Incentives in the Market for Mortgage-Backed Securities*

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Abstract

We study the nonprime (subprime and alt-A) business model of making and then securitizing risky home loans involving little or no borrower equity to marginal borrowers. In our model, originators make nonprime loans, bankers investigate loan quality (due diligence) and then securitize a fraction of the loans to meet money managers' demand for mortgage-backed securities (MBSs), default risk is increasing in supply, money managers compete in a tournament for investor funds, and investors rely on money managers' past performance relative to a benchmark as a signal of their skill. We show that bankers may conduct less due diligence as loan volume (and risk) increases, some money managers will buy overpriced MBSs, money managers may conduct less diligence as risk increases and have incentives to understate risk to investors, an asset price bubble may form, especially if investors underestimate risk or money manager diligence or money managers underestimate banker diligence, and the bubble will tend to grow as long as economic times remain good. In equilibrium, bankers rationally buy and securitize large amounts of high downside risk MBS, with little or no investigation, and rational money managers purchase them. Legal due diligence requirements for bankers and money managers can reduce the size and probability of a possible bubble.

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1 Introduction

High default rates on nonprime (subprime and Alt-A) mortgage loans and securitizations are widely viewed as a central trigger for the financial crisis. In hindsight, the business model of making and securitizing home loans involving little or no borrower equity, low or no documentation of buyer assets and income, and high and escalating ratios of loan payments-to-asserted income, to people with suspect credit, while counting on home price appreciation to provide the means to repay, appears odd. One view is that subprime lending was an "irrational exuberance" (Shiller, 2006). A less charitable view is that some actors knew the models they relied on were flawed, but proceeded anyway, because of large near-term payoffs. A more charitable view, pursued here, is that all actors behaved rationally given their incentives and what was known at the time.

In our model, the originators who made nonprime loans, the bankers who securitized them, the money managers who bought the structured securities, the rating agencies who supplied the critical AAA ratings, and many of the investors who invested with money managers who bought the securitized instruments had incentives — arising from agency costs and externalities — to underinvestigate a known tail risk and minimize its probability and expected size. This is not a "rational speculative bubble," inflated knowingly by smart investors who believe they can get out before the bubble bursts (e.g., Brunnermeier and Nagel, 2004). Nonprime securitizations barely traded, especially before 2006, so most purchasers of securitized mortgages had no way out. Nor need it be certain at the time, or even probable, that we are in a bubble. Instead, there is a risk, perhaps small, of a bad outcome, but each relevant actor has an incentive to underinvestigate that risk, to underdisclose the risk to others, and to acquire the securities despite the risk.

In our model, originators who make nonprime loans need financing and want to shed risk, and securitization provides both. Bankers are expected to investigate loan quality (a practice known as due diligence). If their diligence returns a good quality signal, they securitize a fraction of the loans to meet money managers' demand for mortgage-backed securities (MBSs). If the MBSs later default, the banker loses valuable reputation. Default risk is increasing in loan supply. Money managers compete in a tournament for investor funds, and investors rely on money manager past performance, relative to a benchmark of similarly risky securities, as a signal of money-managing skill. We show that bankers may conduct less due diligence as loan volume (and risk) increases, because expected reputation loss in bad future states of the world is outweighed by profit from securitizing in future good states. Some money managers will buy MBSs, even if they are overpriced, because they gain more in expectation from winning the tournament in future good states than from losing it in future bad states. Money managers may conduct less diligence as risk increases and have incentives to understate risk to investors. An asset price bubble may form, especially if investors underestimate MBS risk or money manager diligence or if money managers underestimate banker diligence. The bubble will tend to grow as long as economic times remain good.

In equilibrium, bankers rationally buy and securitize large amounts of high downside risk MBS, with little or no investigation, and rational money managers purchase them. There is no simple cure for the resulting risk of an asset price bubble, but legal due diligence requirements for bankers and money managers can reduce the size and probability of possible future bubbles. While we model MBS, the core of the model readily generalizes to other securities.

Section 2 develops our main model in a one period economy. Section 3 discusses various extensions. These include a multiple-period economy, optimal broker and money manager diligence, optimal legal sanctions for due diligence failures, and incorporating into the model rating agencies which assess risk on behalf of money managers but have their own incentives to underinvestigate and understate risk.

