

# RISK PREMIUM SHIFTS AND MONETARY POLICY: A COORDINATION APPROACH

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Our understanding of crisis propagation and the telling of the crisis narrative have been heavily influenced by the events surrounding the 2008 crisis, which has focused on the leverage of banks and other financial intermediaries. Since then, the focus has shifted from banks to financial market liquidity, in line with the shift in the pattern of financial intermediation as global banks have increasingly given way to long-term investors operating in the bond market. Long-term investors are often portrayed as a stabilizing influence in financial markets, absorbing losses without insolvency and cushioning market shocks caused by leveraged players. However, recent episodes such as the so-called taper tantrum of 2013 have shown that even long-term investors may have limited appetite for losses, and that they will join in a selling spree when one arrives. The issue of evaporating market liquidity and one-sided markets in the face of concerted selling by investors has occupied an important place in recent policy discussions.<sup>1</sup>

The taper tantrum of 2013 is but a recent case of the general phenomenon in which monetary policy shocks are associated with

The views expressed here are those of the authors and not necessarily those of the Bank for International Settlements. We are grateful to Mike Woodford, Christian Hellwig, Enrico Perotti, Cecilia Parlatore, and Ernesto Pasten for discussions.

1. See, for instance, the BIS report on market-making and market liquidity by the Committee on the Global Financial System (BIS, 2014); the chapters on market liquidity in the *IMF Global Financial Stability Review* (IMF, 2015a, 2015b). Fender and Lewrick (2015) lay out the dimensions of the debate.

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changes in the risk premium inherent in market prices, over and above any change in the actuarially fair long-term interest rate implied by the expectations theory of the yield curve. Shiller, Campbell, and Schoenholtz (1983) document the early evidence. Hanson and Stein (2015) and Gertler and Karadi (2015) add to the accumulated evidence that monetary policy appears to operate through changes in the risk premium inherent in asset prices, in addition to changes in the actuarially fair long-term rate.

The fact that the risk premium fluctuates so much opens up a gap between the theory and practice of monetary policy. Discussions of central bank communication often treat the market as if it were an individual with beliefs. Transparency over the path of future policy rates is seen as a device to guide long-term rates, and crucially, such guidance is seen as something amenable to fine-tuning. The term market expectations is often used in connection with central bank guidance. Although such a term can serve as a shorthand, it creates the temptation to treat the “market” as a person with coherent beliefs. The temptation is to anthropomorphize the market and endow it with attributes that it does not have (Shin, 2013).

However, the market is not a person. Market prices are outcomes of the interaction of many actors, and not the beliefs of any one actor. Even if prices are the average of individual expectations, average expectations fail even the basic property of the law of iterated expectations. In other words, the average expectation today of the average expectation tomorrow of some variable is not the average expectation today of that variable (Allen, Morris, and Shin, 2006).

In this paper, we explore a coordination model of the transmission of monetary policy with heterogeneous market participants. Our model has the feature that monetary policy exerts a direct impact on risk premiums through the risk-taking behavior of market participants. In the model, risk-neutral investors, interpreted as asset managers, interact with risk-averse households in a market for a risky bond. Although the asset managers are motivated by long-term fundamental asset values, there is an element of short-termism generated by the aversion to coming last in short-term performance rankings among asset managers. We interpret the friction as the loss of customer mandates of the asset managers, consistent with the empirical evidence on the sensitivity of fund flows to fund performance. Thus, the friction in the model is that relative performance matters for fund managers.

The importance of relative ranking injects spillover effects across asset managers and an endogenous coordination element in their portfolio choice. The cost of coming last generates behavior that has the outward

appearance of shifts in preferences. Just as in a game of musical chairs, when others try harder to grab a chair, more effort must be expended to grab a chair oneself. The ensuing scramble for the relatively safer option of selling the risky bond in favor of the short-term asset leads to a jump in the yield of the risky bond that has the outward appearance of a sudden jump in the risk aversion of the market. The global game approach permits the solution of the trigger level of the floating interest rate when the scramble kicks in. Therefore, when the central bank signals higher future rates, the impact on asset prices is often abrupt, as the risk-taking behavior of market participants undergoes discrete shifts. We could dub this channel of the transmission of monetary policy the risk-taking channel, following Borio and Zhu (2012) who first coined the term.

