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BANKING, FINANCIAL CRISES, AND BEHAVIORAL FINANCE[‡]

Lending Booms, Smart Bankers, and Financial Crises[†]

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Financial crises typically follow economic booms with leverage-financed asset price bubbles (Reinhart and Rogoff 2008; Schularick and Taylor 2012). The real-sector impact of each crisis, especially the 2007–2009 financial crisis, is enormous. Why do financial crises keep occurring, despite the increasing associated significant economic rupture?

This paper develops a theory of financial crises based on a behavioral bias called the "availability heuristic," which is the proclivity of individuals to take a mental shortcut that relies on immediate examples that come to mind (Tversky and Kahneman 1973 provide experimental evidence of this bias). That is, people often assess the probability of an event by the ease with which past occurrences can be remembered. Quite often, factors or events related to personal experiences become more salient in this recollection. And some future events are perceived to be so unique that past history is deemed irrelevant in evaluating the likelihood of their occurrence.

I rely on this bias and argue that crises are caused by agents believing that outcomes are influenced by the a priori unknown skills of banks even though there is a nonzero probability that these outcomes are purely exogenous.[1] Good outcomes therefore lead to an *excessive* upward revision in beliefs about bankers' skills. Thus, after a long sequence of good outcomes, *all* agents—banks as well as their investors and regulators—believe that banks are highly capable of managing risk. This causes banks and investors to underestimate the true risk in high-risk products, so additional institutions rush in to invest in them. In effect, risk is mispriced because risk-management ability is overestimated. The increased market entry means more potential buyers of a bank's loans; this provides enhanced liquidity to the market for high-risk assets, attracting more institutions. Eventually, there is a nonzero probability with which investors learn about the true risk in the high-risk products, causing liquidity to dry up and a crisis to commence.

This explanation for financial crises is consonant with many of the stylized facts related to crises. It shows that crises can occur even if incentives are properly aligned, and it guides appropriate regulatory responses. This theory also explains why the economy falls to pieces after a financial crisis. Hall (2010) observes that macroeconomic models do not explain why GDP and employment often fail to recover soon after the crisis-related financial frictions have dissipated. The theory in this paper is also consistent with financial innovation being a precursor to financial crises (e.g., Gennaioli, Shleifer, and Vishny 2012; and Thakor 2012), and overlending by banks during economic booms and periods of high stock prices that sow the seeds of a subsequent crisis (e.g., Thakor 2000).

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[1] This may be because some agents are conditioning their beliefs based on observed compensation levels in banking, which may themselves be driven by beliefs about the importance of skills that are formed based on some memorable past experience that no longer applies. That is, they may observe banks hiring really smart people at high wages and also observe high profitability in banking, and conclude based on this correlation.

Section I develops the model, Section II contains the main results. Section III introduces a loan resale market, and also discusses why the economy falls to pieces after a crisis. Section IV concludes. All proofs, as well as a discussion of the related literature and the marginal contribution of this paper, are in my companion paper (Thakor 2014) available online.

I. The Base Model

A. *Preferences and Loan Choices*

There is universal risk neutrality and five dates: $t = 0$, 1, 2, 3, and 4 that cover two time periods. At $t = 0$, there are N_0 banks in the market. Each bank can choose to invest \$1 at $t = 0$ in either a prudent loan (P) or a risky first-period loan (R). Both loans mature at $t = 2$. For simplicity, the entire \$1 is raised at $t = 0$ in the form of (uninsured) debt financing. The debt is short-term, so first-period investors can withdraw funding at $t = 1$, or wait until $t = 2$. The repayment promised to investors differs based on when they withdraw. This short-term debt creates a maturity mismatch on the bank's balance sheet. If the bank survives until $t = 2$, it makes its second-period loan (P or R), with investors having the option to withdraw at $t = 3$.

P Loans.—Loan P is either good (G) or bad (B), but no one can determine for sure a priori whether the loan is G or B. A G loan pays off $X_p > 1$ w.p. 1, and a B loan pays off X_p w.p. $b \in (0,1)$ and 0 w.p. $1 - b$. There are two possible states of nature in any given period, $\xi \in \{\xi_e, \xi_\tau\}$. In state ξ_e, the probability that the loan is type G is purely exogenous and fixed at $r \in (0,1)$. In state ξ_τ, the probability that the loan is type G depends on the talent of the bank doing post-lending monitoring.[2] There are two possible types of banks: talented (τ) and untalented (u). A type-τ bank monitors the P loan with perfect efficiency and is thus able to ensure that the loan is G w.p. 1. A type-u bank, however, has no monitoring ability and thus ends up with a B loan w.p. 1. The common prior belief at $t = 0$ is that the probability that any given bank is type-τ is r, and the probability that it is type u is $1 - r$. The true probability of state ξ_e is $\lambda \in (0,1)$, a small number. However, all agents believe at $t = 0$ that $\lambda = 0$. At $t = 1$, ξ is realized. However, this realization is *not* observed until $t = 3$, at which date all agents receive a common signal that reveals ξ to them. This captures *lags* in learning. This signal is a *completely unanticipated* shock in the sense that all agents are unaware of the possibility of the signal until it arrives.