2 Main Model

2.1 Securities and Market Participants

We model a one-period economy in which a loan originator issues loans, that are then securitized and sold through an intermediary (i.e., a broker or an investment banker) to a large number of money managers. Throughout, we assume for simplicity and without loss of generality that the interest rate in the economy is zero. The securities are in short supply because they are created out of cash flows that the loan originator expects to receive from borrowers. The loan originator controls the fraction of the cash flows that are resold via the broker. Originators, brokers, and money managers all understand that a larger fraction must include riskier cash flows.

More specifically, the total cash flows that the originator receives from the unit mass of borrowers is given by

$$\tilde{m} = \begin{cases} 1, & \text{prob. } 1-\phi \\ \tilde{\delta}, & \text{prob. } \phi, \end{cases} \tag{1}$$

where $\phi \in (0,1]$, and $\tilde{\delta}$ is a random variable with a probability density function $f(\cdot)$, cumulative density function $F(\cdot)$, and whose support is in $[0,1]$. We can think of $\tilde{m}$ as the fraction of the money lent (in present value terms) that the originator will receive from the borrowers. With probability $1-\phi$, the originator receives the entire money that he has lent; with probability ϕ, some of the borrowers default on their loan and the originator receives only a fraction $\tilde{\delta}$ of the total money that he has lent. As such, $1-F(\delta)$ can be interpreted as the fraction of borrowers who cannot afford to repay their loan when the economy reaches a state of the world in which default occurs.[1]

[1] Although this analogy assumes that borrowers either repay their loan in full or pay nothing in default, the model

In an effort to obtain the financing needed to make additional loans, and to rid his books of the cash flow risk that comes with the risk of default, the originator sells, through a broker, a senior claim on the cash flows from $\tilde{m}$ in the form of $s \in (0,1]$ securities that each pay $\tilde{t}_s = \min\{\frac{\tilde{m}}{s}, 1\}$. Together these s securities aggregate to a debt claim that promises s against the underlying cash flows $\tilde{m}$, that is, each security is a fraction $\frac{1}{s}$ of $\min\{\tilde{m}, s\}$. Using (1), it is easy to verify that $\tilde{t}_s$ pays at least $t \in [0,1]$ with probability $H_s(t) \equiv (1-\phi) + \phi\big[1 - F(st)\big] = 1 - \phi F(st)$. In particular, the securities default with probability $1 - H_s(1) = \phi F(s)$. Since $F(s)$ is increasing in s, the newly created securities are riskier when they are issued in large supply (when s is large) and when the underlying mortgages are more likely to default (when ϕ is large). When $\tilde{\delta}$ is a continuously distributed random variable, the new securities are practically riskless when there are only a few of them (i.e., when s is close to zero), since $F(0) = 0$. The following lemma shows that the payoff that holders of these securities can expect is also decreasing in s and ϕ.

Lemma 1. *The expected payoff of* $\tilde{t}_s$ *is*

$$\mathrm{E}\big[\tilde{t}_s\big] = 1 - \frac{\phi}{s}\int_0^s F(\delta)d\delta, \tag{2}$$

which is decreasing in s *and in* ϕ*.*

Although we do not model the originator's loan-making activities, it is reasonable to assume that this originator operates in a less constrained fashion when he can repackage and sell a large portion of the cash flows that he receives from borrowers. For example, doing so allows the originator to issue more mortgages and thereby collect more commission revenues. To capture this, we assume that the originator is able to generate an extra $\alpha\beta(s)$ of revenues when he successfully sells off s securities, where $\alpha > 0$, $\beta(0) = 0$, $\beta(1) = 1$ and $\beta(s)$ is increasing in s for $s \in [0,1]$. Thus, as long as the originator receives a fair price for each security $\tilde{t}_s$, he is willing to pay a broker up to $\alpha\beta(s)$ to package and resell s securities.[2] These quantities (price of the security, marginal value of selling additional securities, etc.) will be part of the originator's decision about the optimal portion of the underlying cash flows to sell.

