Regulatory
Studies Center
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Regulatory Insight

The Unintended Consequences of Banking Regulations: Shadow Banking

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Abstract

Shadow banks are not subject to the stringent regulation that traditional banks are and can pose great risks to the financial system. Since the financial crisis, banking regulations have been tightened to reduce the fragility of the financial system. However, an unintended consequence is that tighter regulations, such as higher bank capital requirements, can cause an expansion of shadow banking activity. This effect, if large enough, may offset the intended impact of regulation. The overall impact of recent regulatory changes on systemic risk of the financial system is therefore less clear. In this *Regulatory Insight*, I discuss the interaction between regulation of traditional banks and shadow banking by reviewing a few recent papers modeling bank capital requirements and shadow banking. These studies suggest important implications for optimal regulatory policy. Although tightening capital requirements may lead to an increase in a larger shadow banking sector, it can still have an aggregate welfare-improving effect. However, the presence of shadow banking indeed poses more uncertainty and challenges to the supervision of financial institutions.

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By 2007, the size of the shadow banking sector had become as large as the traditional banking sector. Although not uniformly defined, shadow banks generally refer to "financial intermediaries that conduct maturity, credit, and liquidity transformation without explicit access to central bank liquidity or public sector credit guarantees."[1] Examples include asset-backed commercial paper conduits, money market mutual funds, investment banks, and mortgage companies. The shadow banking system is subject to less regulation than traditional banking and "inherently fragile" due to the lack of access to the the public safety net. Many view shadow banking as a key contributor to the 2007-2009 financial crisis. Since then, banking regulations have been tightened to reduce the fragility of the financial system. However, a prevailing view among both practitioners and academics is that tighter regulations, such as higher bank capital requirements, causes an expansion of shadow banking activity. This effect, if large enough, may offset the intended impact of regulation. In this *Regulatory Insight*, I discuss the interaction between regulation of traditional banks and shadow banking by reviewing a few recent theoretical papers in this literature.

Plantin (2015) develops a simple model to show how tightening bank capital requirements can increase shadow banking activity. In the model, banks are subject to a prudential regulation that sets a cap on the risk-adjusted leverage of banks. At the same time, banks can pursue regulatory arbitrage via shadow banking: they can bypass the capital requirement by trading with money market funds (MMFs) in a spot market that the regulator does not observe. The model shows that higher capital requirements can induce banks to transfer riskier claims to their creditors through shadow banking, causing an expansion of shadow banking activity.

These unintended consequences of regulation raise the concern that tightening capital requirements may not help improve financial stability. It is therefore crucial to understand the net effect of higher capital requirements on the overall risk of the financial system in the presence of shadow banking. Martinez-Miera and Repullo (2019) assess the effects of bank capital requirements on the structure and risk of a financial system where direct market finance and intermediated finance through regulated banks and shadow banks coexist. They show that, although a higher capital requirement can lead to a reduction in the risk of loans issued by regulated banks, it also increases the risk of loans shifting to shadow banks. The net effect on the financial system thus depends on which effect dominates.

Begenau and Landvoigt (2021) quantify this net effect by developing and calibrating a general equilibrium model. Similar to Plantin (2015), they also demonstrate that tightening capital requirements leads to a larger shadow banking sector. However, the increase in the risk of shadow banking is economically small and dominated by a substantial reduction in the risk of regulated banks. On net, the financial system becomes more stable, despite riskier shadow banks.

[1]The Financial Stability Board broadly defines shadow banking as "credit intermediation involving entities and activities outside the regular banking system."

These studies suggest important implications for optimal regulatory policy. Although tightening capital requirements may lead to an increase in shadow banking activity, the overall impact on systemic risk of the financial system is less clear. In the remainder of this article, I briefly summarize the models in these studies and discuss their main ideas.

