavior by managers, which involves marking positions such that the net asset value is set above or below the true value of fund shares, resulting in wealth transfers across existing, new, and redeeming fund investors. They find that the returns smoothing is particularly serious for corporate bond funds with hard-to-mark assets and not as much for Treasury bond funds; furthermore, when a fund's return is low, the fund is more likely to mark the bond positions higher than the true value. Under this situation, existing shareholders would have particularly high incentives to withdraw their money while the mark is good.

Third, the trading cost associated with outflows can be high for corporate bond funds. Although substantial disagreement exists in the literature, the estimates of trading costs in corporate bonds indicate that they are generally large. For instance, Bessembinder, Maxwell, and Venkataraman (2006) estimate round-trip (purchase and sale) trading costs during the first half of 2002 to be approximately 25 basis points, or $6,750 on an average-sized transaction. After the introduction of TRACE in 2002, this figure decreased to about half. Edwards, Harris and Piwowar (2007) estimate that the round-trip transaction costs in corporate bonds range from approximately 150 basis points for the smallest trade size to about three bps for the largest trade size. Bao, Pan and Wang (2011) use the covariance in corporate bond returns to estimate the trading costs and find that the median implied bid-ask spread is 1.50%. These results support the view that it is costly to trade corporate bonds. In times of distress or low liquidity, or for assets which trade particularly infrequently and are thus hard to price, we expect trading costs of corporate bonds to be much larger.

Finally, the structure of corporate bond funds that hold illiquid assets but provide withdrawal rights to their investors on a daily basis would give rise to payoff complementarities. Like other open-end mutual funds, the costs imposed by investors' liquidation in corporate bond funds are not fully reflected in the price these investors get when they redeem the shares, but are shared by investors who keep their money in the fund. The NAV at which investors can buy and sell their shares in the funds is calculated using the same-day market close prices of the underlying securities but the trades made by the funds in response to redemptions are most likely to happen after the day of the redemptions. Given the three preceding features of the corporate bond fund market – infrequent corporate bond trading, uncertain pricing of corporate bonds, and high costs associated with investor outflows – the negative externality of redeeming investors on remaining shareholders can be particularly high for corporate bond funds, which could intensify the run risk.

Given the high potential and large costs of financial fragility in corporate bond funds, we would expect mutual fund managers to take measures to mitigate this risk. For instance, under the Investment Company Act, a fund may impose fees on redemptions of fund shares held for a short period, i.e., redemption fees. On March 3, 2005, the Securities and Exchange Commission voted to adopt a rule concerning voluntary redemption fees, which allows a mutual fund to adopt a redemption fee of no more than 2 percent of the amount of the shares redeemed to discourage short-term trading. In practice, however, redemption fees do not appear to be popular among mutual funds. For example, our reading of fund prospectuses indicates that despite a wide range of fixed income mutual funds offered, PIMCO charges a 1% redemption fee only for investors in shares of the PIMCO Senior Floating Rate Fund (invested mainly in floating-rate high yield bank loans) on redemptions and exchanges made by the investor within 30 calendar days after the shares' acquisition. Clearly, even for this fund, the redemption fee is far from being adequate in eliminating the strategic complementarities that we stress in our paper. Such reluctance of open-end mutual fund managers to impose tighter redemption fees on shareholders, however, is consistent with the excessive open ending among funds competing aggressively to attract investors' money (Stein, 2005).[7]

B. Hypothesis Development

Our hypotheses are based on the idea that strategic complementarities exist among investors in corporate bond mutual funds driven by the illiquidity of their assets. When they redeem their shares, they get the net asset value as of the day of redemption. The fund then has to conduct costly liquidation that hurts the value of the shares for investors who keep their money in the fund. Hence, strategic complementarities emerge, such that the expected redemption by some

[7] In a different context – hedge funds – Getmansky (2012) finds that despite much more common lock-up periods and redemption fees, the sensitivity of flow to performance appears concave. This is likely because of restrictions on inflows, which prevent investors from chasing after top performers.

investors increases the incentives of others to redeem. Chen, Goldstein, and Jiang (2010) provide a model, based on the global-games literature, which clarifies this point formally regarding the difference between illiquid and liquid equity funds. A similar model should apply for corporate bond funds and for the comparison between corporate bond funds and equity funds. The idea is that corporate bond funds are less liquid than equity funds, due to the features of the corporate bond markets as mentioned earlier, and so the strategic complementarities they create for investors are greater than those in equity funds. This leads to the first hypothesis.

Hypothesis 1: Corporate bond funds exhibit a more concave flow-to-performance relationship than equity funds.

The same logic should extend to changes in liquidity over time. Dick-Nielsen, Feldhutter and Lando (2012) document that corporate bond illiquidity varies over time and contributes substantially to bond yield spread during the financial crisis. As Cici, Gibson and Merrick (2011) note, returns smoothing is particularly serious for corporate bond funds with hard-to-mark assets. During periods of high illiquidity, corporate bonds trade less and are harder to mark. As a result, corporate bond fund managers have more latitude to mark their positions, resulting in more uncertainty in the true NAV of the funds. Moreover, during these periods liquidation costs are higher. Hence, strategic complementarities are stronger in such periods and corporate bond fund outflows are expected to be stronger if they underperform in such periods. This leads to the second hypothesis.

Hypothesis 2: During periods of higher illiquidity, corporate bond funds exhibit greater sensitivity of outflows to low past performance.

Following up directly on the above ideas, corporate bond funds with more illiquid assets impose greater complementarities on their investors and so would have greater amplification leading to more outflows following low past performance. The reason is that funds with more liquid assets will not have to bear high costs liquidating their positions in short notice to meet redemption requests. This leads to the third hypothesis.

Hypothesis 3: Corporate bond funds with more illiquid assets exhibit greater sensitivity of outflows to low past performance.

Finally, we expect strategic complementarities to be weaker in funds that are held mostly by institutional investors. These investors are large and hold a large proportion of the funds' assets; their holdings are not as affected by other investors' actions. By holding on to their own shares rather than selling them, they guarantee that their holdings do not suffer from the price decline arising from their own selling. In other words, these investors internalize the externalities they impose and are less prone to strategic complementarities. Other investors, knowing that the institutional investors provide strategic stability, are also less inclined to withdraw. This point is made formally in the model of Chen, Goldstein, and Jiang (2010). This leads to the last hypothesis.

Hypothesis 4: The effect of illiquidity on the sensitivity of outflows to bad performance is weaker in funds that are held mostly by institutional investors.

III. Sample Construction and Empirical Measurements

A. Sample Construction

Data on corporate bond funds come from the Center for Research in Security Prices (CRSP). Our sample period is January 1992 to December 2014. Prior to 1991, there are few corporate bond funds in the CRSP database. Since we use one year of data to estimate the alpha of individual bond funds, our flow-performance tests start from January 1992. A bond fund typically issues several share classes with different bundles of expense ratios, management fees, front-end and/or back-end sales charges (loads), minimum investment requirements, and restrictions on investor types to attract investors with different wealth levels, investment horizons, and investment mandates. Since these fund share-level characteristics can influence the investment and redemption decisions of mutual fund investors, we use individual fund share classes as our unit of observations. We supplement fund data with time-series data of VIX from the Chicago Board Options Exchange (CBOE), the TED spread (difference between the three-month London Interbank Offered Rate (LIBOR) and the three-month Treasury-bill interest rate) and the Federal Fund Rate from the Federal Reserve Economic Data available through the St. Louis Fed.

We select corporate bond funds based on the objective codes provided by the CRSP. Specifically, to be classified as a corporate bond fund, a mutual fund must have a (1) Lipper objective code in the set (‘A’,‘BBB’,‘HY’,‘SII’,‘SID’,‘IID’), or (2) Strategic Insight objective code in the set (‘CGN’,‘CHQ’,‘CHY’,‘CIM’,‘CMQ’,CPR’,’CSM’), or (3) Wiesenberger objective code in the set (‘CBD’,‘CHY’), or (4) ‘IC’ as the first two characters of the CRSP objective code. We require at least one year of fund history before a fund is included in our sample and exclude index corporate bond funds, exchange traded funds, and exchange traded notes from the CRSP mutual fund database. Our final sample includes 4,679 unique fund share classes and 1,660 unique corporate bond funds. To compare the behavior of investors in corporate bond funds and equity funds, we follow Jiang and Zheng (2014) to select the sample of equity funds.

B. Empirical Measurements

The key variables in our empirical analyses are mutual fund flows, performance, and proxies for the liquidity of fund assets. As a standard practice, we impute net fund flows from the total net assets of each fund share class between consecutive points in time and the interim net fund return.[8] Specifically, flow for fund *k* in month *t* is defined as:

$$Flow_{k,t} = \frac{TNA_{k,t} - TNA_{k,t-1}(1 + R_{k,t})}{TNA_{k,t-1}}$$

where $R_{k,t}$ is the return of fund *k* during month *t*, and $TNA_{k,t}$ is the total net asset value at the end of month *t*. To mitigate the influence of outliers (a standard practice in the literature), fund flows are winsorized at the 1% and 99% levels.

To measure performance of corporate bond funds, we estimate a bond fund’s average alpha in the past year by performing rolling-window time-series regressions for each fund using past 12 months of data. One issue that merits a special discussion is the benchmark relative to which performance is measured. Given the scarcity of studies on the investment and redemption decisions of corporate bond fund investors, we resort to both theory and prior empirical studies on flows of equity funds for guidance. Our primary performance measure is fund *Alpha*, which is

[8] O’Neal (2004) uses gross inflows and outflows to examine the purchase and redemption decisions of mutual fund investors. Since our analysis is motivated by potential adverse consequences of mutual fund trading forced by net redemptions, we use net fund flows, which also make our results comparable with the vast literature on flow-performance relations for equity funds.

the intercept from a regression of excess corporate bond fund returns on excess aggregate bond market and aggregate stock market returns. We use the Vanguard total bond market index fund return and CRSP value-weighted market return to proxy for aggregate bond and stock market returns.