This set-up is relevant for understanding the role of the availability heuristic in generating financial crises. Even though some pre-crisis conditions are ubiquitous—such as high bank leverage and asset price bubbles—there are invariably circumstances unique to each crisis. For example, prior to the savings and loan crisis (S&L), we had high interest rates, an inverted yield curve, and no formal risk-adjusted capital requirements. Prior to the 2007–2009 crisis, we had the credit default swap market, shadow banking, and a broad set of mortgage-backed securities. These unique crisis-specific circumstances may be so compelling that agents may view historical data as being useless in predicting a future crisis, causing plausible indicators of an impending crisis to be ignored.[3]

At $t = 0$, the prior belief about the probability of success of P at $t = 2$ is $r_o^P \equiv r + [1 - r]b$, and I assume that $r_o^P X_p > 1$, so P is socially-efficient given these prior beliefs. However, $bX_p < 1$ so a bank known to be type-u almost surely would never be able to raise financing for a P loan.

R Loans.—R can be either good $(\hat{G})$ or bad $(\hat{B})$. No one knows a priori whether a given loan is $\hat{G}$ or $\hat{B}$. A $\hat{G}$ loan pays off X_R w.p. $q \in (0,1)$

[2] Banks are experts in screening/monitoring borrowers (e.g., Ramakrishnan and Thakor 1984). The specification here captures "model uncertainty." In reality, investors are always unsure about the extent to which payoffs are influenced by bankers' skills. Moreover, they may be mistaken about the true state of the world because it cannot be reasonably inferred by building plausible "scenarios" based on past experience.

[3] Such as risky lending and high asset prices. Tversky and Kahneman (1982, p. 177) write: "Some events are perceived as so unique that past history does not seem to be relevant for the evaluation of their likelihood. In thinking of such events, we often construct *scenarios* … that lead from the present situation to the target event. If no reasonable scenario comes to mind, the event is deemed impossible or highly unlikely." When there is a lending boom and things are going well, it may be hard to construct scenarios in which the economy moves from that state to a crisis.

and 0 w.p. $(1-q)$, whereas a $\hat{B}$ loan pays off 0 w.p. 1. It is assumed that the $\hat{G}$-type R loan dominates the G-type P loan, i.e., $qX_R > X_P$.

As with P, there are two states of nature with R: $\xi \in \{\xi_e, \xi_\tau\}$. In state ξ_e, the loan is type $\hat{G}$ with an exogenously fixed probability r. In state ξ_τ, the probability that the loan is type $\hat{G}$ depends on the bank's skill, and the common belief is that a type-τ bank will ensure w.p. 1 that it is a $\hat{G}$ loan, whereas a type-u bank will ensure w.p. 1 that it is a $\hat{B}$ loan. As with P, the probability of state ξ_e is λ and of state ξ_τ is $1-\lambda$, and all agents believe at $t=0$ that $\lambda = 0$. The difference in loan repayment probabilities across the good and bad loans is assumed to be greater for R than for P, i.e., $q > 1-b$. R is more complex than P, so the bank's skill is more important for R.

At $t=0$, the prior probability of success of the R loan at $t=2$ is $r_o^R \equiv rq$, and it is assumed that $r_o{}^R X_R < 1$, so the R loan is socially inefficient given the prior beliefs. If either P or R is prematurely liquidated (i.e., at $t=1$ in the first period or $t=3$ in the second period), there is a loss of nonpledgeable rent $K > 0$. Absent premature liquidation, the borrower would enjoy this rent.

B. *Observability and Knowledge Assumptions*

Each bank's loan choice at any given date as well as whether the loan repaid or defaulted are commonly observable. So investors know the bank's choice (P or R) before providing financing. Moreover, at $t=3$, a common signal is observed which reveals the true model about whether outcomes are exogenous or dependent on bank skill.

C. *Capital Market Financing*

The capital market is competitive, so investors' expected return on bank debt is zero. If investors liquidate a loan at $t=3$, they collect $L \in (rqX_R, rqX_R + K)$.

II. Analysis of the Basic Model

A. *Analysis of Outcomes at $t=2$: Second-Period Lending Choice*

PROPOSITION 1 (Bank's Second-Period Lending): *In the second period: (i) the bank will exit the market if its first-period loan defaults at $t=2$, and (ii) if its first-period loan repays, then the bank makes an R loan at $t=2$ if the posterior belief that the bank is talented, conditional on first-period success, exceeds a cut-off, and a P loan otherwise.*

The intuition is that first-period failure lowers posterior beliefs about the second-period repayment probability so much that even P is not viable, whereas first-period success raises the posterior belief about the bank being talented sufficiently to ensure that the expected second-period repayment probability with an R loan is high enough to make it more attractive than P.

Although first-period loan success increases the posterior belief about the bank being talented for both P and R loans, it causes a bigger increase for the R loan because the difference in repayment probabilities across talented and untalented banks is higher for the R loan than (q) for the P loan $(1-b)$, given $q > 1-b$.