To sell claims against its loans, the originator goes through a broker who serves as a gatekeeper. The broker is expected, in accordance with industry custom, to conduct a "due diligence" investigation of the risk of the securities and to refuse to participate in issuing securities backed by mortgage loans if he finds the securities to be "too risky." More specifically, the banker can gather information about the risk of default and payoff that can be expected from $\tilde{t}_s$, and to decline to

accommodates situations in which some borrowers repay their loans partially.

[2]Note that a similar functional form would result if we instead assumed that the originator is risk averse.

participate if this downside risk is deemed to be excessive.[3] By exerting effort $e \in [0,1]$ at an effort cost of $C(e) = \frac{c}{2}e^2$, the broker learns with probability e if the original mortgage pool $\tilde{m}$ is about to default. More technically, we assume that the broker observes a signal $\tilde{\imath}$, which is either good ($\tilde{\imath} = 1$) or bad ($\tilde{\imath} = 0$), where

$$\Pr\{\tilde{\imath} = 0 \mid \tilde{m} < 1\} = e = 1 - \Pr\{\tilde{\imath} = 1 \mid \tilde{m} < 1\}, \tag{3}$$

$$\text{and} \quad \Pr\{\tilde{\imath} = 1 \mid \tilde{m} = 1\} = 1. \tag{4}$$

In equilibrium, it will be optimal for the broker not to participate when he observes $\tilde{\imath} = 0$. In that event, the originator retains the loans. We assume that the broker captures the entire surplus from his interactions with the originator; that is, the broker charges $\alpha\beta(s)$ to approve and securitize loans in amount s.

Money managers cannot observe the broker's diligence effort. However, they can punish a broker who approves securities that default ex post by being less willing to buy other securities offered by that broker. The incentive for the broker to exert costly effort and cancel the issue when he observes $\tilde{\imath} = 0$ comes from the loss of reputation that he suffers if he approves the issue and the securities end up defaulting (i.e., $\tilde{t} < 1$). To capture this force, we assume that a default comes with a utility penalty of $\rho \in [0, c)$ for the broker.[4] Thus, in his decision to exert effort, the banker must weigh the fees, $\alpha\beta(s)$, that he receives from approving the issue against the cost ρ in the event that the issued securities default. The following lemma characterizes this decision.

Lemma 2. *With an issue of size s, the broker's optimal effort choice is $e = \max\{0, e(s)\}$, where*

$$e(s) \equiv \frac{\phi}{c}\left[\rho F(s) - \alpha\beta(s)\right]. \tag{5}$$

If the broker's reputation cost is sufficiently small relative to the payoff from proceeding, in the sense that the broker would choose to proceed even after conducting diligence and receiving a bad signal, the broker is better off exerting no diligence effort and thus never observing $\tilde{\imath} = 0$. Thus, in equilibrium, if the broker exerts positive effort, the broker will approve the issue only if $\tilde{\imath} = 1$.[5] We can see from (5) that the broker exerts positive effort only when $\rho F(s) > \alpha\beta(s)$.

Both the reputation-based incentive to engage in diligence, represented by $\rho F(s)$, and the fee-based incentive to proceed with the offering despite the risk, $\alpha\beta(s)$, are increasing in offering size s.

[3] We could equivalently assume that this function of the broker is performed by a rating agency that reports directly to the broker. We address below the role of a rating agency whose work supplements, instead of replacing, the broker's due diligence.

[4] As it will become clear later, the assumption that $\rho < c$ ensures an interior solution for the broker's effort. This simplifies the analysis and exposition without affecting the results.

[5] Note also that, although brokers can potentially lie to money managers, there is no point to do so. A broker who expects to lie, if he receives a bad signal, is better off not investigating and avoiding the cost of investigation in the first place. Thus, brokers will only investigate when they expect to report truthfully.

Which effect dominates will depend on the relative shapes of the default risk function $F(s)$ and the payoff function $\beta(s)$. Finally, when $e(s)$ is positive, we can also see from (5) that the broker's effort is increasing in ϕ: the broker works harder to protect his reputation as the underlying pool of mortgages is riskier.

