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Assessing macro-financial linkages: A model comparison exercise

R. Gerke [a], M. Jonsson [b], M. Kliem [a], M. Kolasa [c], P. Lafourcade [d], A. Locarno [e], K. Makarski [c], P. McAdam [f,*]

[a] Bundesbank, Germany
[b] Sveriges Riksbank, Sweden
[c] Narodowy Bank Polski, Poland
[d] De Nederlandsche Bank, The Netherlands
[e] Banca d'Italia, Italy
[f] European Central Bank, Germany

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ABSTRACT

The recent global financial crisis has increased interest in macroeconomic models that incorporate financial frictions. We illustrate the simulation properties of five medium-sized general equilibrium models used by central banks in the Eurosystem. The models include a financial accelerator mechanism (convex "spread" costs related to firms' leverage) and/or collateral constraints (based on asset values). We provide results from impulse responses to shocks originating in the financial sector as well as a monetary policy shock. Overall, the models share qualitatively similar and interpretable features. This gives us confidence that we have some common understanding of the mechanisms involved. Finally, we survey recent trends in the literature on financial frictions.

1. Introduction

Recent episodes of financial-market turbulence from 2007 onwards have increased the demand for general equilibrium models that can account for the interaction between financial markets, inflation and the real economy. Yet, many existing policy models largely assume frictionless financial markets (with a few notable exceptions, such as Christiano et al., 2003). This reflects academic and empirical controversy regarding the importance of financial channels. Some analyses stress them as a key amplifier and source of business-cycle fluctuations (e.g. Bernanke et al., 1999) while others suggest that their impact may be confined to periods of deep financial distress (see Meier and Mueller, 2006).

Moreover, the spreads between policy and commercial rates are typically small with similar time-series properties, justifying modelers turning a blind eye. During periods of intense financial stress, however, this breaks down (e.g., Gilchrist and Zakrajsek, 2012). The question then becomes how frequent large financial crises are. In their wide-ranging historical study, Reinhart and Rogoff (2009) suggest that financial crises are frequent and share many common characteristics, in particular plunging stock and house prices, persistently high unemployment rates, and soaring government debt.

Against this background, our paper surveys the strength and nature of financial channels and frictions in a number of prominent central bank models of the Eurosystem, when examined over common simulation exercises. The paper proceeds as follows. In the next section, we address the important developments in modeling of financial frictions. Section 3 takes a first look at the participating models. They represent a useful cross-section: three are estimated on euro area data, one from Swedish and one from Polish data — the latter two are thus examples of countries outside the single currency. In Section 4 we present harmonized model simulations. These are useful for two main reasons: (i) if, for commonly scaled shocks, the models share qualitatively similar and interpretable features, this gives us confidence that we have some common understanding of the mechanisms involved, and (ii) model development is a continuous process and so comparisons of model reactions allow us to build up robustness and common knowledge in the development and assessment of existing models. The common shocks considered are: a standard monetary shock, an equivalent spread shock, a net worth shock, a loan-to-value ratio shock, and a "valuation" shock. We finish by describing briefly an emerging new generation of models with financial frictions looking at future research direction in the field of modeling financial friction.

* Corresponding author.
E-mail address: peter.mcadam@ecb.europa.eu (P. McAdam).

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2. Related literature

The financial crisis of the past three years has spawned a wealth of papers attempting to model its main narrative lines, in particular the macro-financial feedback effects. Nevertheless, the profession did not wait for the onset of the crisis to try to embed financial frictions into a macroeconomic framework: a generation of models grew out of the Bernanke and Gertler (1989) and Bernanke–Gertler–Gilchrist (BGG, 1999) financial accelerator and the Kiyotaki and Moore (KM, 1997) collateral constraint analyses, both developed more than a decade ago. Such models provided new channels to amplify and propagate real and financial shocks to the real economy. At the heart of these models are agency problems between borrowers and lenders that are solved with appropriate contracting schemes, which in turn introduce a role for leverage, risk and spreads. The BGG framework emphasizes the role of the external finance premium, the cost wedge between raising funds internally or externally; the KM framework highlights instead the importance of collateral constraints, which restrict borrowing to a fraction of assets. In both cases, variations in asset prices are key in determining borrowing behavior, as they affect either the price (via the finance premium) or the quantity (via collateralization) of funds available to borrowers.