Several reasons prompt the choice of this simple measure of fund *Alpha*. First, a positive (negative) intercept from this regression for a given mutual fund over a particular period indicates that investors holding passive stock and bond market portfolios would have improved their mean-variance performance had they tilted their portfolios towards (away from) the fund. Therefore, the measured *Alpha* can, a priori, be an important determinant of the investment and redemption decisions of bond fund investors if they expect future alphas to be persistent. Second, a growing number of studies find that alpha from the Capital Asset Pricing Model (CAPM) drives flows into and out of equity mutual funds, and the explanatory power of CAPM alpha for fund flows is higher than alternative, multifactor models (see Berk and Van Binsbergen, 2014; Barber, Huang, and Odean, 2014). Although for equity funds it may be reasonable to approximate the wealth portfolio using the aggregate stock market return following the spirit of CAPM, for corporate bond funds, it seems natural to include both bond and stock markets to approximate fluctuations in the wealth portfolio.[9] Third, from an asset pricing perspective, a growing literature establishes common risk factors driving both stock and bond returns (e.g., Fama and French, 1993; Koijen, Lustig, Van Nieuwerburg, 2014). Therefore, it is reasonable to adjust for the exposures to bond and stock market risks when computing corporate bond fund alpha.

We consider several robustness tests. First, instead of using both stock and bond market factors, we use a more parsimonious, one-factor model with the aggregate bond market return to compute the corporate bond fund alpha. Second, to improve the precision of beta estimates, we first estimate fund beta using past two or three years of return data, and then compute the alpha of the bond fund over the next month. Third, we use fund returns in excess of the cross-sectional

[9] Earlier tests of CAPM approximate returns on the wealth portfolio using the value-weighted returns to stock and bond markets (e.g., Friend, Westerfield, and Granito, 1978). Since our objective is not to literally test if the aggregate wealth portfolio is mean-variance efficient, and for the benefit of mitigating measurement errors in the relative value of stocks and bonds, we adopt a more flexible approach of including both stock and bond market returns in the regression. Another advantage of our approach is that it allows individual funds to have different exposures to stock and bond markets.

average of all corporate bond fund returns as alternative measures of fund performance. Fourth, we use raw fund returns in excess of the risk-free rates. These results, unreported to conserve space, show that the corporate bond fund flow-performance relation is never convex. It is either concave or linear, but never convex. In contrast, equity funds exhibit convex flow-performance relations in all specifications.

To test our hypotheses, we need both aggregate and fund-level measures of liquidity. We first construct measures of the aggregate corporate bond market liquidity. Bao, Pan, and Wang (2011) find that movements in the aggregate stock market volatility, as proxied by the VIX index, strongly impacts the liquidity of corporate bonds. We therefore use the VIX index as one measure of aggregate corporate bond liquidity. Brunnermeier and Pedersen (2009) show that asset market liquidity co-moves with the funding liquidity of financial institutions that supply liquidity to asset markets. We use the TED spread and the Federal funds rate to capture funding liquidity to financial institutions, which in turn determines the liquidity of corporate bond markets. According to Nagel (2014), the Federal funds rate is also an important determinant of aggregate liquidity premiums that reflect the scarcity of liquidity, due to the fact that when the Federal funds rate increases, the opportunity cost of holding cash rises. Finally, we use the index of aggregate corporate bond market illiquidity proposed by Dick-Nielsen, Feldhutter and Lando (DFL 2012). Since the DFL index is estimated using the TRACE data, it has a shorter history, starting from July 2002 to June 2013. It shares an 86% correlation coefficient with VIX. We use movements in these aggregate liquidity measures to capture the periods when bond fund managers find it more difficult to trade corporate bonds in the secondary market and/or more costly to raise money from other institutions. As a result, the liquidity conditions of fund assets deteriorate, which renders the concern of fund investors for the negative externality arising from other investors' redemption decisions more acute.

In addition to aggregate liquidity, we also look at variation in the liquidity of assets held by individual corporate bond funds. The SEC regulates that a mutual fund restricts the holding of illiquid assets to be below 15% of fund assets. Since the concept of liquidity is often elusive and the level of liquidity in asset markets tends to be volatile, this binary classification of liquid and illiquid assets has clear limitations. As a first approximation, we use an elementary but powerful proxy for the liquidity of a fund's assets, namely its cash holdings (the fraction of fund assets held in cash). To accommodate redemption requests from clients, fund managers may have multiple means, e.g., disposal of undesired holdings, selling liquid assets, using the proceeds from new clients (inflows), and loans from financial markets or other institutions such as the fund family. When faced with large, abrupt net redemptions, however, cash provides fund managers with the most reliable source of liquidity. Moreover, while adverse market events (e.g., the failure of Lehman Brothers) can render the liquidity of previously liquid financial assets (e.g., shares of money market funds) suddenly illiquid, the liquidity of cash is largely insulated from these movements. These considerations prompt us to use the pre-determined level of cash holdings to proxy for the liquidity of a fund's assets, which, according to our hypothesis, will influence the redemption decisions of fund investors.

Of course, the level of cash holdings can reflect fund managers' anticipation of the fund's foreseeable liquidity needs, and therefore could be endogenous, which may reverse the direction of causality. This concern of endogeneity, however, implies that conditional on poor past performance, funds with higher cash holdings should experience large subsequent redemptions, due to fund managers' anticipation effect. This predicted direction is opposite to that of our hypothesis and, if relevant, could potentially bias us away from finding evidence that supports our hypothesis.

C. Summary Statistics

Figure 2 shows the total net assets and dollar flows of actively managed corporate bond funds in our sample. The total net assets in this segment have been trending up in our sample period, particularly since the onset of the recent financial crisis. As of 2008, there was $649 billion under management. From 2008 to 2014, this figure has almost tripled to more than $1.8 trillion. Such a steady increase in corporate bond fund assets, however, masks increasingly volatile fund flows. For instance, corporate bond funds attracted net inflows of approximately $190 billion in 2009 but experienced net redemptions of nearly $60 billion from existing funds in 2013. Such massive flows into corporate bond funds naturally raise the concern of potential instability, if corporate bond fund performance and the direction of flows are to reverse in the future.

Table 1 presents the summary statistics for the funds in our sample from January 1992 to December 2014. Over this sample period, active corporate funds record returns of 0.42% and an inflow of 0.82% per month on average. The median fund share-class size is $59 million, with a median age of 6.89 years. On average these funds have annual expense of 1.04% and approximately 29% of them charge rear-end loads. The funds hold 3.5% of their assets in cash on average, but the cash holding practices vary substantially across funds with a standard deviation of 10%. The top one percent of funds holds as much as 46.7% of their assets in cash, while the bottom one percent has negative cash holding (i.e. leverage) of 36.72%. Fewer than 20% of the funds have negative cash holdings. On average, 23% of the fund share-classes are institutional.

IV. Results

A. Flow-Performance Relation for Corporate Bond Funds

To analyze the flow-performance relation for corporate bond funds, in light of Hypothesis 1, we perform the following regression:

$$Flow_{i,t} = \alpha + \beta_1 Alpha_{i,t-12\to t-1} + \beta_2 Alpha_{i,t-12\to t-1} \times I(Alpha_{i,t-12\to t-1} < 0) + \gamma \times Controls_{i,t} + \varepsilon_{i,t}, \quad (1)$$

where $Flow_{i,t}$ is fund i's net flow in month t, $Alpha_{i,t-12\to t-1}$ is fund i's alpha in the past one year, and $I(Alpha_{i,t-12\to t-1}<0)$ is an indicator variable equal to one if the fund achieves a negative alpha in the past year and zero otherwise. $Controls_{i,t}$ includes a battery of fund characteristics: Lagged Flow (the fund's net flow in month t-1), Log(TNA) (the natural log of fund assets), Log(Age) (the natural log of fund age in years), Expense (the fund's expense ratio), and Rear Load (an indicator variable equal to one if the fund charges back-end loads and zero otherwise). To control for the aggregate flows into and out of the corporate bond fund sector, we include the month fixed effect. To allow for temporal dependence of regression residuals at the level of fund share class, we cluster standard errors by fund share class. To compare our results with the literature on equity funds, we also estimate the same regression for stock funds in the same period. To make the results comparable, we use the same two-factor model to estimate equity fund alpha. The results, however, are similar if we use one-factor model for equity mutual funds.

Panel A of Table 2 shows the results. We find a concave flow-performance relation for corporate bond funds: the sensitivity of flows out of corporate bond funds to bad performance is much higher than that of flows into those funds to good performance. The slope coefficient for *Alpha* is 0.621, and the slope coefficient for *Alpha* interacted with the negative alpha dummy is 0.507 and is statistically significant. In other words, the sensitivity of outflows to negative alpha is 1.128 (= 0.621+0.507), which is 82% higher than that of the inflows to positive alpha (0.621).

Such a concave flow-performance relation for bond funds is markedly different from the convex flow-performance relation documented in the stock fund literature. In the second column, we confirm the existence of such a convex flow-performance relation for stock funds during our sample period. For stock funds with positive alpha, a one percent increase in alpha is associated with 1.462 percent increase in fund flows. But for stock funds with negative alpha, a one percent decrease in alpha is associated with a 0.836% (=1.462-0.626) decrease in fund flows. The sensitivity of outflows to negative alpha is therefore 32% lower than that of inflows to positive alpha, which implies a convex flow-performance relation for stock funds, as consistent with prior literature.

In the context of fragility, the effect of outflows is particularly important. Comparing the results of the bond funds to the stock funds, we find that the sensitivity of flows in bond funds in the negative region is greater than that in equity funds. A one percent decrease in alpha leads to about a third higher outflows in bond funds (1.128%) compared to the outflows this would create in stock funds (0.836%). We also find the difference between the two coefficients on the negative alpha indicator variable statistically significant at the 1% level when we run a regression that pools the corporate bond and equity funds together.