The key parameter for the strength of the risk-taking channel is the size of the asset management sector. Quantities thus matter. When the sector is large relative to risk-averse households, risk premiums can be driven very low by signaling low future policy rates. In return, however, the central bank must accept a narrower region of fundamentals when risk premiums can be kept low, together with a larger jump in risk premiums when the policy stance changes.

Our main results provide a model of exit of managed funds from key asset markets, generating a jump in the risk premium. We also combine this model with an account of flows into and out of the funds, and the strategic complementarities between the fund managers' investment decisions and decisions of investment managers to invest in or redeem from the funds.

We describe the main model in the next section 1, providing a dynamic context in section 2. Our results hold several implications for the conduct of monetary policy, but we postpone discussion of the implications until section 3. Our paper also bears on investor flows in bond mutual funds. We return in the concluding section to review what incremental lessons our paper can provide to this literature. We first present the model and the solution.

## **1. MODEL**

There are two groups of investors. First, there is a continuum of risk-neutral investors interpreted as asset managers. Asset managers are indexed by the unit interval  $[0, 1]$ , consume once only at the terminal date, and do not discount the future. Asset managers are evaluated against a benchmark index and rewarded for beating the index (or penalized for lagging behind the index). In other words, the

payoff of the asset manager is the difference between the realized return on the portfolio and the realized return on the benchmark index. The benchmark index is fixed exogenously, but its realization is uncertain, as described below. For the purpose of our exercise here, we may interpret the benchmark index as a market interest rate, and the asset managers' performance will be evaluated against this benchmark market interest rate. There is one additional element in the payoffs of the asset managers. Although asset managers care about long-term asset values, they suffer from "last-place aversion" in that they are subject to a penalty (described below) if they are ranked last in the value of their short-term portfolio. We can interpret this penalty as the loss of customers suffered by the asset manager, as reflected in the empirical evidence on the positive relationship between fund flows and fund performance.

The second group of investors are risk-averse household investors. They do not discount the future, they consume once only at the terminal date, and they behave competitively.

All investors form portfolios between two types of assets—a risky asset and a safe asset. The long-term asset is a risky zero-coupon bond that pays only at the terminal date, but the payoff is risky. The expected payoff at the terminal date is  $v$  with variance  $\sigma^2$ . There is an outstanding amount of  $S$  units of the risky bond. The safe asset is a storage technology that pays zero.

### 1.1 Three-Period Model

We first examine the benchmark version of our model, which has three dates, 0, 1 and 2. The timeline is depicted in figure 1. At date 1, asset managers choose how much of the risky bond to hold. They all have one unit of wealth, which they can allocate between the risky bond and the floating-rate account. Asset managers cannot borrow and cannot take short positions.

The realized value of the risky bond is uncertain, with expected value  $v$ . The return on the benchmark index between date 1 and date 2 is denoted by  $1 + r$ . The price of the risky bond  $p$  is determined by market clearing.

Households have mean-variance preferences, and at date 1, they submit a competitive demand curve for the risky bond. Household  $h$  has the following utility function:

$$U_h = vy - \frac{1}{2\tau_h} y^2 \sigma^2 + (e - py), \quad (1)$$

where  $y$  is the risky bond holding of the household,  $e$  is the endowment, and  $\tau$  is risk tolerance. We assume that the endowment  $e$  is large enough that the first-order condition determines the optimal portfolio. From the first-order condition with respect to  $y$  and summing across households, the aggregate demand for the risky bond for the household sector is

$$p = v - \frac{\sigma^2}{\sum_h \tau_h} y \tag{2}$$

$$= v - cy,$$

where  $c$  is the positive constant defined as  $c = \sigma^2 / \sum_h \tau_h$ , and  $\sum_h \tau_h$  is the aggregate risk tolerance for the household sector as a whole.