When the broker exerts some effort (i.e., $e > 0$) and is known to approve the issue if and only if he observes $\tilde{\imath} = 1$, then the posterior distribution of loan quality $\tilde{m}$ and the expected payoff of $\tilde{t}$, conditional on the issue being approved, are no longer given by (1) and (2) respectively. Given that the broker is more likely to observe $\tilde{\imath} = 1$ when $\tilde{m} = 1$ than when $\tilde{m} < 1$, the posterior distribution of $\tilde{m}$ experiences a first-order stochastic shift. The following lemma characterizes this posterior distribution and derives the expected payoff of the s securities, which we denote by $\tau(e, s)$.

Lemma 3. *Suppose that the broker exerts effort $e > 0$ to investigate loan quality and approves the issue if and only if $\tilde{\imath} = 1$. Then the posterior distribution of the underlying pool of mortgages is given by*

$$\{\tilde{m} \mid \tilde{\imath} = 1\} = \begin{cases} 1, & \text{prob. } \frac{1-\phi}{1-e\phi} \\ \tilde{\delta}, & \text{prob. } \frac{(1-e)\phi}{1-e\phi}. \end{cases} \tag{6}$$

Each security in the approved issue of size s has default probability (of paying off less than one) $\frac{(1-e)\phi}{(1-e\phi)}F(s)$, and has an expected payoff of

$$\tau(e, s) \equiv \mathrm{E}\big[\tilde{t}_s \mid \tilde{\imath} = 1\big] = 1 - \frac{(1-e)\phi}{(1-e\phi)s}\int_0^s F(\delta)d\delta. \tag{7}$$

The securities can be bought by risk-neutral money managers who compete for customers through their fund's performance and the reputation that it generates. Since $\tilde{t}_s \leq 1$, the price of each of the s newly issued securities, denoted by p and to be set in equilibrium, will always lie in $(0, 1)$. We assume that there is a unit mass of money managers who are each endowed with the same positive amount of money,[6] and who compete for customers through their fund's performance and associated reputation. When the loan originator's issue is approved by the broker, each money manager is free to invest in one and only one of the newly issued risky securities.[7] Alternatively, money managers can invest in a perfectly riskless security, a t-bill, which pays a sure return of zero over the period and is available in infinite supply. In order to capture the idea that money managers face tournament-like payoffs, we assume that a payoff of $w > 0$ is split equally across the mass of managers with the top fund performance at the end of the period.[8]

[6]It will soon become clear that we only need to assume that each money manager has enough money to afford one of the s new securities issued by the originator.

[7]The assumption that every money manager can only invest in one of the newly issued securities is made purely for simplicity. It ensures that money managers do not seek to take infinite positions in the risky security, something that could equivalently be the result of risk aversion.

[8]See Lazear and Rosen (1981), Malcomson (1986), Bhattacharya and Guasch (1988), and Brown, Harlow and

2.2 Equilibrium

The money managers choose which security to invest in by comparing their expected returns. Interestingly, as we show, some money managers always choose to invest in the newly issued securities, regardless of their expected return. That is, there are no equilibrium in which all money managers invest only in the t-bill. To see this, assume that the entire mass of money managers chooses to invest in the riskless t-bill, and consider the problem of one atomless manager. If this manager invests in the t-bill as well, then he will receive $\frac{w}{1}$ for sure at the end of the period since every single fund will generate a payoff of one at the end of the period, and so every manager shares the tournament payoff. Alternatively, the manager can invest in one of the risky securities, each of which has a payoff of $\tilde{t}_s$. In the event that this risky security pays off more than its price $p \in (0,1)$, which occurs with strictly positive probability since $\Pr\{\tilde{t}_s > p \,|\, \tilde{\imath} = 1\} > \Pr\{\tilde{t}_s = 1 \,|\, \tilde{\imath} = 1\} = 1 - \frac{(1-e)\phi}{(1-e\phi)} F(s) > 0$, the manager receives the entire payoff w. Because he is atomless, this is infinitely valuable to him. Clearly therefore, his decision is to invest in the risky security and this decision is likely to be imitated by other money managers. Thus the conjectured equilibrium in which all money managers invest in the t-bill is impossible.