To have a detailed description of the shape of the flow-performance relation, we also use a flexible piece-wise linear regression specified as follows:

$$Flow_{i,t} = \alpha + \sum_{j=1}^{5} \beta_j \times Q_{i,j,t} \times Alpha_{i,t-12\rightarrow t-1} + \gamma \times Controls_{i,t} + \varepsilon_{i,t}, \qquad (2)$$

where $Q_{i,j,t}$ is an indicator variable that represents the quintile membership of fund i based on its past one year performance $Alpha_{i,t-12\rightarrow t-1}$. For instance, if the fund falls in the bottom 20% of all corporate bond funds in our sample based on its past year performance, then $Q_{i,1,t}$ =1 (Bottom) and $Q_{i,j,t}$ =0 for j in the set (2,3,4,5) for month t. In this way, we allow the slope of flow-performance relation to differ across different quintiles of fund alpha. The choice of quintile membership reflects the tradeoff between parsimony and flexibility.

Panel B of Table 2 reports the results, which show a concave flow-performance relation for corporate bond funds: the sensitivity of flows out of corporate bond funds to bad performance is higher than that of flows into those funds to good performance. The effect is acute at the tail end of the returns. Specifically, the slope coefficient for Alpha interacted with the Bottom quintile indicator variable is 1.117, whereas that for Alpha interacted with the Top quintile indicator variable is merely 0.708. In other words, among the bottom performance quintile of funds, a one percent decrease in alpha is associated with 1.117 percent fund outflows, whereas a one percent increase in alpha is associated with only a 0.708 percent increase in fund inflows among the top performance quintile of funds.

In the second column, we report results for stock funds. For stock funds in the top performance quintile, a one percent increase in alpha is associated with 1.40 percent increase in fund flows. For stock funds in the bottom performance quintile, a one percent decrease in alpha is associated with a 0.83 percent decrease in fund flows. Comparing the results of the corporate bond funds to the stock funds, we find that the sensitivity of flows in corporate bond funds in the negative (positive) region is greater (smaller) than that in equity funds. Hence, the flow-performance relation is more concave for corporate bond funds than for equity funds. These results provide initial support for the existence of strategic complementarities in corporate bond fund investors' redemption decisions, as compared to their equity counterparts. These complementarities amplify the response of outflows to bad performance.

So far, the results we report are based on the performance measure of alpha calculated using a two-factor model, i.e., fund alpha is measured as the intercept from a regression of excess corporate bond fund returns on excess Vanguard total bond market returns and excess CRSP value-weighted stock market returns. Despite the reasons outlined previously that lead us to favor this proxy for corporate bond fund alpha, we also conduct similar exercises where we construct alternative measures of fund performance: alpha from a one-factor model, alpha based on predetermined fund betas, style-adjusted fund returns, and fund returns in excess of the risk-free rate. These results, unreported to conserve space, show that the corporate bond fund flow-performance relation is never convex. It is either concave or linear, but it is never convex. In contrast, equity funds consistently exhibit convex flow-performance relations in all specifications.

B. Illiquidity and Sensitivity of Redemptions to Poor Performance

Why do flows out of corporate bond funds experience greater sensitivities to negative performance than those of stock funds? One natural explanation is the presence of strategic complementarities. Corporate bond funds invest in more illiquid assets. Investors' outflows may lead to costly liquidation by corporate bond funds, where the costs would be borne by the remaining investors. This creates a first-mover advantage which amplifies the reaction of outflows to bad performance. Under this explanation, outflows should be much more sensitive to bad performance during periods that are more illiquid. One would expect that liquidation costs imposed on funds due to outflows will be more severe during periods of higher illiquidity, when bonds trade even less and there is more uncertainty about their valuation. Hence, strategic complementarities in withdrawals should be stronger in times of greater aggregate illiquidity. As a result, flow-performance relationships for bond funds are expected to be more concave during periods of high illiquidity. To test this hypothesis based on time-series variation, we perform the following regression:

$$\begin{gathered} Flow_{i,t} = \alpha + \beta_1 Alpha_{i,t-12\to t-1} + \beta_2 Alpha_{i,t-12\to t-1} \times Illiquidity_t + \gamma \times Controls_{i,t} + \varepsilon_{i,t}, \\ \forall Alpha_{i,t-12\to t-1} < 0, \end{gathered} \tag{3}$$

where $Illiquidity_t$ is an indicator variable equal to one if the particular illiquidity proxy is above the sample mean. We use the subsample of funds with negative alpha without imposing such restrictions on the right-hand-side variables. The four proxies we use for illiquidity are VIX, TED spread, Federal funds rate, and DFL Illiquidity index.

Table 3 shows that the high sensitivity of investor redemptions to poor fund performance is driven mostly by periods when corporate bond markets are illiquid based on these four proxies. The aggregate stock market volatility as proxied by the VIX index is associated with lower corporate bond market liquidity (Bao, Pan, and Wang (2011)). We find that during liquid periods with low VIX, alpha's association with flow is basically flat. During illiquid periods with high VIX, a 1% decrease in alpha is associated with 0.622% (= -0.131+0.753%) extra outflows.

Asset market illiquidity can arise from funding illiquidity from institutions as demonstrated in Brunnermeier and Pedersen (2009). TED spread measures the difference between the interest rates on interbank loans and on Treasury bills, while Federal fund rates measure the rates at which banks trade federal funds with each other. Both measure funding liquidity to financial institutions. We use these two measures of funding liquidity to proxy for asset market illiquidity.

We find that during illiquid periods with high TED spread and Fed funds rate, 1% lower alpha is associated with 0.628% and 0.693% more outflows respectively.[10] During liquid periods, alpha's association with flow is basically flat or slightly positive. The difference between high and low liquidity periods is significant in both cases.

Finally, we use a direct measure of the index of aggregate corporate bond market illiquidity estimated using the TRACE data by Dick-Nielsen, Feldhutter and Lando (DFL 2012). Despite a relatively short data sample period starting from July 2002 to June 2013, we find a similar result. During highly illiquid period with high DFL index, 1% lower alpha is associated with 0.666% (= - 0.746 +1.412) more outflows. The outflows arising from negative alphas are completely due to highly illiquid periods, and the difference between high and low liquidity periods is significant.

Overall, we find that the corporate bond funds have larger outflow-to-poor-performance sensitivity during highly illiquid periods. This supports the idea of strategic complementarities driven by illiquidity. It should be noted that the volatile and tight periods with high VIX, high TED spread and Fed funds rate are exactly the periods when the systemic risks are the highest.

[10] 0.628% = -0.121%+0.749%; 0.693% =0.272%+0.421%.

We find that during such periods, corporate bond funds are particularly prone to outflows following bad performance.

If it is indeed the first-mover advantage which amplifies the reaction of outflows to bad performance, then outflows should be much more sensitive to bad performance among corporate bond funds that are more illiquid. This is Hypothesis 3 introduced in the previous section.

We test Hypothesis 3 by exploring the impact of asset liquidity on the flow-performance relation for corporate bond funds. To measure liquidity at the fund level, we use the fund's most recent level of cash holdings prior to month *t* to ensure that the level of cash holdings is not simply the outcome of flows in month *t* and the information is available to fund investors. To control for the possibility that the level of cash holdings may be systematically different for corporate bond funds with different investment styles and mitigate the influence of potential outliers, we create a Low Cash indicator variable that equals one if the fund has cash holdings below the average fund in the same style and zero otherwise.

Since we are primarily interested in how asset liquidity influences investors' redemption decisions, we use two regression specifications to test for this impact:

$$\begin{aligned} Flow_{i,t} &= \alpha + \beta_1 Alpha_{i,t-12\to t-1} + \beta_2 Alpha_{i,t-12\to t-1} \times I(Alpha_{i,t-12\to t-1} < 0) + \\ &\beta_3 Alpha_{i,t-12\to t-1} \times I(Alpha_{i,t-12\to t-1} < 0) \times Illiquidity_{i,t} + \gamma \times Controls_{i,t} + \varepsilon_{i,t}, \end{aligned} \tag{4}$$

$$\begin{aligned} Flow_{i,t} = \alpha + \beta_1 Alpha_{i,t-12\to t-1} + \beta_2 Alpha_{i,t-12\to t-1} \times Illiquidity_{i,t} + \gamma \times Controls_{i,t} + \varepsilon_{i,t}, \\ \forall Alpha_{i,t-12\to t-1} < 0. \end{aligned} \tag{5}$$

In regression (4), we use full-sample information, but restrict the coefficients for the control variables to be the same across funds with negative and positive alpha, whereas in regression (5), we use the subsample of funds with negative alpha without imposing such restrictions on the control variables.

Table 4 shows the results. Column (1) replicates the results for bond funds in Table 2 as an initial starting point where we run regression of fund flows on previous year's performance and performance for funds with negative alphas. As seen before, flow-performance sensitivity is much higher for funds with negative alphas than for funds with positive alphas. In Column (2), we add the interaction term between low cash and the performance variables. For funds with high cash, a 1% decrease in alphas result in 0.964% (=0.937+0.0274%) increase in outflows. In contrast, for funds with low cash, a 1% decrease in alphas results in 1.661% (=0.937+ 0.0274−0.534+1.231%) extra outflows. Hence, among funds with low cash holdings, negative fund alpha results in significantly higher flow-performance sensitivity.

Using the entire sample of funds in the regressions requires the control variables to have the same coefficients during over- and under-performance of funds. To relax this constraint, we limit the data sample to the funds with negative alphas in the regression, which allows us to focus on the underperforming funds. Column (3) shows that the results are similar in that specification as well. Funds with low cash holdings have higher flow-performance sensitivity. Consistent with hypothesis 3, we find that low cash funds have significantly higher sensitivity of outflows to bad performance than high cash funds.

So far, we show that among corporate bond funds, those with lower asset liquidity tend to experience greater sensitivity of outflows to bad performance, i.e., their flow-performance relationship is more concave. Consistent with Hypothesis 3, the evidence supports the idea that asset illiquidity creates strategic complementarities among bond-fund investors in their redemption decisions.

This finding has important policy implications as well. In the context of fragility, funds with higher cash holdings may be subject to less outflows after poor performance. Hence, funds can mitigate the amplification of outflows by holding a cash buffer. Our paper focuses on corporate bond funds. But this finding would lend some indirect support to the current proposal of holding a capital buffer in the context of money market funds. (See Hanson, Scharfstein and Sunderam (2014).)