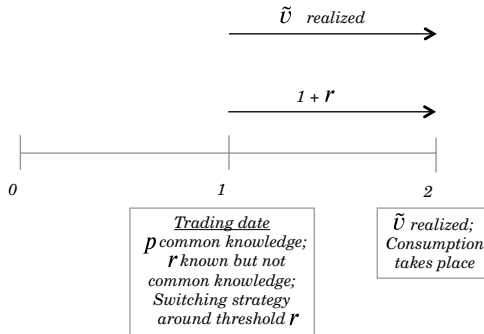
Asset managers hold  $A$  units of the bond, which is exogenous for now. Households hold the remainder  $S - A$ . Thus, prices are determined by the asset market position, with

$$p = v - y(S - A),$$

and the risk premium is

$$\frac{v}{p} = \frac{v}{v - y(S - A)}.$$

**Figure 1. Time Line for Three Period Model**



Asset managers' primary objective is to maximize the return on their investors' funds. The investors in the funds are assumed to be seeking to maximize long-run expected returns. The return to investing in bonds is the risk premium. The alternative investment is the safe asset, with zero return. The excess return relative to the index is given by

$$\frac{v}{v - y(S - A)} - r.$$

However, in our model, asset managers not only care about long-run returns in excess of the benchmark index, but also suffer from last-place aversion.<sup>2</sup> We assume that there is a penalty suffered by any asset manager whose portfolio value is ranked last at date 1. The penalty could be interpreted as a decline in the asset manager's funds under management due to withdrawals by their customers. Below we discuss alternative forms of strategic complementarity that could have generated strategic complementarities in asset managers' incentives.

In particular, if any asset manager is ranked last (or equal last) at date 1, and proportion  $x$  of asset managers has a strictly higher portfolio value, then the asset manager suffers a payoff penalty of  $\phi x$ , where  $\phi$  is a positive constant. The asset manager's payoff is

$$\frac{v}{v - y(S - A)} - r - \phi x. \tag{3}$$

## 1.2 Global Game

When viewed as a one-shot game between the asset managers with complete information, there would be an equilibrium where no asset manager sells and everyone gets a payoff

$$\frac{v}{v - y(S - A)} - r,$$

as long as

$$\frac{v}{v - y(S - A)} - r \geq 0,$$

2. The term last-place aversion is taken from Buell and others (2014), who use the concept in the very different context of the welfare economics of social deprivation.

and there will be an equilibrium where all asset managers sell if

$$\frac{v}{v - y(S - A)} - r \leq \phi x.$$

However, asset managers are not certain what other managers will do. We use global games analysis (Morris and Shin, 2003) to capture the idea that there is strategic uncertainty among managers. In particular, suppose that managers are almost sure about the evolution of the benchmark index, but there is a small amount of heterogeneity. Thus, the benchmark index  $r$  is uncertain, but investors have good information about it. At date 1, asset manager  $i$  observes signal  $\rho_i$  of  $r$  given by

$$\rho_i = r + s_i, \tag{4}$$

where  $s_i$  is a uniformly distributed noise term, with realization in  $[-\epsilon, \epsilon]$  for small positive constant  $\epsilon$ . The noise terms  $\{s_i\}$  are independent across asset managers. We further assume that the ex-ante distribution of  $r$  is uniform on some interval. The assumption that  $r$  and the noise term  $s_i$  are uniformly distributed is for expositional simplicity only.

Based on their respective signals, asset managers decide whether to hold the risky bond or sell it. Since asset managers are risk-neutral, it is without loss of generality to consider the binary choice of hold or sell. A strategy for an asset manager is a mapping:

$$\rho_i \mapsto \{\text{Hold, Sell}\} \tag{5}$$

A collection of strategies (one for each asset manager) is an *equilibrium* if the action prescribed by  $i$ 's strategy maximizes  $i$ 's expected payoff at every realization of signal  $\rho_i$  given others' strategies.

As the first step in the solution, consider switching strategies of the form

$$\begin{cases} \text{Sell} & \text{if } \rho > \rho^* \\ \text{Hold} & \text{if } \rho \leq \rho^* \end{cases} \tag{6}$$

for some threshold value  $\rho^*$ . We first solve for equilibrium in switching strategies. We search for threshold point  $\rho^*$  such that every asset manager uses the same switching strategy around  $\rho^*$ . We appeal to the following result in global games. Recall that  $x$  is our notation for the proportion of investors who sell.