Expansion of Shadow Banking under Tighter Capital Requirements

To illustrate how a tightening in bank capital requirements can cause an increase in shadow banking activity, I briefly summarize the model discussed in Plantin (2015). The author first examines a baseline model absent shadow banks and considers the optimal regulatory policy in the model. The model has two periods: $t = 1, 2$. At date 1, the household receives an endowment of W. The entrepreneur decides its production scale N_1, which is the number of units of consumption goods to be produced at date 2. At date 2, the entrepreneur can revise the production scale from N_1 to N_2, at an adjustment cost:

$$\frac{k}{2}(N_2 - N_1)^2.$$

The entrepreneur can always walk away without producing any output.

The bank has a storage technology to store the household's endowment from date 1 to date 2, so that the household can trade with the entrepreneur for the consumption goods. The bank has access to two investment opportunities at date 1: (1) a loan portfolio, which repays $L + l$ if the portfolio is of high quality at date 2 (with probability p) or L if the portfolio is of low quality (with probability $1 - p$), and (2) a long-term investment opportunity, which generates a gross return of $x + f(x)$ (with probability q) or x only at some remote date 3 (with probability $1 - q$).

The bank issues a security backed by the portfolio to the household for its deposit at date 1, and the bank can pledge all or part of the portfolio's expected payoff to the household. The security is characterized by $\lambda, \mu \in [0, 1]$ such that the household receives $\mu L + \lambda l$ if the portfolio turns out to be good and μL if it is bad.

Plantin (2015) shows that the bank values cash at date 1 more than at date 2 because its date-1 investment is nonpledgeable. Therefore, without any regulation, the bank chooses to issue the largest possible security against the portfolio and thus pledges its entire portfolio to the household ($\mu = \lambda = 1$), which creates the largest possible adjustment costs for the entrepreneur. The bank chooses this excessive leverage, because it does not fully internalize all the costs from transactions between the household and the entrepreneur due to the riskiness of its liabilities. This leverage externality calls for regulatory interventions.

The regulator imposes a security design on the bank shareholder at date 1 and chooses the

optimal λ^* and μ^* by maximizing the utilitarian welfare:

$$L + pl - I + qf(\mu L + \lambda pl - I) + W(1-c) - \frac{k}{2}p(1-p)(\lambda)^2 l^2,$$

where $I > 0$ is the initial outlay required for the loan portfolio at date 1, and $c \in (0,1)$ is the disutility to the entrepreneur for the production of each unit of output. As a result, the optimal security is such that $\mu^* = 1$ and $\lambda^* \in (0,1)$ is the unique solution to

$$qf'(\lambda^* pl + l - I) = \lambda^* k(1-p)l.$$

The fraction λ^* represents the fraction of the risky part of the assets, which is the net regulatory leverage. The model thus shows that tighter capital requirements (i.e., a lower λ^*) can reduce the negative leverage externality that the bank imposes on the rest of the economy (while accompanied by higher costs of equity capital).

Plantin then adds shadow banking into the model as an alternative to traditional banking. He introduces a secret market in which the bank can trade with the MMF at date 1 and thereby bypass the capital requirement. The MMF, an agent in the shadow banking sector in this model, also issues money-like liabilities to nonfinancial agents. The regulator does not observe the secret market and thus cannot prevent the bank from imposing more risk on the household indirectly through the MMF. Plantin solves for the optimal regulatory leverage chosen by the regulator in the presence of this shadow banking activity in two steps: (1) fixing an arbitrary regulatory leverage λ and characterizing the shadow banking activity, and (2) determining the optimal leverage λ^* when the regulator rationally anticipates such activity.

To see how shadow banking activity responds to an increase in regulatory requirements, suppose the net regulatory leverage is λ. The bank can sell all or part of its risky cash flow $(1-\lambda)l$ to the household via the MMF. The MMF offers a highest possible price at which he is willing to buy stakes in the portfolio:

$$r = \frac{pq}{1-p+pq},$$

which equals to the probability that the bank has a good portfolio and a valuable investment opportunity. The bank then chooses the fraction to sell λ' by maximizing its utility. The first-order condition derived is:

$$(p\lambda + r\lambda')l = \varphi(\frac{1-p}{pq}) + I - L,$$

where φ is defined as $\varphi = f'^{-1}$. The result indicates that λ' is decreasing in λ, suggesting that tighter regulatory constraints (a lower λ) lead to more shadow banking activity (a higher λ').