C. The Effect of Large Investors

Turning to Hypothesis 4, strategic complementarity should be less important in determining fund outflows if the fund ownership is mostly composed of institutional investors. The reason is that large institutional investors hold larger positions in the funds and so they are more likely to internalize the negative externalities generated by their outflows. Hence, they serve as a constraining force in reducing coordination problems that lead to runs on funds. For funds with large investors, we expect the effect of illiquidity on the flow-performance relation to be less significant.

In Table 5, we examine the effect of complementarities in the case of institutional investors. Following Chen, Goldstein, and Jiang (2010), we classify bond funds into institutional-oriented funds and retail-oriented funds. A fund is classified as an institutional-oriented (retail-oriented) fund if more than 80% (less than 20%) of fund assets are owned by institutional investors through institutional share class.

Overall, table 5 shows that the effect of asset illiquidity on the outflow to bad performance sensitivity is not significant among institutional-oriented funds but only significant among retail-oriented funds. The first two specifications show the results for institutional-oriented funds. The coefficient that we are interested in is the interaction term between alpha and low cash. Strategic complementarity implies that low-cash, illiquid fund would have higher fund flows sensitivity, hence a higher coefficient in the interaction term. The presence of institutional investors would serve as a constraining force however and reduce such effect. Indeed, as we expect, among institutional-oriented funds, fund flows sensitivity is not any higher for illiquid (low cash) funds. The coefficient on the interaction term between alpha and low cash is insignificant in both specifications (1) and (2) with different control variables.

When we turn to the last two specifications (3) and (4) which show the results for retail-oriented funds, the effect is very different from that of the institutional-oriented funds. As expected, in such cases, fund flows sensitivity is significantly larger for low-cash, illiquid funds. The coefficient for alpha*low cash is positive and statistically significant for both specifications. Hence, consistent with hypothesis 4, we find that the effect of illiquidity on the sensitivity of outflow to bad performance diminishes when the fund is held mostly by institutional investors. The effect is coming only from the retail-oriented funds, where coordination failures are expected to be a problem.

The results point to another measure that can tame the fragility in fund outflows; namely, concentrated fund ownership. Internalizing the externality, large shareholders reduce the sensitivity of outflows to bad performance. The retail-oriented funds, however, can still create significant problems, as retail investors are more affected by strategic complementarities and rush to the exit.

D. Treasury Bond Funds

So far in the paper, we have focused on corporate bond funds. As a comparison, in this sub-section, we examine the flow-performance relation for Treasury bond funds. Treasury bonds are traded in more liquid secondary markets than are corporate bonds (e.g., Harris, 2015). Due to the enhanced liquidity, we would expect the force of strategic complementarity to be weaker for Treasury bond funds, and thus the flow-performance relation for Treasury bond funds to be less concave than for corporate bond funds.

We estimate the flow-performance relation for Treasury bond funds in Table 6. The results indicate that, similar to equity funds, Treasury bond funds exhibit a convex flow-performance relation. Panel A shows a negative and statistically significant coefficient for *Alpha×(Alpha < 0)*, which indicates that outflows are less sensitive to underperformance than are inflows to outperformance. Panel B shows the piecewise-linear relation between fund flows and fund alpha, which generates a similar image: the response of outflows to underperformance tends to be flat, whereas that of inflows to outperformance tends to be steep.

These results on Treasury bond funds provide further support for the influence of illiquidity on mutual fund investors' redemption decisions. Treasury funds and equity funds, both investing in relatively liquid assets, exhibit a convex flow-performance relation, but this is not true for corporate bond funds which invest in much more illiquid assets.

E. Asymmetric Payoffs

One alternative explanation for the greater concavity of the flow-performance relation for corporate bond funds than for equity funds is that investors in corporate bond funds may perceive corporate bonds as an asset class with limited upside potential but larger downside risk. As a result, their investment decisions may be more sensitive to underperformance of corporate bond funds. The results on Treasury funds described above provide some evidence against this hypothesis, since Treasuries have a similar payoff structure to corporate bonds. These results, as mentioned above, are more consistent with the idea that liquidity of the assets held by the fund is a driving factor.

To assess this alternative hypothesis more directly, we examine the asymmetric payoffs of corporate bonds by explicitly considering downside betas in the calculation of fund alpha performance. Specifically, we expand our base-line two-factor model with two interaction terms: the excess bond market return multiplied by an indicator variable equal to one if excess bond market return is negative and zero otherwise, and the excess stock market return multiplied by an indicator variable equal to one if excess stock market return is negative and zero otherwise.

As shown in Table 7, the flow-performance sensitivity for corporate bond funds remains higher for funds with negative alpha than for funds with positive alpha. For instance, Column 2 shows that the slope coefficient for *Alpha×(Alpha<0)* is three times as large as the slope coefficient for Alpha with a *t*-statistic of 6.54. This result suggests that asymmetric payoffs may not be the main driver of the concavity of the flow-performance relation for corporate bond funds.

V. Economic Impact of Corporate Bond Fund Flows

In this section, we examine the impact of shocks to flows into and out of the aggregate corporate bond fund sector on subsequent macroeconomic activity. The idea is that to accommodate large unexpected flows, bond fund managers often have to trade corporate bonds in the relatively illiquid secondary market. The resulting demand shocks can have significant impact on corporate bond prices and the credit risk premium. Understanding this channel is crucial for understanding the potential for a broader impact of the dynamics of fund flows. The analysis in this section is still exploratory, but sheds some light on the basic relations.

To operationalize this idea, we build on the recent work by Gilchrist and Zakrajsek (2012) which finds that variation in credit risk premiums has substantial predictive power for measures of macroeconomic activity. Their specific measure of credit risk premiums is computed via two steps. They first compute a credit spread index based on the prices of individual corporate bonds traded in the secondary market. They then decompose the credit spread into a component that is due to expected defaults and another component that is due to credit risk premium, which they refer to as the excess bond premium (EBP). Through a vector autoregression (VAR) framework, they show that shocks to the excess bond premium lead to substantial fluctuations in macroeconomic variables.

Although Gilchrist and Zakrajsek (2012) focus on shocks to financial intermediaries in credit markets, such as leveraged broker-dealers, as a driver of EBP, we focus on demand shocks arising from unexpected flows out of and into the corporate bond fund sector as a force leading to fluctuations in EBP. As an exploratory study, we first evaluate how corporate bond fund flows are related to Gilchrist and Zakrajsek (2012)'s excess bond premium measure. Specifically, we conduct a bivariate VAR with quarterly corporate bond fund outflows (fund flows times -1) and excess bond premium on a quarterly basis, and estimate the response of EBP to shocks to the corporate bond fund outflow. For this and subsequent VAR analysis, our sample period is from 1991Q1 to 2010Q3 with two lags of the endogenous variables.[11]

Figure 3 shows that in response to a one percent increase in corporate bond fund outflows during a quarter, the excess bond premium rises during the contemporaneous quarter, and jumps up further by 9.2 basis points during the next quarter and another 7.6 basis points subsequently. All these responses are statistically significant and economically meaningful, which supports our conjecture that demand shocks to corporate bonds induced by fund flows impact bond prices and the credit risk premium in a meaningful way.

Then we proceed to estimate the macroeconomic consequences of shocks to the corporate bond funds. To this end, we estimate a VAR model in the spirit of Gilchrist and Zakrajsek (2012), replacing the EBP with fund outflows. Specifically, the VAR includes (1) log difference of real personal consumption expenditure; (2) log-difference of real business fixed investment; (3)

[11] The data on EBP and other macroeconomic variables are available through https://www.aeaweb.org/articles.php?doi=10.1257/aer.102.4.1692.

log-difference of real GDP; (4) inflation as measured by the log-difference of the GDP price deflator; (5) the quarterly fund outflow; (6) the quarterly (value weighted) excess stock market return from CRSP; (7) the ten-year (nominal) Treasury yield; and (8) the effective nominal federal funds rate. Through this specification, we estimate the influence of the quarterly fund outflow that is orthogonal to the current state of the economy, on the future state of the economy.

Figure 4 shows the impulse response functions of the endogenous variables to the shock to the corporate bond fund outflow. An unanticipated increase by one percent in the outflow leads to reductions in future consumption, investment and output growth rates over the next several quarters. The macroeconomic effect of the outflow shock is quite substantial. For instance, in response to an unexpected one percent increase in fund outflows, the GDP growth rate declines by 0.084, 0.067, and 0.065 percentage points in the subsequent three quarters, reaching an accumulated decline of 0.22 per cent. These results indicate that variations in flows out of and into the corporate bond fund sector have meaningful impact on future macroeconomic conditions, possibly through the credit risk premium channel.

VI. Departure of the "Bond King" and Investor Redemptions

In this section, we study the effect of the departure of Bill Gross on the funds he managed. Bill Gross, known on Wall Street as the Bond King, is the founder of PIMCO, a large fund management company, and one of the most celebrated bond fund managers.[12] On September 26, 2014, Bill Gross abruptly quit PIMCO and joined Janus, a much smaller firm. By all accounts, his departure came as a big surprise to the market and to PIMCO senior management. [13]

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[12] He was named by Morningstar as the Fixed Income Manager of the Year for 1998, 2000, and 2007, the first person to receive this award more than once, and was recognized for his "excellent investment skill, the courage to differ from consensus, and the commitment to shareholders necessary to deliver outstanding long-term performance." Wall Street Journal, http://topics.wsj.com/person/G/bill-gross/52

[13] According to New York Times, the surprising exit "came after Mr. Gross learned in recent weeks that top executives at Pimco and Allianz, the German insurer that owns it, had grown tired of his leadership and were weighing a change." Despite these, "the timing of the departure of Mr. Gross even seemed to catch Pimco and Allianz off guard, despite the behind-the-scenes planning to remove him. By late afternoon Friday, photographs of Mr. Gross, his biography and well-read monthly investment letters still appeared prominently displayed on the Pimco website." See http://dealbook.nytimes.com/2014/09/26/william-gross-leaves-pimco-to-join-janus/?_r=0

In PIMCO, Bill Gross managed the Total Return Fund, a giant bond fund with assets under management of $221 billion as of June 2014. In October, the first full month after his surprise departure, clients pulled $27.5 billion. "Half of those redemptions from the Pimco Total Return Fund occurred in the first five trading days of October and they then slowed sharply", according to a statement from PIMCO.[14]

The Total Return Fund consists of four different funds: Total Return Fund I, Total Return Funds II, Total Return Fund III, and Total Return Fund IV.[15] In 2011, Gross founded Total Return Fund IV, which relies less on derivative and leverage, and forgoes "high-yield debt, borrowing to create leverage, and investing in options."[16]

As a result of its mandate, Total Return Fund IV has much higher cash holdings than the first three funds. As of June 2014, Total Return Fund IV holds cash that equals 2.5% of the total asset under management, while Total Return Fund, Total Return Fund II, and Total Return Fund III hold cash below 0.5% of the total asset under management (see figure 5). In addition to the typical cash holdings, PIMCO has been holding a substantial amount of assets in the form of commingled cash vehicles, which serves the purpose of liquidity management. At the end of September 2014, Total Return Fund IV holds the highest fraction of assets in commingled cash vehicle (29.3%), which is substantially higher than the rest of the three funds: TRF (16.2%), TRF II (25.5%), and TRF III (20.9%).