In order to characterize the equilibrium demand for the newly issued securities, we must calculate the probability that a money manager generates the highest return amongst his peers. This probability, calculated in the following lemma, depends on three crucial quantities whose equilibrium values will be derived later: the supply s of the risky securities, the effort e exerted by the broker before approving the issue, and the price p that money managers pay to acquire the security.

Lemma 4. *Assuming that the broker exerts effort e, a money manager who opts to purchase one of the s newly issued securities for a price p wins the money management tournament with probability*

$$q(e, s, p) \equiv 1 - \frac{(1-e)\phi}{(1-e\phi)} F(sp). \tag{8}$$

Furthermore, $q(e, s, p)$ is increasing in e, and decreasing in s and p.

The comparative statics with respect to e, s and p make intuitive sense. First, securities are less likely to default when the broker exerts a lot of effort before approving them; as such, because the money manager is more likely to receive a payoff of one after paying $p < 1$ for the security, he is more likely to beat the riskless rate of return (of zero). Similarly, the securities are riskier when a larger portion of $\tilde{m}$ is issued and so, for the same price and same effort by the broker, $\tilde{t}_s$ is less likely to pay off at least p. Finally, of course, the higher the price of the security, the less likely the security will pay off more than p.

Starks (1996) for more detailed models of tournaments between multiple agents.

Because the tournament payoff w must be shared between more managers when a large fraction of them hold risky securities increases and $\tilde{t}_s > p$, the appeal of the risky securities decreases with the number of money managers who hold it. In equilibrium, the managers must be indifferent between investing in $\tilde{t}_s$ and investing in the riskless rate. The following proposition derives the equilibrium fraction of money managers who choose to invest in the risky security. Given that money managers can only purchase one unit of the risky security, this fraction also represents the equilibrium demand for the newly issued securities.

Proposition 1. *Assuming that the size of the originator's issue is s, that each security sells for p, and that the broker exerts an effort of e to investigate the issue, the fraction of money managers who invest in the risky security (i.e., the demand for the risky security) is given by*

$$\lambda(e,s,p) = \frac{1}{2}\left(1 + \frac{w}{\Delta(e,s,p)}\right) - \sqrt{\frac{1}{4}\left(1 + \frac{w}{\Delta(e,s,p)}\right)^2 - q(e,s,p)\frac{w}{\Delta(e,s,p)}}, \tag{9}$$

where $\Delta(e,s,p) \equiv p - \tau(e,s)$. Furthermore, $\lambda(e,s,p)$ is increasing in e, decreasing in s and p, $\lambda(e,s,0) = 1$, and $\lim_{p\to\infty} \lambda(e,s,p) = 0$.

It is intuitive and clear from the proof of Proposition 1 that the equilibrium fraction of money managers who purchase the newly issued securities, as given by (9), is increasing in the probability $q(\cdot)$ that each wins the tournament. Similarly, it is straightforward to verify that (9) is decreasing in $\Delta(\cdot)$, keeping everything else fixed. The intuition for this result comes from the fact that $\delta(\cdot)$ represents the price premium over the risky securities' fair price, $\tau(\cdot)$. When this premium is high, money managers are more reluctant to invest in these securities, as their return is then not as likely to exceed the riskless rate. When this premium is zero (i.e., when securities are priced fairly in financial markets), the equilibrium demand for the risky securities reduces to $\lambda(e,s,p) = w$: the money managers' demand is directly proportional to how much they stand to gain when they win the tournament.

The comparative statics with respect to p are especially useful in Proposition 1. In particular, the fact that, for any s, the demand $\lambda(\cdot)$ is decreasing in p and that all (none) of the money managers purchase the risky securities when the price is zero (infinity) guarantees that there will be a unique price $p \in (0,\infty)$ that equates supply and demand. This equilibrium price, which is the unique $p^*(s)$ that solves $\lambda\big(e(s), s, p^*(s)\big) = s$, is characterized in the following proposition.

