Bank Portfolio Choice, Uninsurable Risks and Regulatory Constraints

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In this paper we estimate a structural quantitative model of banking to perform counterfactual experiments that can be used to inform the policy debate of the likely economic outcomes from various policy decisions, including forcing banks to hold more equity capital. Relative to the existing literature, the model has a rich balance sheet structure where wholesale funding and liquid securities coexist in the bank's balance sheet, with substantial cross-sectional heterogeneity arising from background risks and bank choices. We emphasize the maturity transformation role of banks with loans having a larger duration, while banks can decide simultaneously on new loans, dividends, money market borrowing and liquid asset holdings, while they make endogenous default decisions.

Policy makers recognize the importance of developing quantitative models to assess both microprudential and macroprudential risks in the financial system. These tools aim to improve the identification and assessment of systemically important risks from high leverage, credit growth, or money market freezes. Moreover, quantitative structural models can be used in real time to perform counterfactual experiments and complement the tools available to regulators upon making policy decisions. Interesting counterfactuals might be a change in capital requirements by a certain pre-specified point in time. For instance, in October 2011 European political leaders agreed that Eurozone banks should increase their Core-Tier I capital ratio to 9% by the end of June 2012 to boost trust in the solvency of the banking system. A quantitative model that could assess the range of possibilities in the nine months following the decision would be a useful complement to the other inputs used in analyzing the impacts of such a decision.

Given the need for such applied, quantitative models, we construct a structural model of bank lending behavior, assuming that a bank's objective is to maximize shareholder utility. Banks perform dynamically a maturity transformation function as in Diamond and Dybvig (1983). In addition, banks face the possibility of financial distress that affects their optimal decisions. Financial distress may arise from adverse shocks in profits that may lead to equity capital shortfalls, in conjunction with a debt overhang problem discussed in Duffie (2010) that prevents banks from raising external equity capital in a crisis situation. Bank financial distress may also arise due to elevated costs of wholesale funding or, in an extreme case, a money-market freeze due to market imperfections.[1]

Banks' optimal decisions are influenced by perceived profit opportunities, funding conditions and background risk perceptions. Such perceptions are driven by exogenous processes for funding costs, asset quality (such as the loan write-off levels) and shocks to certain balance sheet items, such as customer deposits and tangible equity. We emphasize that despite being exogenous, these data generating processes are calibrated using microeconomic bank balance sheet and profit and loss data and are consistent with the empirical evidence. Banks therefore face different background risks in an incomplete markets setup in the spirit of Allen and Gale (2004).

Our approach is quantitative in nature, with the model evaluated by its ability to replicate the cross-sectional and time series evolution of bank balance sheets in the U.S.. The empirical part of the approach is inspired by Kashyap and Stein (2000) and Berger and Bouwman (2013). We condense this heterogeneity into a few broad categories: long-term loans and short-term liquid assets on the

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[1] Banks' limited access to equity markets could also arise due to adverse selection problems a la Myers and Majluf (1994) and the information sensitivity of equity issuance. That problem might be particularly acute in a situation where a bank faces an equity shortfall due to loan losses, in which case information sensitivities may prevent the bank from accessing external equity capital from private investors.

asset side; and long-term deposits, short-term wholesale liabilities, and equity on the liability side. We do so because we are interested in providing a setting where policy advice can be readily given through counterfactual, quantitative experiments using a richer balance sheet structure than existing models.

The quantitative model is estimated using a Method of Simulated Moments (see, for example, Hennessy and Whited (2005)) and is successful in replicating the data in a number of dimensions. In the model, smaller banks rely more on deposits than larger banks because smaller banks face a larger cost of accessing wholesale markets. As a result, larger banks are also more highly levered than smaller banks. Moreover, leveraged banks are more likely to fail in a recession, both in the model and in the data. Banks invest in liquid assets along with making loans and the model replicates the substantial component of liquid assets in the balance sheet. Liquid assets are held as a way to hedge illiquidity risk arising from long-term loan provision and also as a way to smooth background risk (deposit outflow volatility).

The model replicates the wide range of cross sectional heterogeneity in loans and liquid assets to total assets through the idiosyncratic risks (deposit and loan write-off shocks) that each bank faces. The tighter deposit to asset ratio is also replicated through a convex funding cost to access the wholesale market.

Empirically, in the time series dimension, the deposit to asset ratio is countercyclical while the loan to asset ratio is procyclical. Leverage and failure rates are also countercyclical. The model predicts similar cyclical properties for these variables. The deposit to asset ratio in the model is countercyclical because banks lower lending and shrink their balance sheets by reducing reliance on wholesale funding markets during recessions. The model also predicts strongly procyclical loan growth that is slightly asymmetric (positive spikes tend to happen when the economy exits the recessionary period). The model also generates strongly countercyclical failure rates, consistent with the data. Moreover, these failure rates are more likely for highly levered firms and are driven by bad loan shocks. Overall, we interpret these findings as consistent with quantitative features of the data, therefore we use the model for counterfactual analysis.

One issue of policy concern that the model can be used to analyze is the effect of changing capital requirements. Maintaining a higher level of capital (lower leverage) could increase banks' resilience to shocks and reduce the likelihood of bank failures. On the other hand, imposing higher capital requirements is likely to become a contentious issue with most bank executives pointing out that such measures could negatively affect banks' return on equity and their ability to provide financial intermediation services for the real economy. Moreover, more stringent capital requirements can potentially reduce banks' financial flexibility and therefore might increase the likelihood of failure. Therefore, setting capital requirements at an appropriate level is a balancing act.

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