**Lemma 1.** *Suppose that investors follow the switching strategy around  $\rho^*$ . Then, in the limit as  $\varepsilon \rightarrow 0$ , the density of  $x$  conditional on  $\rho^*$  is uniform over the unit interval  $[0, 1]$ .*

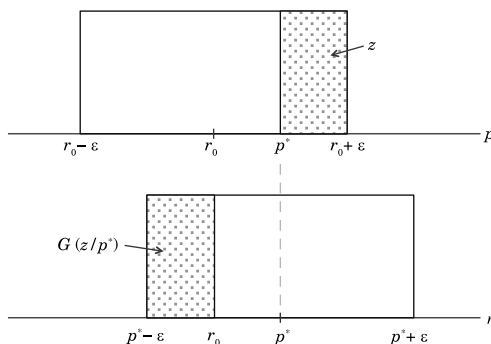
To make the discussion in our paper self-contained, we present the proof of lemma 1. For economy of argument we show the proof only for the case of uniformly distributed  $r$  and uniform noise. However, this result is quite general and does not depend on the assumption of uniform density and uniform noise (Morris and Shin, 2003, section 2).

The distribution of  $x$  conditional on  $\rho^*$  can be derived from the answer to the following question (Q): “My signal is  $\rho^*$ . What is the probability that  $x$  is less than  $z$ ?” The answer to question (Q) gives the cumulative distribution function of  $x$  evaluated at  $z$ , which we denote by  $G(z | \rho^*)$ . The density over  $x$  is then obtained by differentiating  $G(z | \rho^*)$ . The steps to answering question (Q) are illustrated in figure 2.

When the true realization of the benchmark index is  $r$ , the signals  $\{\rho_i\}$  are distributed uniformly over the interval  $[r - \varepsilon, r + \varepsilon]$ . Investors with signals  $\rho_i > \rho^*$  are those who sell. Hence,

$$x = \frac{r + \varepsilon - \rho^*}{2\varepsilon}. \quad (7)$$

**Figure 2. Deriving the Subjective Distribution over  $x$  at Switching Point  $\rho^*$**





When do we have  $x < z$ ? This happens when  $r$  is low enough, so that the area under the density to the right of  $\rho^*$  is squeezed. There is a value of  $r$  at which  $x$  is precisely  $z$ . This is when  $r = r_0$ , where

$$\frac{r_0 + \varepsilon - \rho^*}{2\varepsilon} = z \tag{8}$$

or

$$r_0 = \rho^* - \varepsilon + 2\varepsilon z. \tag{9}$$

See the top panel of figure 2. We have  $x < z$  if and only if  $r < r_0$ . We need the probability of  $r < r_0$  conditional on  $\rho^*$ .

For this, we must turn to player  $i$ 's posterior density over  $r$  conditional on  $\rho^*$ . This posterior density is uniform over the interval  $[\rho^* - \varepsilon, \rho^* + \varepsilon]$ , as in the lower panel of figure 2. This is because the ex ante distribution over  $r$  is uniform, and the noise is uniformly distributed around  $r$ . The probability that  $r < r_0$  is then the area under the density to the left of  $r_0$ , which is

$$\begin{aligned} \frac{r_0 - (\rho^* - \varepsilon)}{2\varepsilon} &= \frac{(\rho^* - \varepsilon + 2\varepsilon z) - (\rho^* - \varepsilon)}{2\varepsilon} \\ &= z, \end{aligned} \tag{10}$$

where the second line follows from substituting in equation (9). Thus, the probability that  $x < z$  conditional on  $\rho^*$  is exactly  $z$ . The conditional cumulative distribution function  $G(z | \rho^*)$  is the following identity function:

$$G(z | \rho^*) = z. \tag{11}$$

The density over  $x$  is thus uniform. Finally, the uniform density over  $x$  does not depend on the value of  $\varepsilon$ . For any sequence  $(\varepsilon_n)$  where  $\varepsilon_n \rightarrow 0$ , the density over  $x$  is uniform. This proves lemma 1.