The Net Effect on the Financial System

Although there is a consensus that higher capital requirements tend to increase the size of the shadow banking sector, it is less clear whether it leads to overall higher risk of the financial system. Martinez-Miera and Repullo (2019) assess the effects of bank capital requirements on the structure and risk of a financial system where direct market finance and intermediated finance through regulated banks and shadow banks coexist. They show that higher capital requirements reduce the risk of loans that stay with regulated banks, while increasing the risk of loans that shift toward shadow banks. If the second effect is larger, tightening capital requirements is associated with an increase in the overall risk of the financial system. However, Martinez-Miera and Repullo (2019) do not compare the quantitative magnitude of these two effects in the paper, so it is ambiguous in terms of the net effect of higher capital requirements on the overall financial system with shadow banking.

Begenau and Landvoigt (2021) fill this gap to examine the net effect by building and calibrating a quantitative model. The simplified two-period model in their paper illustrates the idea. There are two types of banks in the model: regulated commercial banks (C-banks) and unregulated shadow banks (S-banks). Banks in this economy do not act as an intermediary between investors and entrepreneurs. Instead, banks own a production technology. Banks buy capital at date 0 at price p in a competitive market and produce one unit of consumption good out of each unit of capital at date 1, subject to idiosyncratic production shocks.

S-banks and C-banks issue deposits B_j at prices q_j and equity shares S_j at prices p_j to households ($j = \{S,C\}$). C-bank deposits are insured and safe for households, while S-banks are risky and may suffer default. S-banks choose the amount of capital to buy, K_S, and the amount of deposits to issue, B_S, at date 0 by maximizing its expected net present value:

$$\max_{K_S,B_S} q_S(B_S,K_S)B_S - pK_S + \beta E[\max\{\rho_S K_S - B_S, 0\}].$$

C-banks are subject to a regulatory capital constraint that limits the amount of deposits they can issue to a fraction $1-\theta$ of the expected payoff of capital at date 1, $E(\rho_C K_C)$. θ is the regulatory capital ratio. C-banks' maximization problem is:

$$\max_{K_C,B_C} q_C B_C - pK_C + \beta E[\max\{\rho_C K_C - B_C, 0\}].$$

$$s.t.\ B_C \leq (1-\theta)E(\rho_C K_C).$$

The price for S-banks' deposits q_S depends on the bank's leverage choice, defined as $L_S = B_S/K_S$, while the price for C-banks' deposits q_C is not sensitive to the leverage choice.

A representative household owns all financial assets in the economy and gets an endowment of 1 unit of the capital good at date 0. The household gets utility from consumption and liquidity services:

$$U = C_0 + \beta(C_1 + \psi H(A_S, A_C)),$$

where $H(A_S, A_C)$ is the utility from liquidity as a function of deposits issued by S-bank and C-bank. The household faces a budget constraint at date 0:

$$C_0 = p - q_S A_S - q_C A_C - p_S S_S - p_C S_C,$$

and a budget constrain at date 1:

$$C_1 = (1 - L_S)A_S + A_C + S_S K_S (1 - F_S(L_S))(\rho_S^+ - L_S) + S_C K_C (1 - F_C(L_C))(\rho_C^+ - L_C)) - T,$$

where T is government lump-sum tax to bail out deposits, $(1 - F_j(L_j))(\rho_j^+ - L_j)$ denotes the expected cash-flow from owning bank type j equity. The household's problem is to choose C_0, C_1, S_j, and A_j by maximizing its utility subject to the two budget constraints.

By solving the social planner's problem and competitive equilibrium, Begenau and Landvoigt show that the competitive equilibrium deviates from the social planner allocation. In particular, the S-bank leverage in a competitive equilibrium is greater than the social planner solution. The authors then assess the effect of a higher capital requirement by examining the comparative statics of the competitive equilibrium with respect to θ. The results suggest that a higher θ: (1) reduces C-bank leverage, (2) causes an expansion of the S-bank sector in terms of the share of deposits, and (3) can either raise or lower S-bank leverage, depending on model parameters. Results (1) and (2) are consistent with those of Plantin (2015) and Martinez-Miera and Repullo (2019).

