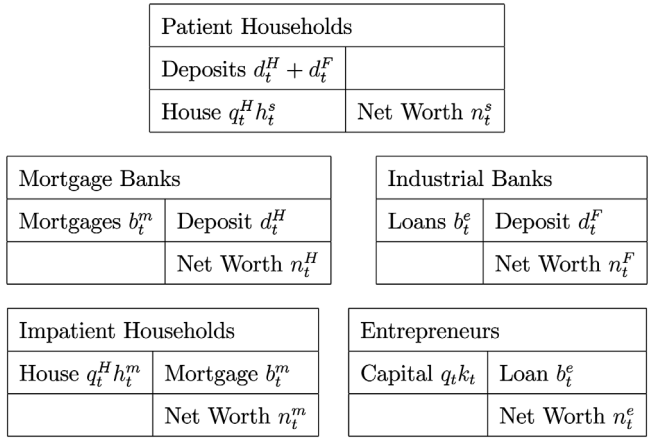
Discussion of "Capital Regulation in a Macroeconomic Model with Three Layers of Default"

Nobuhiro Kiyotaki
Princeton University

How do shocks to productivity and asset quality generate large fluctuations of aggregate production when banks, firms, and some households are credit constrained? What are the effects of alternative macroprudential policies? In order to answer these questions, the authors develop a macroeconomic framework in which the effects of shocks propagate through the fluctuations of asset prices and balance sheets of households, firms, and banks. A particular feature of their framework is that the liquidation of assets after bankruptcy is very costly, because a significant fraction of the assets is depreciated during the process. Since the banks have limited liability and the government uses a general tax (through deposit insurance) to cover the loss incurred by depositors after a bank's default, banks and their customers receive the implicit subsidy from the government when the probability of bank default is positive. This generates a serious moral hazard, as banks rely on deposits too much to make risky loans to households and firms. The regulation of bank capital requirement is essential to mitigate this moral hazard problem and the distortion of resource allocation. The authors use their quantitative model to show that there is a significant gain in welfare by raising the capital requirement from the present standard of 8 percent to 10.5 percent of risky loans to the private sector. A further increase of capital requirement will reduce social welfare because the financial intermediation becomes too small. This paper asserts that it is more important to set the average capital requirement at an optimal level than to fine-tune the capital requirement procyclically.

Because my comments are largely specific to their model, let me highlight the key assumptions. There are infinitely lived households

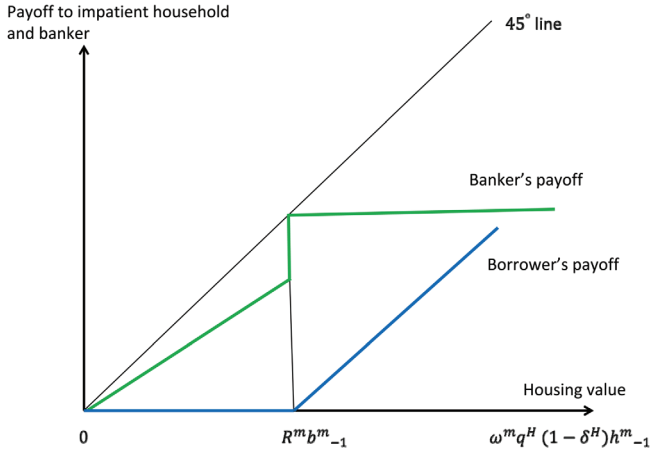
Figure 1. Diagram of Balance Sheets of Households, Entrepreneurs, and Banks



with patient and impatient types. There is a sequence of entrepreneurs and bankers who live for two periods. The entrepreneurs and bankers are risk neutral, distribute a fraction of gross returns as dividends to their owners (patient households), and save the rest, which becomes the net worth of the entrepreneurs and bankers of the next generation. There is one homogeneous output. Capital stock and housing are subject to aggregate and idiosyncratic shocks to the depreciation, and can be accumulated by investment in capital stock and housing. Production of new capital and housing are subject to the adjustment cost; the production technology of new capital and housing is decreasing returns to scale in the short run even though it is constant returns to scale in the long run.