In the limit as  $\varepsilon \rightarrow 0$ , every investor's signal converges to the true interest rate  $r$ . Fundamental uncertainty disappears, and it is without loss of generality to write the investor's strategy as being conditional on the true interest rate  $r$ . Therefore, we search for an equilibrium in switching strategies of the form

$$\begin{cases} \text{Sell} & \text{if } r > r^* \\ \text{Hold} & \text{if } r \leq r^* \end{cases} \tag{12}$$

Figure 2 reveals the intuition for lemma 1. As  $\varepsilon$  shrinks, the dispersion of signals shrinks with it, but so does the support of the posterior density over  $r$ . The region on the top panel corresponding to  $z$  is the mirror image of the region on the bottom panel corresponding to  $G(z | \rho^*)$ . Changing  $\varepsilon$  stretches or squeezes these regions, but it does not alter the fact that the two regions are equal in size. This identity is the key to the result. The uniform density over  $x$ , which has been dubbed Laplacian beliefs (Morris and Shin, 2003), implies that the strategic uncertainty faced by players in the global game is at its maximum, even when the fundamental uncertainty faced by players shrinks to zero.

### 1.3 Solution

Given Laplacian beliefs, the switching point  $r^*$  is the return that makes each asset manager indifferent between holding and selling. That is,  $\rho^*$  satisfies

$$\frac{v}{v - y(S - A)} - \frac{1}{2}\rho^*. \quad (13)$$

Therefore, the return  $r^*$  is given by

$$r^* = \frac{c(S - A)}{v - c(S - A)} - \frac{1}{2}\phi. \quad (14)$$

It remains to verify that asset managers strictly prefer to sell when  $r > r^*$  and strictly prefer to hold when  $r < r^*$ . Both propositions follow from the monotonicity of the payoff (equation 3).

The monotonicity of the payoff difference  $u(x) - w(x)$  implies that the switching strategy around  $r^*$  is the unique dominance-solvable equilibrium in the sense that it is the only equilibrium that survives the iterated deletion of strictly dominated strategies (Morris and Shin, 2003, section 2). Therefore, the solution given by equation (14) is the complete solution in that there is no other equilibrium—whether in switching strategies or in any other strategies. We summarize the solution as follows.

**Proposition 2.** *There is a unique dominance-solvable equilibrium. In this equilibrium, all asset managers use the switching strategy around  $r^*$  defined by equation (14), selling the risky bond when  $r > r^*$  and holding when  $r \leq r^*$ .*

We note some properties of the solution. First, the threshold return  $r^*$  is decreasing in  $\phi$ . Therefore, the worse is the last-place aversion of the asset managers, the more jittery they become and the lower is the interest rate at which they jump from holding the risky bond to selling out.

Perhaps more important is the effect of changes in  $A$ , the size of the asset management sector. When the asset management sector is large relative to the household investors, the price impact of concerted sales is large. The strategic interaction between asset managers is thus heightened. To use our analogy with the musical chairs game, a larger asset management sector means that the musical chairs game becomes more competitive. There is more at stake in coming last in the game, so that asset managers are willing to jump ship at a lower threshold interest rate.

The impact of the asset management sector can be seen in several features of our solution. The larger is  $A$  relative to the total stock  $S$ , the higher is the market price  $p$ . As  $A$  increases, the risk premium of the risky bond becomes more compressed. The risk premium when the size of the asset management sector is  $A$  is given by

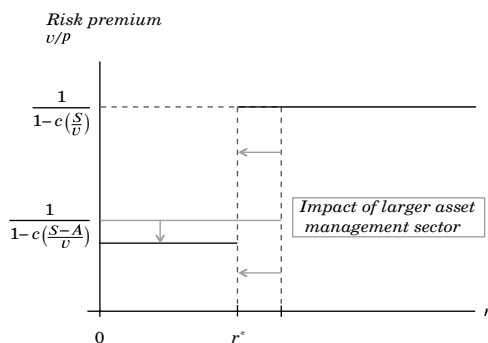
$$\frac{v}{p} = \frac{v}{v - c(S - A)}, \quad (15)$$

which is decreasing in  $A$ . Consequently, a large asset management sector can be used by the central bank to keep the risk premium compressed.