Result (3) suggests that the effect on S-bank leverage is ambiguous. Begenau and Landvoigt argue that there are two competing effects. One is the competition effect. C-banks have a competitive advantage due to deposit insurance, whereas an increase in the capital requirement reduces C-banks' competitive advantage compared to S-banks. As a result, investors shift to S-bank equity, increasing S-bank liquidity and reducing their leverage. On the other hand, there is a demand effect. An increase in the capital requirement raises the liquidity premium of both types of banks, leading to an increase in S-bank leverage. The authors then calibrate the model to see how S-bank leverage responds to an increase in the capital requirement.

The calibration indicates that a higher capital requirement indeed reduces C-bank leverage, making C-banks safer. However, S-banks issue more deposits per dollar of assets they hold, leading to higher S-bank leverage. As a result, S-banks become riskier, and overall S-bank defaults raise. Does the increased risk of S-banks undo the gain from safer C-banks? The calibration suggests that it does not. First, fewer C-bank defaults reduce deadweight losses and thus increase

consumption. Second, the demand effect leads to increases in capital accumulation and aggregate output. Together, these resource gains offset the losses from higher S-bank risk. Overall, tightening capital requirements increases aggregate welfare.

Optimal Regulatory Policy in an Economy with Shadow Banking

As discussed above, Plantin (2015) points out that a tighter capital requirement may induce regulated banks to transfer riskier claims to unregulated shadow banks, and this endogenous response may offset the direct impact of regulation. However, this does not eliminate the need for regulation.

Both Martinez-Miera and Repullo (2019) and Begenau and Landvoigt (2021) suggest that, in general, imposing capital requirements is still welfare improving. Martinez-Miera and Repullo show that requiring banks to have more capital than they would choose in the absence of regulation improves social welfare. However, this welfare-improving effect vanishes at some level of capital requirements, because capital requirements also increase the cost of equity. Therefore, there is a point beyond which further raising the capital requirements is welfare decreasing. The simulated model in Begenau and Landvoigt (2021) quantitatively gauges the effects of different levels of capital requirements on aggregate welfare and indicates that increasing capital requirements θ up to 30 percent leads to increased welfare relative to the benchmark (10 percent). The optimal aggregate capital ratio that maximizes welfare is 16 percent ($\theta = 0.16$).

Following the financial crisis, global bank regulators strengthened capital requirements. In 2010, the Basel Committee on Banking Supervision promulgated new requirements in Basal III, an international accord that sets standards to "strengthen the regulation, supervision and risk management of banks." In parallel, U.S. legislators passed the Dodd-Frank Act (DFA) in the same year. In 2013, federal agencies issued regulations that jointly implemented the capital requirements in Basal III and the DFA. The Basel III and DFA standards introduced a more narrow measure of capital, common equity tier 1 (CET1), and a series of new requirements such as capital buffers, stress tests, and a supplemental leverage ratio. Many of those changes were to impose stricter requirements for large banking organizations. The current capital requirements for large banks include a minimum CET1 capital ratio of 4.5 percent for each bank and a stress capital buffer that varies across banks but is at least 2.5 percent. Despite the post-crisis regulatory reforms to strengthen capital requirements, the appropriate amount of capital remains highly controversial, and the presence of shadow banking adds an extra layer of uncertainty to the impact of recent regulatory changes on systemic risk of the financial system.

Conclusion

In this *Regulatory Insight*, I discuss the interaction between regulation of traditional banks and shadow banking, with a focus on bank capital requirements. Since the financial crisis, regulators have imposed higher capital requirements to improve financial stability, but this regulatory action can have unintended consequences. As illustrated in the model of Plantin (2015), tightening capital requirement for traditional banks can cause an increase in shadow banking activity. This effect does not necessarily undo the gain from reduced risk of regulated banks, as shown by Martinez-Miera and Repullo (2019) and Begenau and Landvoigt (2021), which suggest that a moderate level of capital requirements can still be welfare improving. However, the presence of shadow banking indeed poses more uncertainty and challenges to the supervision of financial institutions.