The balance sheets of households, entrepreneurs, and banks are described in the diagram in figure 1. Patient households are ultimate lenders, who save their wealth in the form of housing and deposits to mortgage banks and industrial banks. Mortgage banks use the deposits and net worth to make mortgage loans to impatient households. Industrial banks use the deposits and net worth to make loans to entrepreneurs. Impatient households and entrepreneurs are ultimate borrowers. Impatient households put together their net worth and mortgage to buy houses. Entrepreneurs use their net worth and loans from industrial banks to buy capital stock for production.

Figure 2. Payoff to Impatient Household and Mortgage Bank



All the debts are secured by collateral assets and are non-recourse, as the borrower can walk away from the debt obligation, leaving the collateral asset behind, without further penalty. The face value of debt is non-contingent in terms of goods. Figure 2 describes the payoff to the mortgage borrower (impatient household) and the mortgage bank as functions of the value of the collateral house. The horizontal axis is the value of the house which the impatient household (borrower) bought with debt in the last period. The total collateral value $\omega_t^m q_t^H (1-\delta_t^H) h_{t-1}^m$ is subject to the aggregate shock to the depreciation rate δ_t^H, the housing price q_t^H, and an idiosyncratic quality shock ω_t^m. When the collateral housing value is at least as large as the debt obligation $R_{t-1}^m b_{t-1}^m$ (which equals the gross real interest rate times the debt from the previous period), the borrower repays the debt in full. The banker's payoff equals the face value of debt $R_{t-1}^m b_{t-1}^m$, and the borrower's payoff equals the gap between the collateral value and the debt obligation. When the collateral housing value is smaller than the debt obligation, the borrower walks away with zero net payoff. When the banker liquidates the collateral house, the banker loses a fraction μ^m in the process and obtains only $(1-\mu^m)\omega_t^m q_t^H (1-\delta_t^H) h_{t-1}^m$ as its payoff. We can think of this bankruptcy cost as a cost of verifying the collateral value or an extra depreciation during the process of default.

Figure 3. Payoffs to Mortgage Bank, Depositors, and Government

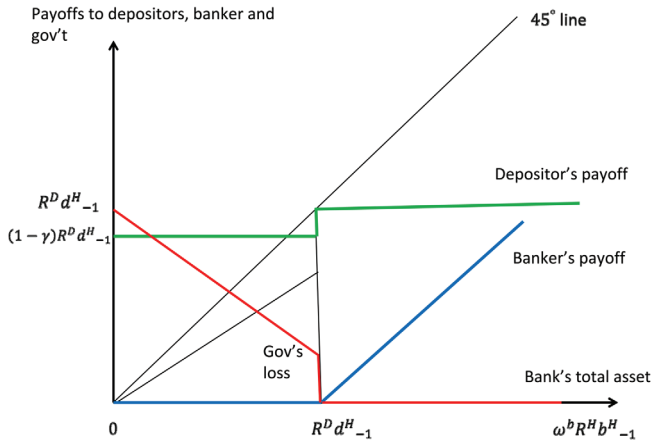


Figure 3 describes the payoffs to the mortgage bank, the depositors, and the government as functions of the total asset value of the mortgage bank. The horizontal axis is the total asset value of the mortgage bank $\omega_t^H \widetilde{R}_t^H b_{t-1}^H$, which equals the product of aggregate mortgage loans made in the previous period b_{t-1}^H, the realized average rate of returns on mortgage loans $\widetilde{R}_t^H$ (which is the average rate of return on all mortgage loans after taking into account the fraction of defaulted loans), and an idiosyncratic shock to the loan performance of this bank ω_t^H. When the total asset of the bank is larger than or equal to the deposit obligation $R_t^D d_{t-1}^H$, the bank pays the depositors in full and keeps the rest as its payoff. The government is not involved in this case. But when the total asset of the bank is smaller than the deposit obligation, the bank defaults. The government liquidates the bank asset, loses a fraction of μ^H of the asset value, and obtains only $(1-\mu^H)\omega_t^H \widetilde{R}_t^H b_{t-1}^H$ after liquidation. The government covers the loss incurred by depositors by taxing as much as $R_t^D d_{t-1}^H - (1-\mu^H)\omega_t^H \widetilde{R}_t^H b_{t-1}^H$. Even though the depositors recover the deposit returns through the government deposit insurance, they lose a fraction γ of the total returns on deposits due to the disruption of deposit service. Therefore, in this economy, the bankruptcy of the banks is extremely costly because the society loses a significant amount of resources—the sum of the costs of liquidating bank assets

and disruption of deposit service, $\mu^H \omega_t^H \widetilde{R}_t^H b_{t-1}^H + \gamma R_t^D d_{t-1}^H$. (Note that μ^H is 30 percent and γ is 10 percent in the authors' calibration.)