Proposition 2. *The equilibrium price $p^*(s)$ is decreasing in s, and it is greater (smaller) than the fair price $\tau\big(e(s), s\big)$ if and only if the supply s of risky securities issued by the originator is smaller (greater) than w.*

When money managers have a lot to gain from ranking amongst the top short-run performers (i.e., when w is large) and when the supply of securities that enhance their performance in most states of the world is limited (i.e., when s is small), the price of these securities can exceed the rational fair price that their eventual payoff should command. In essence, these securities are valued by money managers not just for their expected returns, but also for the properties of their return distribution. That is, in the money managers' competition for investors, the large probability of generating a few extra basis points weighs more heavily than the small likelihood of a disastrous return.

This result is highly reminiscent of the market for mortgage-back securities (MBS) prior to the 2008 financial crisis. Indeed, by cleverly tranching pools of cash flows received from mortgage payments, loan initiators were able to shift more and more of the downside risk of the resulting mortgage-backed securities into fewer and fewer states of the world. As a result, these securities appeared to pay a nearly riskfree rate that is greater than the rate on treasury securities, but the improbable downside risk came with extreme negative shocks. The large value of $q\big(e(s), s, p^*(s)\big)$ associated with these securities made them very attractive to money managers, who have strong incentives to match the performance of other money managers by generating the few extra basis points that seemed to come with MBS. In this light, the meltdown in the value of nonprime securities during 2007-2008 may have simply been akin to an unlikely but not impossible negative realization of $\tilde{m}$.

3 Extending the Model: Textual Overview

Small pieces of the model are specific to subprime, but many aspects are not. We will discuss extensions to collateralized loan obligations contemporaneous with nonprime mortgage securitization, dot-com and telecom shares in the late 1990s, junk bonds issued to finance leveraged buyouts in the 1980s, and offerings by individual repeat borrowers.

3.1 Model Core and Challenges

The textual overview of the model goes beyond the formal model presented above. It reflects where we plan to go, rather than where we are currently. In building the model, we face the usual tradeoff. On the one hand, a model with many moving parts may describe reality well, but may not have much empirical content nor provide much guidance for intuition. On the other hand, a model that is too simplistic may not capture all the relevant economic forces. The model we sketch below still has too many moving parts and so our our goal is to find a happy medium between it and the core model of section 2.

More specifically, we will consider adding individual pieces to our core model as feasible, including: (i) multiple competing bankers; (ii) externalities from banker and money manager behavior; (iii) rating agency incentives and externalities from rating agency behavior; (iv) institutional investor incentives in choosing money managers; and possibly (v) originator incentives. We envision a set of "nested" partial equilibrium models, covering each of the principal actors, which share core features and assumptions, but are solved separately.

3.2 All Actors

All actors understand that there is a small risk of a very bad future economic state of the world which increases with the volume of mortgage securities. However, they are unsure as to how large this risk is, or how bad the bad state outcome will be. This captures the dynamic element in which the larger the mortgage securitization market, the lower the average quality of securitized loans, and the more likely a subsequent bad outcome becomes. However, each loan originator has a small (i.e., infinitesimal in the model) market share and so does not affect the overall supply of mortgage-backed securities in the economy. This in turn implies that loan originators do not internalize the impact of making more bad loans on the risk of a crash. So too for each banker, money manager, and investor.

3.3 Loan Originators

Loan originators make mortgage loans, resell them to bankers, and earn fee income by doing so. The main model above assumes that originators have made a fixed supply of loans, and bankers decide how much of these loans to securitize. Equivalently, the market scale s could capture loan volume, with most or all loans being securitized, and originators responding to higher demand by originating riskier loans.

The main model also assumes that loans are fairly priced so that, banker fees aside, money managers receive sufficient upside in good states to offset the downside risk in bad states. An extension would allow originators to respond to higher demand by originating "bad" loans, defined as loans with negative expected value: the present value of borrower payments is smaller than the sum of the loan amount + present value of all transaction costs (origination and transaction). Bad loans will either have lower expected payoffs than good (zero present value) loans, through a combination of lower returns, conditioned on future state, or lower (higher) odds of a good (bad) future. Yet if demand exceeds the supply of good loans, money managers will still purchase securities that provide a blend of good and bad loans, and bankers will purchase and securitize those blends.

Originators will originate any loan they can resell, good or bad, unless constrained by "skin in the game" — long-term costs of making bad loans which exceed their fee income (both current income and expected income from refinancing loans in good future states). Originators prefer not to have skin at risk, can choose which banker to sell loans to, and will sell to the banker who offers the best deal, as measured by the present value difference between fee income and expected loss on skin.