As discussed, three of the funds were very different in nature than the fourth one – Total Return Fund IV, which had significantly higher amounts of cash and other liquid assets. Following the main theme of our paper, we would expect outflows to be amplified by illiquidity of the funds' assets. Hence, we would expect Total Return Fund IV to have lower outflows than the other three funds.

Figure 5 shows the patterns of investment outflows of the four Total Return Funds in October 2014, the first full month after Gross' departure. There are outflows in Total Return

[14] http://www.bloomberg.com/news/articles/2014-11-04/pimco-total-return-lost-27-5-billion-after-gross-s-exit
[15] The original Total Return Fund I was founded in 1987. Subsequently, in 1991, to accommodate clients' needs, Gross founded Total Return Fund II, which is barred from investing in high yield bonds, and Total Return Fund III, which is barred from investing in gaming, tobacco and spirits industries.
[16] http://www.bloomberg.com/news/articles/2011-03-11/gross-starts-derivative-lite-version-of-pimco-total-return-as-rally-ends

Funds I, II, and III that amount to 15%, 22% and 30% of the funds' assets, respectively. In contrast, Total Return Fund IV benefits from a modest *inflow*.

Consistent with our hypothesis, Total Return Fund IV is the only one out of the four funds that did not see sharp withdrawals following Gross' resignation. This is particularly interesting because up until then Total Return Fund IV had flows that were very highly correlated with those of the other three funds. The pairwise correlations of flows from the four Total Return Funds were above 99%.

VII. Conclusion

Corporate bond funds have grown tremendously in recent years. They hold a large fraction of corporate bonds outstanding in the US which have an important role in the financing of firms' investments and operations. Despite their importance in the marketplace, there is very little research to date studying their flows patterns. We provide such a study in this paper and show that the familiar convex relationship between flows and performance in equity funds does not hold in corporate bond funds. The relationship in corporate bond funds is much more concave, indicating a stronger sensitivity of outflow to poor performance.

We also show that the sensitivity of outflows to bad performance in corporate bond funds is much stronger in times of aggregate illiquidity and among funds that hold more illiquid assets. Moreover, the effect of illiquidity on the sensitivity of outflows to bad performance is driven mostly by retail-oriented funds and not by institutional-oriented funds.

These findings are all consistent with the presence of payoff complementarities among corporate bond-fund investors driven by the illiquidity of their assets. Investors know that the redemption by others will impose liquidation costs on the fund that will reduce the return for those staying in the fund, and so there is a tendency to redeem with others, which acts to amplify the effect of negative performance on outflows.

Funds can take different measures to alleviate the amplification of outflows. These include holding a cash buffer, putting restrictions on redemptions, or changing the formula for net asset value calculation in the case of redemptions. Regulators should also be aware of the pattern of outflows in corporate bond funds in thinking about the stability of the financial system as a whole and in cases where there are externalities from funds to market prices and real economic activity.

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Figure 1 Distribution of Bond Fund Assets across Investment Objectives

This figure plots the share in net fund assets for fixed income mutual funds grouped by their investment objectives over the period 2000 to 2013. The source of data is the 2014 Investment Company Institute Fact book.

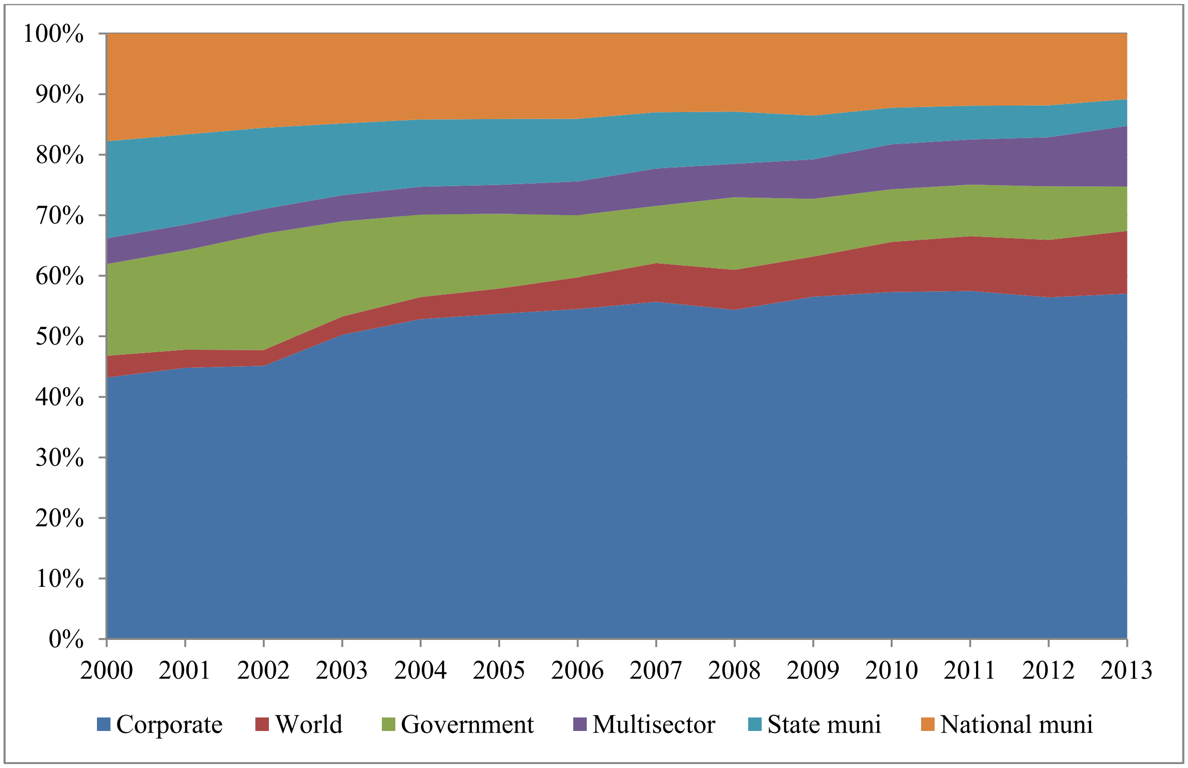


Figure 2 Total Net Assets and Dollar Flows of Active Corporate Bond Funds

This figure shows total net assets (TNA) and dollar flows of actively managed corporate bond funds from 1991 to 2014. We exclude index corporate bond funds, exchange traded funds, and exchange traded notes from the CRSP mutual fund database.

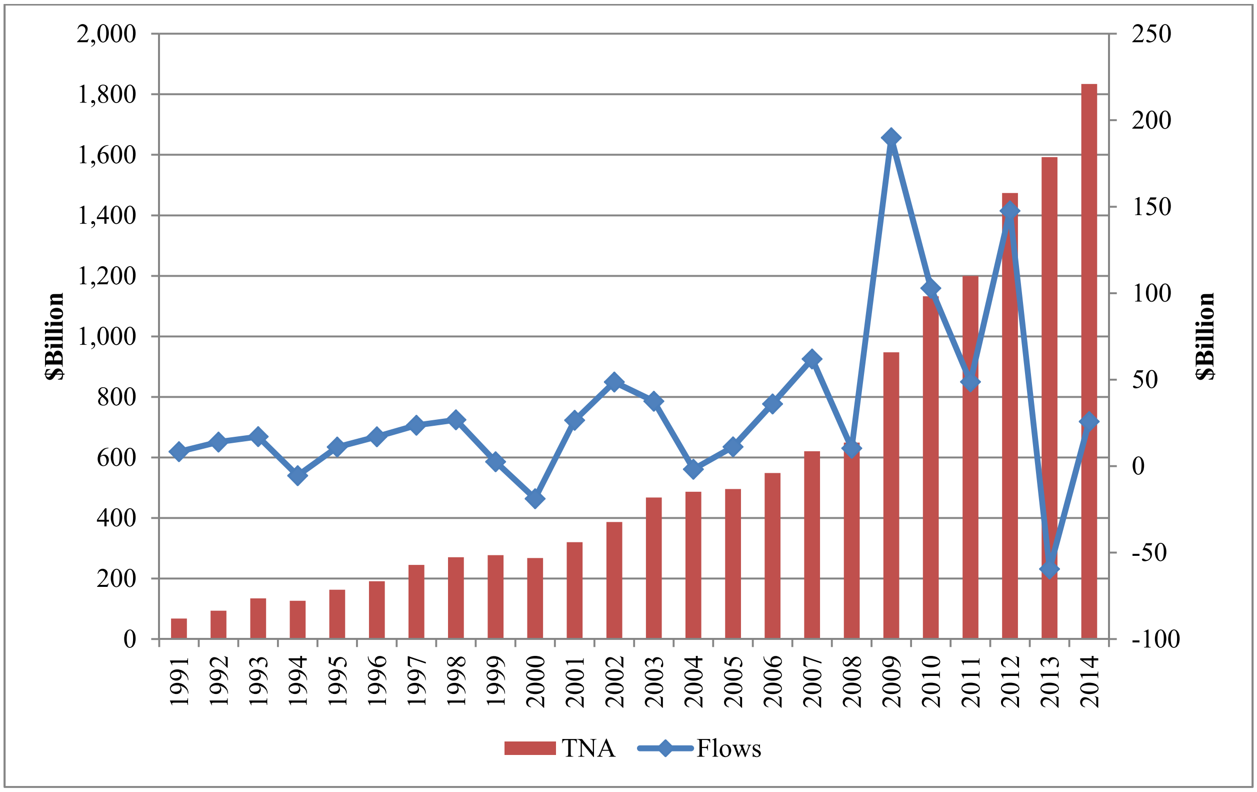


Figure 3: Impact of Corporate Bond Fund Outflows on Excess Bond Premium

This figure depicts the response of Excess Bond Premium (EBP), as proposed by Gilchrist and Zakrajrop (2012), to a one percent shock to the corporate bond fund outflows. The impulse response function is estimated from a vector autoregression (VAR) that consists of the average monthly fund outflows in a given quarter and the quarterly average of the EBP, as available from Gilchrist and Zakrajšek (2012). The band error bands represent the 95th percent confidence interval based on 2000 bootstrap replications.