However, there is a tradeoff that comes from the larger asset management sector. We see from our solution for the threshold interest rate  $r^*$  in equation (14) that the threshold interest rate is also decreasing in  $A$ . This means that the economy will jump to the high risk premium regime at a lower value of interest rates.

Figure 3 illustrates the effect of a larger asset management sector. Large  $A$  entails a lower risk premium in the low risk premium regime, but the jump to the high risk premium regime happens at a lower level of the interest rate. Thus, when the risk premium jumps at the trigger point, the jump will be larger.

**Figure 3. Risk Premium and Critical Threshold  $r^*$  as a Function of the Size of Asset Management Sector**



Turning the comparison around, if we interpret the benchmark index realization  $r$  as a market interest rate, then there is an upper bound to the size of the asset management sector for any level of the market interest rate that is consistent with the low risk premium regime. From the expression for the critical threshold  $r^*$  given by equation (14), for the economy to be in the low risk premium regime, we need

$$r < r^* = \frac{c(S-A)}{v-c(S-A)} - \frac{1}{2}\phi. \quad (16)$$

This gives us an upper bound for  $A$  for the low risk premium regime, namely,

$$A < S - \frac{\phi v}{2c + \phi v}. \quad (17)$$

So far, we have assumed that  $A$  is exogenous. If instead we suppose that  $A$  is growing in the low risk premium regime, then equation (17) represents the relationship between the feasible size of the asset management sector and the interest rate  $r$ . As  $A$  grows, the central bank can maintain low risk premiums by keeping the interest rate low. Once the bound is reached, the central bank must reduce interest rates further to accommodate the growth in  $A$ . During this process, the risk premium continues to become compressed.

By accommodating further increases in  $A$ , the central bank is backing itself into a corner, as shown in figure 3. The risk premium gets compressed as  $A$  grows, but the threshold point moves down. When, eventually, the central bank has to reverse course and raise interest rates, the jump will happen at a lower interest rate, and the jump in risk premium will be that much larger.

We conclude this section by identifying key features of the model. First, we have assumed that strategic complementarities arose for asset managers because of relative performance concerns—more specifically, last-place aversion. There are many reasons why asset managers might be concerned about the actions of money managers. Short-run concerns (in addition to long-run performance) would immediately give rise to the payoffs above. Following Morris and Shin (2004), we might think that while asset managers would like to perform well in absolute terms, they need to attain some minimum return or they will be fired. Relatedly, following Parlatore (2016), if funds rely on implicit or explicit guarantees from other institutions, then “breaking the buck” will require interventions and thus will give another reason for a performance threshold. Finally, Chen, Goldstein, and Jiang (2010) examine the role of classical bank-run payoffs in the context of equities funds, while Goldstein, Jiang, and Ng (2015) consider an analogous exercise for bond funds. If redemptions reduce investors’ returns, then withdrawals by some investors provide incentives for others to withdraw. Our analysis is robust to the exact form of the agency frictions giving rise to strategic complementarities. There is a rich set of results in the literature on mutual fund flows, with the evidence pointing to investor redemptions being reinforced by asset manager sales (see Raddatz and Schmukler, 2012; Shek, Shim, and Shin, 2015). More broadly, our paper adds to the discussion on the procyclicality of the asset management sector (see Bank of England, 2014; Burkart and Dasgupta, 2015).

Second, runs occur in our model when there are changes in the return on short-run assets. We assumed that there was a small degree of heterogeneity in beliefs about those returns. However, all that matters for the global game equilibrium is that there is some heterogeneity in beliefs about some payoff-relevant parameter. As long as this is the case, small changes in returns to short-run assets can give rise to large shifts in funds.