3.4 Bankers

In a world with both good and bad loans, bankers can exclude bad loans from the purchased pool by requiring originator skin or conducting a costly "due diligence" investigation of loan quality. However, as with their incentives to investigate the risk of a bad outcome in the core model of section 2, the degree of diligence will depend on the tradeoff between fee income from selling more securities and reputational cost if a banker sells bad loans, and a bad outcome results.

Originator skin and banker diligence are substitutes, our core model focuses on diligence. This captures the concept that bankers are "reputational intermediaries," who are expected to conduct diligence, under industry practice and legal rules governing securities offerings, and disclose adverse information to money managers. They will suffer a large cost if they fail to do so and a bad future state occurs. This cost comes from a combination of lost reputation and legal liability; we focus on reputation. The core model assumes that money managers do not observe banker diligence. They infer that diligence has (has not) occurred if the future state is good (bad, without a warning from the banker). Money managers understand that banker diligence is costly and that not all bankers engage in diligence. They estimate the likelihood and degree of banker diligence through observing occasional "diligence failures" (bad states, without advance banker warning).

Banker diligence involves two potential externalities, that reduce banker incentives to investigate. First, money managers understand that all bankers have similar incentives. Thus, when they observe a diligence failure (no failure) by one banker, they update their estimates of the likelihood that other bankers have engaged in diligence. Thus, there is an externality in banker reputation — any one banker captures only part of the benefit of its own investment in reputation. Second, competing bankers will receive a negative quality signal issued by any one banker and can investigate and quickly copy the signal. Thus, if a banker reports a bad signal, it realizes only part of the industry gain in reputation from doing so.

3.5 Money Managers

In our core model, money managers compete in a tournament for investor funds by promising skill, and those who buy risky securities share equally in the payoff w if a good state results.

An alternative tournament structure would give money managers payoffs which depend on their alpha (i.e., their returns relative to a benchmark). Managers who take more tail risk achieve higher alpha in good states, but take a higher risk of a bad state. The main model assumes that money managers take risk signals from bankers, and form their own noisy opinions based on those signals. An extension would allow money managers to also either investigate risk themselves, or delegate the investigation to a rating agency. The degree of money manager investigation will depend on the cost of investigation, the gains in improved ability to detect future good or bad states, and the relative payoffs from good and bad states.

This investigation also involves an externality. Discovery by one money manager that the risk of a financial instrument is higher than as reported by a banker is valuable to other money managers as well. However, the manager cannot capture the spillover value of this information, and will often keep it confidential because of the tournament nature of money manager returns. This uncaptured positive externality results in a suboptimal level of diligence by all money managers together.

3.6 Investors

Investors hire money managers. They can observe past returns but not the tail risk taken by the money manager to achieve that return. Past returns could reflect skill or luck, investors are not sure which. In a multi-period extension of our core model, investors update their estimate of money manager skill based on past returns. Thus, investors over(under)-estimate money manager skill if past returns are good (bad). The longer the period of past high returns, the greater the investor overestimate of money manager skill. Thus, in such a multi-period model, investors choose to invest with either risky or safe money managers. Over a period of good returns, they gradually increase their allocation of assets to the risky managers, which fuels greater demand for these assets and a decline in asset quality,

3.7 Rating Agencies

Rating agencies are hired by bankers to provide information on tail risk to money managers. They are an oligopoly, with three competitors and large barriers to new entry, deriving from economies of scale, regulation, and reputation (Partnoy, 2006). Agencies compete for banker business in rating structured finance securitizations, and earn fee income by doing so. There is an annual flow of structured finance offerings, of which each agency has a share.

Ratings can be positive or negative, but bankers will purchase only positive ratings.[9] A positive rating provides a signal to money managers that the downside potential of the security (i.e., the combination of bad state probability and loss given a bad state) is below a standard risk threshold. A rating agency that negatively rates on a particular offering can expect to lose a fraction of its structured finance rating business. A rating agency will suffer a reputational loss if it provide a positive rating which is incorrect in hindsight (the future state of the world is bad), while its competitors provide a negative rating. However, if all three agencies provide similar ratings, the reputational loss to each will be reduced, i.e., pooling provides reputation insurance.