Moreover, because the government pays a large fraction of the loss incurred by depositors from general tax revenues after banks default, the government subsidizes banks' risk taking, indirectly subsidizing both banks' borrowers and depositors. This causes serious moral hazards of excessive leverage and defaults of banks, as well as too many deposits and too much borrowing from banks by impatient households and entrepreneurs.

Because the government deposit insurance causes significant moral hazards and frequent defaults of banks which are very costly to the society, it is not surprising that regulation of minimum capital requirement of banks is beneficial. The question is, how should we set capital requirements? On the one hand, a higher capital requirement reduces the distortion induced by implicit subsidy of deposit insurance. On the other hand, a higher capital requirement reduces the size of financial intermediation and aggregate investment and production. According to the authors' model, the level of capital requirement which maximizes the average welfare of patient and impatient households is 10.5 percent for entrepreneurial loans and about half of that level, 5.25 percent, for mortgage loans. This level is higher than the present level of 8 percent for business loans, but not as high as Admati and Hellwig (2013) recommend, 25 percent. Concerning another issue of regulations about whether we should increase capital requirement during a boom rather than a recession, the authors' model says that the welfare gain from setting the average level of capital requirement at an optimal level is greater than that from adjusting capital requirement procyclically, similar to Admati and Hellwig.

I believe the paper addresses very important questions about macroprudential policy. The authors choose an eclectic approach to put together many frictions: (i) costly state verifications of returns on housing, capital, and bank loans; (ii) government deposit insurance and cost of disruption of deposit service to households; and (iii) collateral constraints on impatient households and entrepreneurs, capital requirement of banks, and limited saving of banks and entrepreneurs. These frictions lead to powerful propagation of shocks to returns on housing, capital, and bank loans through the fluctuations of balance sheets of banks, entrepreneurs, and impatient households.

It is impressive that the authors include all these frictions in a consistent model.

Nonetheless, there are some limitations of the authors' eclectic approach. Their framework does not explain a few fundamental questions. Why do we use non-contingent debt contracts for finance instead of equity contracts? The use of equity contracts would enable the lender and borrower to share the risk of returns on the borrower's asset, avoiding large fluctuations of the borrower's net worth. Why do we have banks in order to transfer funds from patient households to entrepreneurs and impatient households? Why do we need government deposit insurance when the deposit insurance causes such large distortions without proper regulations? Of course, answering all these questions is beyond the scope of this paper. But because the authors are analyzing the welfare implications of the model and making policy recommendations, they should be aware of these questions and try to tighten their theory by referring to the existing literature. Concerning the use of debt contracts, we learn from Townsend (1979) and Gale and Hellwig (1985) that the debt contract is an optimal contract if it is costly for the lender to verify the realized return on the borrower's asset. The only problem for the authors in applying this argument is that the idiosyncratic shock to the asset return is costly to verify, but the aggregate shock is not very costly to verify. Then the aggregate shock is shared between the borrower and the lender under the optimal contract, which would reduce the financial accelerator significantly. Perhaps the authors can argue that the idiosyncratic shocks are much larger than the aggregate shocks for the returns on assets of the individual borrower and thus it is not easy to disentangle the idiosyncratic and aggregate shocks within a period so that the debt contract is an approximately optimal contract.

Concerning the role of banks, Diamond (1984) and Willamson (1987) show that when savings of many households are needed to fund a borrower's project and it is costly for any individual lender to verify the returns of the project, it is efficient to delegate the monitoring role to one lender, the banker (because it is not efficient for many lenders to monitor one project simultaneously). In an ideal situation in which the banker can completely diversify the risk of returns on private loans by lending to many borrowers, the banker can provide safe returns to the other savers (depositors), and thus the other savers do not have to monitor the banker. But when the

banker cannot completely diversify the risk of returns on private loans, then a difficult question of "monitoring the monitor" arises. (See Krasa and Villamil 1992.) One solution is that the banker holds significant equity relative to the risky loans to absorb the default risk of borrowers so that many depositors do not have to closely monitor the banker. Another solution is that the government (or regulator) monitors the banker as a delegated monitor of depositors after the banker defaults on their obligation to the depositors. If the government guarantees the returns to the depositors through deposit insurance, the depositors do not have to worry that the banker and the government may collude and divert their funds together. A related but different argument for the rationale of prudential regulation is made by Dewatripont and Tirole (1993). Of course, this paper's main argument that deposit insurance causes moral hazards of banks (especially after deregulation) has a long tradition, including Kareken and Wallace (1978).