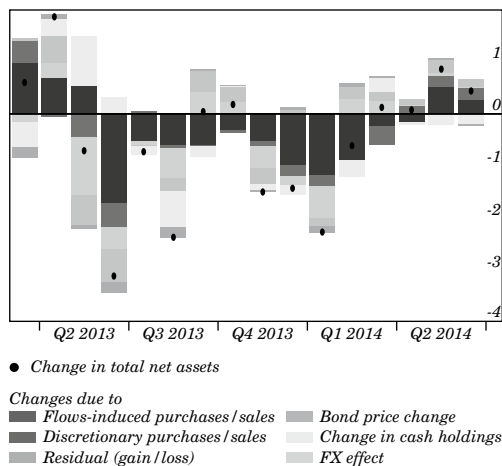
## 2. DYNAMICS

The model described in the previous section focused on the behavior of asset managers, holding fixed the assets  $A$  invested in the sector. We now want to complete the model by discussing how investor funds flow into the asset management sector and redemptions from the sector. There are four stylized facts we would like to capture.

First, there is interaction between investor flows and the short-run coordination problem of asset managers. In particular, just as there is an agency friction in how funds are managed within the asset management sector, there is also an agency friction in how investment managers decide how much to invest in managed bond funds, and there are important interactions between these frictions. Figure 4 below from Shek, Shim, and Shin (2015) shows that investor redemptions from emerging market bond funds and discretionary positions of the funds move together.

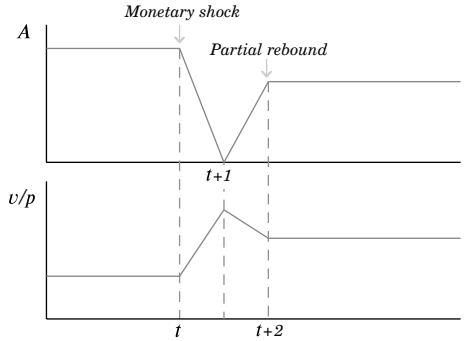
Second, there is a tendency for the asset management sector to be endogenously at a tipping point, where the size of the asset management sector gives rise to a low but positive risk premium. Under the analysis of the previous section, there is a tendency for a run to occur at this tipping point in response to small changes.

**Figure 4. Breakdown of Monthly Changes in Net Asset Value**  
Sum over 14 global EME local currency bond funds,  
in billions of US dollars



Sources: EPFR; authors' calculation.

**Figure 5. Persistent Impact of Increase in Interest Rate above Threshold  $r^*$**



Third, in a period of low interest rates and thus low expected returns in the short-run asset sector, there is a steady flow into the asset management sector. However, and fourth, the outflow when interest rates reverse jumps with the movement of asset manager’s positions, but with “bounce back” where large sales from asset funds are followed by reversals that are not as large as the original outflow (Feroi and others, 2014). See figure 5 for a stylized depiction of such reversals.

How can we explain these four features simultaneously? We assume—consistent with the theory and evidence in Vayanos and Woolley (2013)—that reputational concerns of investment managers give rise to a tendency to allocate funds across sectors based on past performance. This is because investment managers cannot identify whether high or low performance of the sector is sector-specific or reflects overall performance of long-run returns in the economy. This gives rise to momentum in performance and flows. As managers learn, there is a tendency for flows to reverse, giving rise to prices returning to fundamental values and reversal in asset prices. We are now assuming a slow moving friction in fund flows into the management sector which then interacts with the asset managers’ behavior. We write  $A^*$  for the critical size of the asset management sector—identified in the previous section—where the risk premium is driven down to 0. Thus, we consider a reduced-form description of asset flows where

$$A_{t+1} = \lambda(A_t - A_{t-1}) + \mu(A^* - A_t)$$

for some constants  $\lambda$  and  $\mu$ , where the first term in the equation corresponds to the momentum, with funds moving into the sector, resulting in short-run rising prices and more funds moving into the sector. But there is also a long-run effect—captured by the second term—for funds to move into the sector as long as the risk premium is positive.

This model will give rise to the stylized features above. First, the momentum effect will give rise to comovement of asset managers' positions and investment managers' movements of funds. Second, funds will move into the sector and approach  $A^*$ , the critical point at which runs will occur. Third, as money flows into the sector, both terms in the above difference equation will act in the same direction, with short-run performance and long-run concerns of investment managers moving in the same direction. Finally, when fund managers all exit, there are dramatic effects on the risk premium. This will create an incentive for asset managers to jump back in to attain good relative performance. However, redemptions by investors in response to the short-run price change will validate the price movement and the bounce back will not equal the initial decrease in prices.