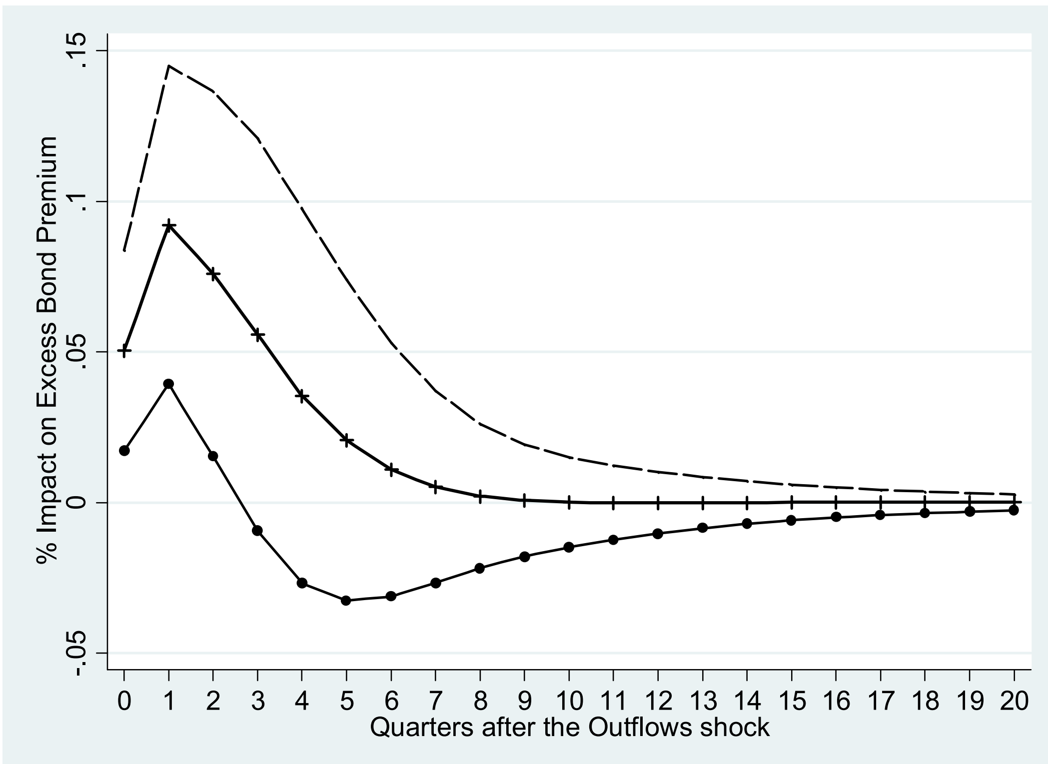
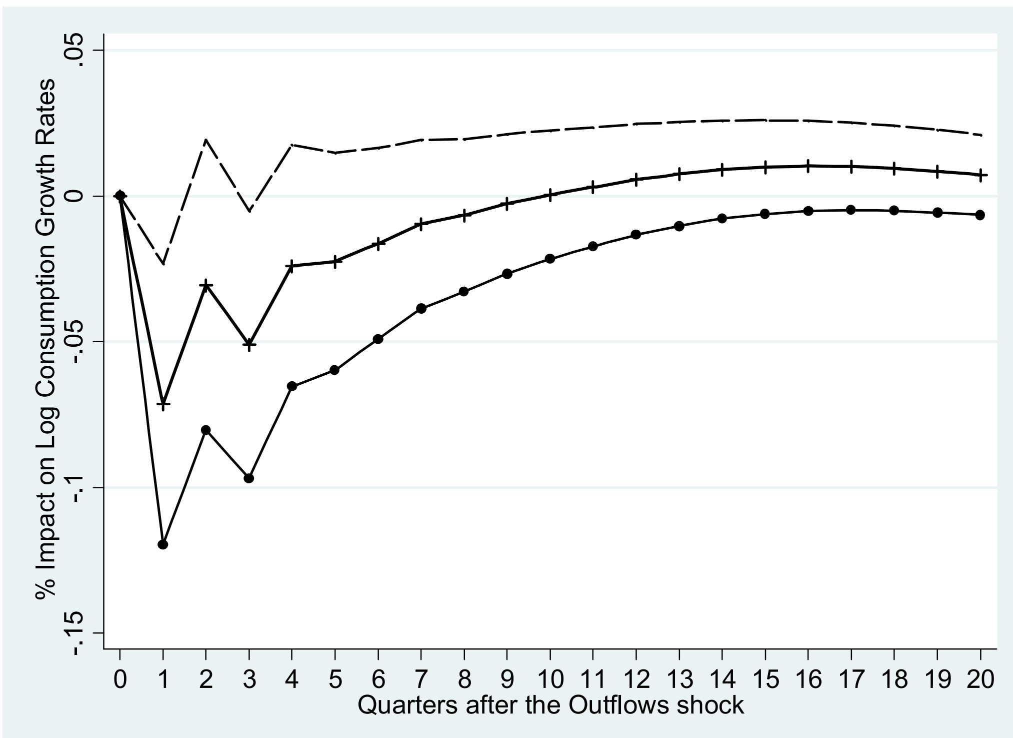


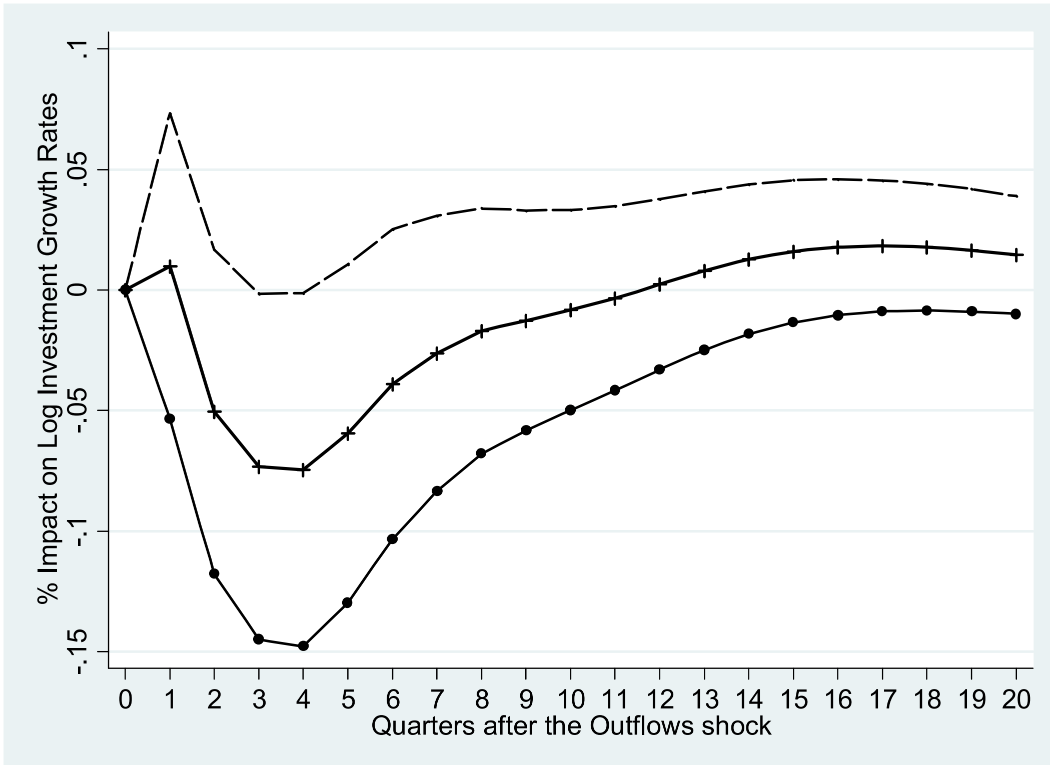
Figure 4: Impact of Corporate Bond Fund Outflows on Macroeconomic Activity

This figure depicts the response of macroeconomic growth rates (consumption in Panel A; investment in Panel B; and GDP in Panel C) to a one percent shock to the corporate bond fund outflows. The impulse response function is estimated from a vector autoregression (VAR) that consists of log-difference of real personal consumption expenditures, log-difference of real business fixed investment, log-difference of real GDP, inflation as measured by the log-difference of the GDP price deflator, the average monthly fund outflows in a given quarter, quarterly value-weighted excess stock market return from CRSP, the ten-year (nominal) Treasury yield; and the effective nominal federal funds rate. Data on macroeconomic variables come from Gilchrist and Zakrajšek (2012). The error bands represent the 95th percent confidence interval based on 2000 bootstrap replications.