B. *First-Period Lending Choice and Second-Period Crisis*

PROPOSITION 2 (Financial Crisis): *All banks invest in P loans at $t=0$ and there is no first-period financial crisis. All banks that experience first-period repayment success make R loans at $t=2$ (assuming that posterior beliefs exceed the talent cut-off in Proposition 1). A financial crisis occurs at $t=3$ if investors learn at that time that the loan repayment probability is purely exogenous. Otherwise, there is no financial crisis and investors are repaid at $t=4$.*

The sequence of events is that banks cannot finance R loans at $t=0$, so they initially make P loans, and there is no crisis.[4] The banks that are successful in the first period invest in R loans in the second period. Even if λ is small, there is a positive probability that at $t=3$ investors will learn that second-period outcomes are exogenous. It is subgame perfect for investors to withdraw at $t=3$, precipitating a crisis. Thus,

[4] Even if revelation of the true model of the world were to occur at $t=1$ and the true model turned out to be $\xi = \xi e$, there would be no crisis since the P loan is efficient even in this case.

with a positive probability, a financial crisis *follows* good bank performance, since banks invest in R loans only following good first-period performance.

III. Loan Resale Market and Post-Crisis Economic Funk

Loan Resale Market.—To analyze the loan resale market, five main elements are added: (i) with probability $\theta \in (0,1)$ a bank's investors experience an idiosyncratic liquidity shock at $t = 3$ requiring immediate repayment from the bank (these shocks are i.i.d. across banks); (ii) to meet the repayment, the bank can either liquidate its loan at L or it can sell it to another bank; (iii) the loan sale price is endogenous and depends on the number of Bertrand competitors capable of buying the loan; (iv) only a bank that had previously invested in that type of loan (P or R) can buy another bank's loan; and (v) bank i's cost of gaining the expertise to manage R is $C_i \geq 0$, with $C_i \in [0, \bar{C}] \subset \mathbb{R}_+$. I then derive the following result.

PROPOSITION 3 (Financial Crisis with Loan Resale Market): *The loan resale market increases:* (*i*) *the bank's second-period expected profits on both the P and R loans; and* (*ii*) *the number of banks that can offer R in the second period. Investors demand immediate repayment from a bank with an R loan at* $t = 3$ *if they experience a liquidity shock or if they receive a signal that the success probability of R is exogenous. In the former case, the bank is liquidated only if it cannot find a buyer for its loan, but in the latter case, all banks that have made R loans are liquidated.*

The possibility of being able to sell the loan to another bank rather than liquidating it increases the profitability of both P and R loans, and it attracts more banks to make R loans, making the second-period risky loan market more liquid and reducing the liquidation likelihood for banks hit with idiosyncratic liquidity shocks. Paradoxically, however, it increases the vulnerability of the banking system to the systematic shock (loan outcomes are exogenous) since this shock only brings down banks that have chosen R, and now there are more of them.

Why the Economy Falls to Pieces Following Credit Crises.—The model can also explain why recessions follow major financial crises. The reason is that a crisis may lower bankers' beliefs about their own skills, and if this decline is sufficiently large, bankers will not even wish to invest in P loans, causing all lending to dry up. In Thakor (2014), I formalize this intuition with a modified version of the model, in which *only* the bank's creditors *privately* learn at $t = 3$ whether the loan repayment probability is exogenous (w.p. λ)or skill-dependent (w. p. $1 - \lambda$). If it is skill-dependent, they also observe the bank's type: whether it is τ or u. Banks see neither of these two signals. All that the bank learns at $t = 3$ is that the true model of the world may have changed and that loan success probabilities *may* be independent of bankers' skills (the bank recognizes at $t = 3$ that the probability of this is λ), but it does not know if that is indeed true.

When creditors withdraw bank funding at $t = 3$, the bank only knows that they must have learned either that the loan repayment probability is exogenous or that it is skill-dependent and that most banks are type-u. If λ is very low, banks may think it likely that investors learned that outcomes are skill-dependent, with a high probability that the bank is type u. Consequently, the posterior belief about the repayment probability with even a P loan can fall below the priors and all lending may cease, causing the economy to fall to pieces. This continues even when the financing friction that investors will not fund banks has disappeared. The reason is not a lack of funds. Rather, it is the banker's lack of confidence.

IV. Conclusion

This paper develops a theory of financial crises based on the availability heuristic and learning about bankers' skills. A long sequence of favorable banking outcomes leads all agents to assign high probabilities to the abilities of banks to manage risks. This provides banks with access to low-cost funding and lax regulation, and bankers—perceived to be highly skilled—are paid high wages. Consequently, if it is revealed that outcomes are skill-independent, a crisis occurs as creditors withdraw funding and the loan sale market dries up. This theory

explains a substantial pre-crisis build-up of liquidity, and then a sudden collapse. It also predicts that such financial crises will be cyclical, likely to follow booms, and characterized by slow post-crisis recovery.

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