### **3. IMPLICATIONS FOR MONETARY POLICY**

Monetary policy is a powerful tool for influencing financial conditions. In particular, the commitment to lower interest rates into the future raises the prices of financial assets and compresses risk premiums, with consequences for real economic activity. In this respect, our analysis shares the conclusions from orthodox monetary analyses on the impact of forward guidance, especially the commitment to lower policy rates in the future.<sup>3</sup>

Our analysis parts company with orthodox monetary analysis on whether forward guidance and commitment to future rates is a policy that can be fine-tuned or reversed smoothly when the time comes to change tack. The market is not a person, and market prices need not correspond to the beliefs of that person. In our global game analysis, monetary policy works through the risk-taking channel, that is, through the risk-taking behavior of different sections of the market. Monetary policy affects risk premiums directly, so that the impact on

3. See Woodford (2012) for a forceful statement of this argument.



real economic activity flows through shifts in risk premiums, as well as shifts in the actuarially fair long-term rates.

One lesson from our analysis is that coordination problems can induce jumps in market prices, and quantities matter in the determination of the threshold points. The size of the asset management sector, as encapsulated by the holding of risky bonds  $A_t$ , determines the risk premium ruling at date  $t$ , as well as the threshold point for the benchmark index  $r_t$  when a sell-off occurs. We can interpret the benchmark index as a market interest rate, and monetary policy will impinge on the coordination problem among asset managers through the determination of the benchmark index  $r_t$ .

To the extent that quantities matter, the lesson is similar to the one from the 2008 financial crisis. Just as we would be concerned with a build-up of leverage and the size of bank balance sheets, we should similarly be interested in the growth of holdings of fixed-income securities of buy-side investors. The central bank can compress risk premiums further by committing to low future interest rates and accommodating an increase in the size of the asset management sector. Nevertheless, there is a trade-off. By accommodating further growth of the asset management sector, the central bank is trading a lower risk premium today for a more disruptive unwinding at a lower threshold interest rate when, eventually, the central bank has to reverse course.

On the empirical front, our model suggests that observing the joint movements of price changes and quantity changes is informative about the risk-taking of market participants. In particular, the model predicts the joint occurrence of price declines and sales of the risky bond. Thus, rather than cushioning shocks, the demand response tends to amplify shocks.

Feroli and others (2014) conduct a vector autoregressive (VAR) analysis of price and valuation changes for risky fixed income categories, such as mortgage-backed securities, corporate bonds, and emerging market bonds. They find price declines are followed by sales, and sales are followed by further price declines. Consequently, the accumulated impulse responses of price and quantity shocks are large.

An implication for the conduct of monetary policy is that the separation of monetary policy and financial stability policy is much harder to accomplish than is often suggested. Under the risk-taking channel, monetary policy affects the economy through shifts in the risk-taking behavior of market participants. As such, any monetary policy shock is also a shock to risk-taking and hence is inseparable from the concern for financial stability.

Discussions of financial stability after the crisis have been conditioned by the experience of the crisis itself. After neglecting the dangers of excessive leverage and maturity mismatch before the crisis, policymakers have given them central importance since the crisis. As is often the case, accountability exercises usually address known past weaknesses, rather than asking where the new dangers are.

Our analysis suggests that the risk-taking channel may operate through financial institutions that are not leveraged. Asset managers typically have very low effective leverage and therefore do not become insolvent in the way that banks or highly leveraged hedge funds do. However, this does not mean that they do not have an impact on the economy. As the protagonists in financial market dynamics shift from banks to asset managers, researchers need to give more attention to the marketwide impact of institutional investors.

The risk-taking channel of monetary policy affects risk premiums directly, with effects on corporate investment and household consumption. These shocks could have a direct impact on GDP growth through subdued investment and consumption. The potential impact on the real economy is tangible, even though no institutions fail and no financial institutions are bailed out using public funds. Asset managers are not “systemic” in the sense defined in the Dodd-Frank Act as they are not “too big to fail.” Nor are there easy regulatory solutions that would substitute for central bank interest rate policy in affecting risk-taking.

Thus, the most important implication of our analysis is that monetary policy and financial stability policy cannot be separated. They are, effectively, the same thing.

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