Panel A: Consumption Growth



Panel B: Investment Growth



Panel C: GDP Growth

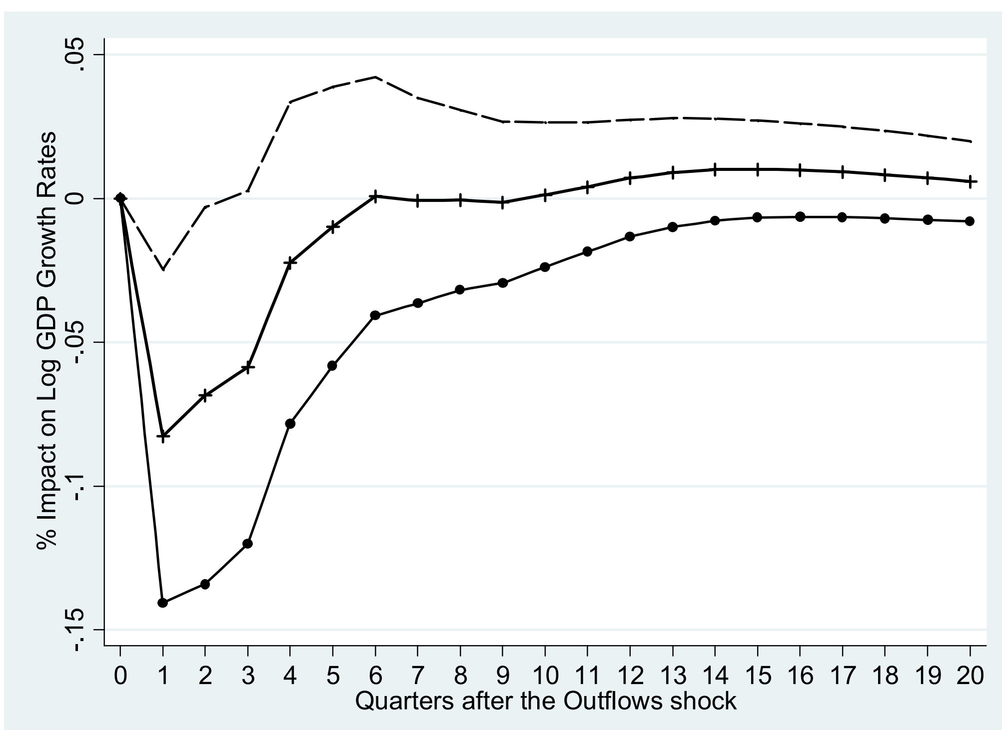


Figure 5 Exiting Total Return Funds following the Departure of Bill Gross

This figure shows the fraction of fund assets withdrawn in October 2014 from PIMCO's Total Return Fund, Total Return Fund II, Total Return Fund III, and Total Return Fund IV following the resignation of the funds' manager, Bill Gross, announced on 26 September 2014. The vertical axis on the left shows proportional fund flows in October 2014 and the vertical axis on the right shows the percentage of fund assets held in cash for these four funds in June 2014.

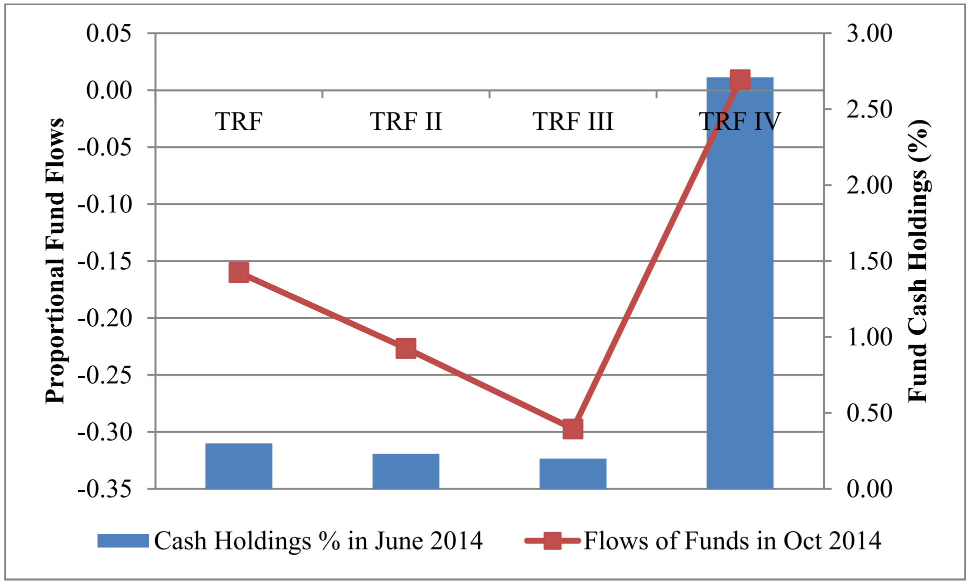


Table 1 Summary Statistics

This table shows the summary statistics for characteristics of active corporate bond funds in our sample from January 1992 to December 2014. Flow (%) is the percentage fund flow in a given month, Fund return (%) is the monthly net fund return in per cent, Log(TNA) is the natural log of total net assets (TNA), Log(Age) is the natural log of fund age in years since its inception in the CRSP database, Expense (%) is fund expense ratio in per cent, Rear load is an indicator variable that equals one if the fund share charges rear loads and zero otherwise, Cash Holdings is the proportion of fund assets held in cash in per cent, Institutional is an indicator variable that equals one if it is an institutional share class, and zero otherwise. The unit of observations is share class-month. The sample includes 4,679 unique fund share classes and 1,660 unique funds. We exclude index corporate bond funds, exchange traded funds, and exchange traded notes from the CRSP mutual fund database.

	Mean	Std Dev	P1	P5	P10	P20	P30	P40	P50	P60	P70	P80	P90	P95	P99	N
Flow (%)	0.82	8.79	-23.83	-7.27	-4.26	-2.27	-1.33	-0.72	-0.20	0.34	1.15	2.54	5.87	11.13	44.09	326035
Fund Return (%)	0.42	1.86	-4.90	-1.93	-1.03	-0.38	0.00	0.25	0.47	0.72	0.99	1.34	1.91	2.54	5.17	326036
Log(TNA)	3.88	2.38	-2.30	-0.51	0.64	1.97	2.84	3.51	4.08	4.64	5.22	5.89	6.72	7.39	8.79	326076
Log(Age)	1.90	0.76	0.22	0.61	0.85	1.20	1.49	1.72	1.93	2.14	2.35	2.58	2.85	3.08	3.56	326871
Expense (%)	1.04	0.48	0.14	0.40	0.50	0.63	0.74	0.82	0.93	1.05	1.26	1.57	1.77	1.90	2.13	326035
Rear Load	0.29	0.46	0	0	0	0	0	0	0	0	0	1	1	1	1	326871
Cash Holdings (%)	3.50	10.04	-36.72	-10.52	-2.54	0.00	1.08	1.97	2.81	3.81	5.00	6.90	11.40	18.31	46.69	326035
Institutional	0.23	0.42	0	0	0	0	0	0	0	0	0	1	1	1	1	326871

Table 2 Flow-Performance Relations: Corporate Bond Funds versus Stock Funds

This table shows flow-performance relations for active corporate bond funds and stock funds from January 1992 to December 2014. Panel A shows the asymmetry in investor responses to outperformance and underperformance (positive versus negative alpha). Panel B shows the piece-wise linear regression. Flow is the proportional fund flow in a given month, Alpha is the average monthly alpha for a given fund in the past year, Bottom to Top represents the rank of a fund in a given month based on its past alpha with Bottom representing the lowest 20th percent and Top representing the highest 20th percent, Log(TNA) is the natural log of total net assets, Log(Age) is the natural log of fund age in years since its inception in the CRSP database, Expense is fund expense ratio, Rear load is an indicator variable that equals one if the fund share charges rear loads and zero otherwise. For both corporate bond funds and stock funds, alpha is the intercept from a regression of excess fund returns on excess aggregate bond market and aggregate stock market returns. We use the Vanguard total bond market index fund return and CRSP value-weighted market return to proxy for aggregate bond and stock market returns. The unit of observations is share class-month. We include month fixed effects and cluster standard errors by fund share class. We exclude index funds, exchange traded funds, and exchange traded notes from the CRSP mutual fund database.

Panel A: Asymmetry between Winners and Losers

	(1)	(2)
	Corporate Bond Funds	Stock Funds
Alpha	0.621***	1.462***
	(6.95)	(47.41)
Alpha× (Alpha<0)	0.507***	-0.626***
	(2.77)	(-14.18)
Lagged Flow	0.154***	0.117***
	(21.63)	(29.67)
Log(TNA)	0.000893***	0.000421***
	(7.06)	(4.95)
Log(Age)	-0.0157***	-0.0184***
	(-31.96)	(-71.37)
Expense	-0.284***	-0.0232
	(-3.66)	(-0.34)
Rear Load	-0.00245***	-0.152***
	(-3.21)	(-6.22)
Observations	307,242	1,578,506
Adj. R^2	0.0627	0.0591

Panel B: Piece-wise Linear Regression

	Corporate Bond Funds	Stock Funds
Alpha×Bottom	1.117***	0.827***
	(8.22)	(30.72)
Alpha×Q2	1.686***	1.681***
	(7.61)	(35.55)
Alpha×Q3	1.577***	2.376***
	(6.54)	(27.79)
Alpha×Q4	0.526***	1.637***
	(4.44)	(31.23)
Alpha×Top	0.708***	1.402***
	(8.13)	(46.32)
Lagged Flow	0.154***	0.116***
	(21.62)	(29.58)
Log(TNA)	0.000887***	0.000413***
	(7.03)	(4.88)
Log(Age)	-0.0157***	-0.0184***
	(-31.92)	(-71.51)
Expense	-0.271***	-0.0235
	(-3.50)	(-0.34)
Rear Load	-0.00245***	-0.152***
	(-3.22)	(-6.24)
Observations	307,242	1,578,506
Adj. R^2	0.0629	0.0599

Table 3 Flow-Performance Relations of Underperforming Corporate Bond Funds during Illiquid Periods

This table shows time-varying flow-performance relations for active corporate bond funds with negative alpha from January 1992 to December 2014. The fund characteristics are defined as in Table 3. We use four indicator variables to capture illiquid period (IlliqPeriod) of corporate bond markets, high VIX, high TED, high FED, and high DFL. IlliqPeriod equals to one if the corresponding time-series variable is above the sample average. VIX is the CBOE's VIX index, TED is the difference between the three-month London Interbank Offered Rate (LIBOR) and the three-month T-bill interest rate, FED is the federal fund rates, and DFL is the corporate bond market illiquidity index proposed by Dick-Nielson, Feldhutter, and Lando (2012). The unit of observations is share class-month. We cluster standard errors by fund share class, and exclude index funds, exchange traded funds, and exchange traded notes from the CRSP mutual fund database.