Rating agencies receive banker reports on risk, and can also engage in their own costly investigation of the accuracy of those reports. Depending on the relative gain from providing positive ratings and the reputational cost from providing a positive rating which is incorrect in hindsight, rating agencies may engage in no investigation and simply accept what bankers tell them, or may engage in some amount of investigation. Rating agency action involves an externality. The agencies intensely watch each other's actions. Competitors are informed about negative ratings and can investigate and decide whether to adopt a similar rating. Thus, an agency captures only part of the expected reputational gain from a negative rating. This externality reduces any one agency's incentive both to provide negative ratings and to investigate banker reports.

3.8 Generating a Bubble

A multi-period extension of our core model can generate a bubble. Assume that bankers persuade money managers to invest in nonprime securitizations, and that a good state ensues. Investor perception of the skill of risky managers will rise, and these managers will attract more funds and invest them in additional nonprime securitizations. Demand for nonprime securitizations, fueled by this past success, will rise, as it does in Proposition 1 when $\phi_u s$ increases and $\phi_d s$ decreases.

However, if there is a limited supply of good loans, bankers will meet rising demand by relaxing diligence and buying a larger proportion of bad loans. As long as the good times last, investors continually raise their estimates of money manager skill, money managers have ever more assets to invest, and bankers meet this demand by buying ever worse loans. Thus, average loan quality deteriorates over time. If investor demand is large enough, it can drive up house prices. Rising house prices strengthen investor beliefs in the skill of risky money managers, by producing positive observed returns while (unobserved by investors) increasing the risk of a bad state and the loss given a bad state.

[9] Alternatively the price on low-rating issue is so low that the associated commission is not worth the banker's effort and time.

3.9 Arbitrage

Arbitrage cannot directly drive down home prices, because there is no market for shorting homes. If securitizations trade, then arbitrageurs can affect trading prices, which would reduce the return reported by money managers, and might cause investors to raise their risk perceptions and limit the funds they provide to money managers who buy securitized loans. But arbitrage capital is in limited supply, especially for a new security whose true characteristics are uncertain.

For nonprime securitizations, a market in which arbitrageurs could short securitizations did not exist until early 2006, and even then this market (based on the ABX.HE index) was thin and noisy. Other arbitrage opportunities (e.g., shorting the bonds of originators) were limited. Moreover, if demand is rising, bankers can meet it by using "shorts" as a source of supply for "synthetic" mortgage securitizations, in which the payoff is based not on the performance of actual mortgage loans but instead on the performance of derivatives linked to mortgage loan performance. These synthetic securitizations both soak up short interest and meet money manager demand without further degrading loan quality. Lewis (2008) reports that bankers actively solicited short interest in mortgage securities, because they needed the shorts to offset the long positions in synthetic securitizations.

References

Bhattacharya, S., and J. L. Guasch, 1988, "Heterogeneity, Tournaments, and Hierarchies," *Journal of Political Economy*, 96, 867-881.

Brown, K. C., W. V. Harlow, and L. T. Starks, 1996, "Of Tournaments and Temptations: An Analysis of Managerial Incentives in the Mutual Fund Industry," *Journal of Finance*, 51, 85-110.

Brunnermeier, M. K., and S. Nagel, 2004, "Hedge Funds and the Technology Bubble," *Journal of Finance*, 59, 2013-2040.

Lazear, E. P., and S. Rosen, 1981, "Rank-Order Tournaments as Optimum Labor Contracts," *Journal of Political Economy*, 89, 841-864.

Lewis, M., 2008, *The End*, www.portfolio.com, December.

Malcomson, J. M., 1986, "Rank-order Contracts for a Principal with Many Agents," *Review of Economic Studies*, 53, 807-817.

Partnoy, F., 2006, "How and Why Credit Rating Agencies Are Not Like Other Gatekeepers," working paper, University of San Diego.

Shiller, R. J., 2006, *Irrational Exuberance*, 2nd ed., Broadway Business, New York, NY.