The authors assume that bankers and entrepreneurs live for two periods, do not consume themselves, and derive utility from the dividend payment to impatient households and the bequest to the next generation of bankers and entrepreneurs. I understand that this is a convenient shortcut to simplify the analysis, but I do not fully understand the roles of entrepreneurs and bankers in this model. Are they real persons who have their own objectives, or are they the agents of impatient households? If they are real persons, why does the social welfare not depend upon their utility? If they are agents of impatient households, why is their objective risk neutral when the impatient households are risk averse? It reminds me of the corporate governance of the Chinese giant company Alibaba, where equityholders receive some dividends and might enjoy capital gains, but they do not have control over the management.

Despite the above theoretical problems, I find the quantitative analysis of this paper for policy evaluation interesting. Yet, the authors perhaps exaggerate the magnitude of resource cost after defaults, because it seems enormous that 30 percent of houses, capital, and bank assets disappear from the economy after they default. Although some resources are wasted after defaults, I consider the effect of defaults to be largely redistribution; the creditors lose and debtors gain from the limited liability. Perhaps one of the reasons why the authors need such a large social cost of defaults is that

the model does not have powerful enough propagation through the fluctuation of asset prices. In their model, the supply of housing and capital is elastic in the long run, even though it is imperfectly elastic in the short run. Thus, the long-run prices of housing and capital are constant and normalized to be unity; their prices cannot be away from unity for a long time. (Even if the asset prices fluctuate in their model, it is largely because their depreciation shocks are persistent by assumption.) I find it a serious limitation, especially for housing. A large part of housing value is the value of land, and the supply of land is inelastic. Thus the housing price can fluctuate and can be away from the normal level for a long time. In Japan, the aggregate land value more than doubled in the 1980s, but it declined since 1992 for more than two decades to a level below that of 1980. If housing and capital contain factors of production with limited elasticity of supply, such as land and intangible capital, then the value of housing and capital would fluctuate more; the fluctuation of net worth of impatient households, entrepreneurs, and banks would be larger; and the financial accelerator effect would be more significant even without the large costs of bankruptcy.

When the prices of housing and capital fluctuate significantly, the idiosyncratic shock to the returns on the bank loan pool, a measure of financial distress, would fluctuate endogenously (instead of being exogenous as in this paper). Each bank often has a comparative advantage in making loans in particular areas and industries, and their collateral value tends to fluctuate more than the national average. Then, when the probability of declining collateral value increases with recession in some regions and industries, the idiosyncratic shock to the returns on the bank loans increases endogenously. In other words, the financial accelerator operates both at local and at aggregate levels, which causes a significant increase in financial distress.

While this paper makes a significant contribution to our understanding of propagation through the balance sheets of banks, entrepreneurs, and households, I still believe we have a way to go in learning the costs and benefits of macroprudential regulation.

References

Admati, A., and M. Hellwig. 2013. *The Bankers' New Clothes.* Princeton, NJ: Princeton University Press.

Dewatripont, M., and J. Tirole. 1993. *The Prudential Regulation of Banks*. Cambridge, MA: MIT Press.

Diamond, D. 1984. "Financial Intermediation and Delegated Monitoring." *Review of Economic Studies* 51 (3): 393–414.

Gale, D., and M. Hellwig. 1985. "Incentive-Compatible Debt Contract: The One-Period Problem." *Review of Economic Studies* 52 (4): 647–63.

Kareken, J. H., and N. Wallace. 1978. "Deposit Insurance and Bank Regulation: A Partial-Equilibrium Exposition." *Journal of Business* 51 (3): 413–38.

Krasa, S., and A. Villamil. 1992. "Monitoring the Monitor: An Incentive Structure for a Financial Intermediary." *Journal of Economic Theory* 57 (1): 197–221.

Townsend, R., 1979. "Optimal Contracts and Competitive Markets with Costly State Verification." *Journal of Economic Theory* 21 (2): 256–93.

Williamson, S. 1987. "Financial Intermediation, Business Failures and Real Business Cycles." *Journal of Political Economy* 95 (6): 1196–1216.