	(1) VIX	(2) TED	(3) FED	(4) DFL
Alpha	-0.131	-0.121	0.272***	-0.746***
	(-0.77)	(-1.11)	(4.03)	(-3.22)
Alpha*IlliqPeriod	0.753***	0.749***	0.421***	1.412***
	(3.89)	(5.37)	(3.81)	(5.21)
IlliqPeriod	0.00690***	0.00148**	-0.00174***	0.00745***
	(9.81)	(2.44)	(-2.85)	(8.11)
Lagged Flow	0.121***	0.123***	0.123***	0.152***
	(15.37)	(15.47)	(15.48)	(14.90)
Log(TNA)	0.000552***	0.000558***	0.000674***	0.000533***
	(3.78)	(3.82)	(4.58)	(2.98)
Log(Age)	-0.0134***	-0.0136***	-0.0141***	-0.0124***
	(-26.78)	(-26.70)	(-26.69)	(-17.88)
Expense	-0.175**	-0.185**	-0.136	-0.284**
	(-1.98)	(-2.10)	(-1.53)	(-2.45)
Rear Load	-0.00294***	-0.00285***	-0.00288***	-0.00611***
	(-3.40)	(-3.29)	(-3.32)	(-5.87)
Observations	171,006	171,006	171,006	100,215
Adj. R^2	0.0339	0.0330	0.0330	0.0429

Table 4 Flow-Performance Relations of Underperforming Corporate Bond Funds with Different Cash Holdings

This table shows flow-performance relations for active corporate bond funds from January 1992 to December 2014. Flow is the proportional fund flow in a given month, Alpha is the intercept from a regression of excess corporate bond fund returns on excess aggregate bond market and aggregate stock market returns, Low Cash is an indicator variable equal to one if the fund has cash holdings below the average fund in the same style and zero otherwise, Log(TNA) is the natural log of total net assets (TNA), Log(Age) is the natural log of fund age in years since its inception in the CRSP database, Expense is fund expense ratio, Rear load is an indicator variable that equals one if the fund share charges rear loads and zero otherwise. We use the Vanguard total bond market index fund return and CRSP value-weighted market return to proxy for aggregate bond and stock market returns. The unit of observations is share class-month. We include month fixed effects and cluster standard errors by fund share class. We exclude index funds, exchange traded funds, and exchange traded notes from the CRSP mutual fund database.

	(1)	(2)	(3)
	Full Sample	Full Sample	Alpha< 0
Alpha	0.621***	0.937***	0.727***
	(6.95)	(7.19)	(6.87)
Alpha×(Alpha<0)	0.507***	0.0274	
	(2.77)	(0.13)	
Alpha*LowCash		-0.534***	0.653***
		(-4.66)	(4.08)
Alpha*(Alpha<0)*LowCash		1.231***	
		(5.32)	
Low Cash		-0.00138***	-0.000322
		(-2.58)	(-0.50)
Lagged Flow	0.154***	0.153***	0.111***
	(21.63)	(21.54)	(14.17)
Log(TNA)	0.000893***	0.000902***	0.000548***
	(7.06)	(7.14)	(3.60)
Log(Age)	-0.0157***	-0.0156***	-0.0143***
	(-31.96)	(-31.71)	(-25.84)
Expense	-0.284***	-0.261***	-0.144
	(-3.66)	(-3.41)	(-1.60)
Rear Load	-0.00245***	-0.00244***	-0.00228**
	(-3.21)	(-3.21)	(-2.54)
Observations	307,242	307,242	171,006
Adj. R^2	0.0627	0.0632	0.0478

Table 5 Flow-Performance Relations of Underperforming Corporate Bond Funds:

The Role of Institutional Investors

This table shows how the flow-performance relations for active corporate bond funds with negative alpha are influenced by large institutional investors. A fund is classified as an institutional-oriented (retail-oriented) fund is more than 80% (less than 20%) of fund assets are owned by institutional investors through institutional share class. Flow is the proportional fund flow in a given month, Alpha is the intercept from a regression of excess corporate bond fund returns on excess aggregate bond market and aggregate stock market returns, Low Cash is an indicator variable equal to one if the fund has cash holdings below the average fund in the same style and zero otherwise, Inst is an indicator variable equal to one if the fund class is an institutional share class and zero otherwise, Log(TNA) is the natural log of total net assets (TNA), Log(Age) is the natural log of fund age in years since its inception in the CRSP database, Expense is fund expense ratio, Rear load is an indicator variable that equals one if the fund share charges rear loads and zero otherwise. We use the Vanguard total bond market index fund return and CRSP value-weighted market return to proxy for aggregate bond and stock market returns. The unit of observations is share class-month. We include month fixed effects and cluster standard errors by fund share class. We exclude index funds, exchange traded funds, and exchange traded notes from the CRSP mutual fund database.

	Institutional-Oriented Funds (Alpha<0)		Retail-Oriented Funds (Alpha<0)	
	(1)	(2)	(3)	(4)
Alpha	1.827***	1.821***	0.916**	0.955**
	(3.29)	(3.26)	(2.12)	(2.21)
Alpha*LowCash	-0.499	-0.496	1.231***	1.207***
	(-0.63)	(-0.63)	(2.76)	(2.72)
Low Cash	-0.00248	-0.00247	-0.000678	-0.000893
	(-1.23)	(-1.22)	(-0.51)	(-0.68)
Lagged Flow	0.105***	0.105***	0.106***	0.106***
	(5.22)	(5.22)	(5.14)	(5.12)
Log(TNA)	0.000208	0.000229	0.000397	0.000601*
	(0.57)	(0.61)	(1.14)	(1.67)
Log(Age)	-0.0161***	-0.0161***	-0.0133***	-0.0129***
	(-9.50)	(-9.37)	(-10.60)	(-10.31)
Expense	0.0261	0.00277	-0.527***	-0.368**
	(0.08)	(0.01)	(-2.95)	(-2.03)
Rear Load	-0.00392	-0.00397	-0.00621***	-0.00595***
	(-1.40)	(-1.42)	(-4.03)	(-3.85)
Inst		-0.000441		0.00463***
		(-0.18)		(3.47)
Observations	19,545	19,545	40,521	40,521
Adj. R^2	0.0377	0.0376	0.0489	0.0494

Table 6 Flow Performance Relations for Treasury Bond Funds

This table shows flow-performance relations for Treasury bond funds from January 1992 to December 2014. Column (1) shows the asymmetry in investor responses to outperformance and underperformance (positive versus negative alpha). Column (2) shows the piece-wise linear regression. Flow is the proportional fund flow in a given month, Alpha is the average monthly alpha for a given fund in the past year, Bottom to Top represents the rank of a fund in a given month based on its past alpha with Bottom representing the lowest 20^{th} percent and Top representing the highest 20^{th} percent, Log(TNA) is the natural log of total net assets, Log(Age) is the natural log of fund age in years since its inception in the CRSP database, Expense is fund expense ratio, Rear load is an indicator variable that equals one if the fund share charges rear loads and zero otherwise. For Treasury bond fund, Alpha is the intercept from a regression of excess fund returns on excess aggregate bond market and aggregate stock market returns. We use the Vanguard total bond market index fund return and CRSP value-weighted market return to proxy for aggregate bond and stock market returns. The unit of observations is share class-month. We include month fixed effects and cluster standard errors by fund share class. We exclude index funds, exchange traded funds, and exchange traded notes from the CRSP mutual fund database.

	(1)	(2)
Alpha	1.785***	
	(2.77)	
Alpha× (Alpha<0)	-1.690*	
	(-1.90)	
Alpha×Bottom		0.199
		(0.45)
Alpha×Q2		-0.827
		(-1.28)
Alpha×Q3		3.047**
		(2.50)
Alpha×Q4		3.939***
		(3.25)
Alpha×Top		1.638***
		(2.65)
Lagged Flow	0.117***	0.117***
	(5.69)	(5.69)
Log(TNA)	0.000372	0.000372
	(1.03)	(1.03)
Log(Age)	-0.0148***	-0.0148***
	(-11.14)	(-11.14)
Expense	-0.699***	-0.699***
	(-2.85)	(-2.85)
Rear Load	-0.0102***	-0.0102***
	(-3.95)	(-3.95)
Observations	34,565	34,565
Adj. R^2	0.0664	0.0664

Table 7 Flow Performance Relations based on Alpha Controlling for Downside Beta

This table shows flow-performance relations for active corporate bond funds from January 1992 to December 2014 using fund alpha that considers downside beta. Specifically, alpha is the intercept from a regression of excess corporate bond fund returns on excess aggregate stock market and bond market returns and two interaction terms, excess stock (bond) market return times a dummy variable equal to one if excess stock (bond) market return is negative and zero otherwise, in the past year. Other variables are defined as in Table 3. The unit of observations is share class-month. We include month fixed effects and cluster standard errors by fund share class. We exclude index funds, exchange traded funds, and exchange traded notes from the CRSP mutual fund database.

	(1)	(2)	(3)
	Full Sample	Full Sample	Alpha< 0
Alpha	0.333***	0.160***	0.557***
	(10.29)	(3.75)	(9.38)
Alpha×(Alpha<0)		0.509***	
		(6.54)	
Lagged Flow	0.155***	0.154***	0.128***
	(21.90)	(21.89)	(14.53)
Log(TNA)	0.000820***	0.000874***	0.000448***
	(6.37)	(6.78)	(2.76)
Log(Age)	-0.0156***	-0.0156***	-0.0146***
	(-31.73)	(-31.80)	(-24.66)
Expense	-0.376***	-0.317***	-0.226**
	(-4.87)	(-4.10)	(-2.40)
Rear Load	-0.00223***	-0.00217***	-0.00246***
	(-2.93)	(-2.85)	(-2.61)
Observations	321,171	321,171	151,443
Adj. R^2	0.0604	0.0607	0.0510