In the following, we highlight some contributions in the literature on these two channels that have made their way into central banks' modeling apparatus, and in particular the five country models that we analyze in the next sections. Admittedly, these contributions do not necessarily reflect the current frontier in research. The reason lies not in lack of interest or resources in central banks but in an incompressible delay from theory to application in the policy world. Models have to be probed, tested, and validated before they can be put online, at the risk of being quickly obsolete. Much work is being done in central banks to integrate the latest research developments into the policy sphere, but the analysis presented here rests on an established modeling core. Section 6 will discuss future directions for central bank models.

2.1. Collateralized debt and business cycle fluctuations

In their seminal paper, Kiyotaki and Moore (1997) show that small and temporary shocks to productivity are amplified and propagated into the economy when debt is fully collateralized. Ex ante heterogeneity across agents in impatience ensures that, in equilibrium, patient agents lend funds to impatient ones, generating credit flows in the economy. Furthermore, physical assets are used both as a factor of production and as collateral for loans. The dynamic interaction between the price of the asset and the credit limits acts to amplify the effect of productivity shocks on output and make it more persistent.

Collateral constraints and discount factor heterogeneity have become popular features in business cycle models, as they have proved useful to explain macro-financial linkages via housing market dynamics. Iacoviello (2005) first highlighted how nominal debt contracts and collateral constraints tied to housing values were instrumental in matching the positive response of spending to a housing price shock and the sluggish reaction of real spending to an inflation shock. More recently, Iacoviello and Neri (2010) find with a KM-style model that shocks to housing demand and supply and to monetary policy account for most of the dynamics of residential investment and housing prices, and that spill-overs from housing markets to consumption are empirically sizeable. With a similar framework, Campbell and Hercowitz (2005) find that lower downpayment requirements and amortization rates for durable goods purchases, as implemented in the financial reforms in the early 1980s, accounted for a large part of the decline in the volatility of output, consumption, and hours worked observed in the Great Moderation. Collateral constraints of the Campbell–Hercowitz type can reproduce the response of durable and non-durable spending to monetary policy shocks, as shown by Monacelli (2009). Calza et al. (in press) show with a similar framework that, in line with empirical evidence, the transmission of monetary policy shocks to residential investment and consumption is stronger when down-payment rates are low and mortgage contracts are set with variable rates. In sum, collateralized household debt is critical to replicate several business-cycle facts related to consumption spending, housing prices and housing investment.

2.2. The external finance premium

The BGG financial accelerator mechanism has also spawned a large literature emphasizing financial frictions on the corporate side. The mechanism relies on interacting production technologies with asymmetric information. The acquisition of capital is financed from both entrepreneurial net worth and external funds. Using a "costly state verification" approach à la Townsend (1979, 1988), BGG assumes that capital goods producers can easily observe the returns to their individual projects, but lenders must incur a cost to do so. This agency problem is solved with an optimal contract that trades off monitoring costs and default probabilities, and implies an external finance premium that depends on the entrepreneur's leverage ratio. It therefore represents a novel amplification and propagation mechanism of productivity shocks.

Using a BGG-style quantitative model, Christiano et al. (2003) argue that the borrowers' balance sheet channel was a major contributor to the amplification and persistence of the Great Depression, much of which owed to an exogenous rise in households' liquidity preference. A shift in preference for accumulating currency instead of time deposits crimps investment by reducing the availability of external funds to entrepreneurs. The accelerator effect, working through the fall in entrepreneurial net worth, exacerbates the impact of the shock on the aggregate economy. Christensen and Dib (2008) show with an estimated version of the BGG model that the financial accelerator improves the fit with respect to US data. Moreover, the nominal aspect of financial contracts significantly amplifies and propagates the effect of demand shocks on investment, while it dampens the effect of supply shocks. Christiano et al. (2010) estimate a similar model on US and Euro data with new financial disturbances capturing time-varying risk profiles of entrepreneurs and their survival probabilities. The authors find that roughly a fifth of the cyclical variability of output in the EU and the US owes to these two shocks, and in particular to the risk shock. When adding an international dimension to the framework, Dib et al. (2008) find that, when applied to Canadian data, financial shocks to the domestic credit market explain a large fraction of cyclical volatility in real variables, while international financial disturbances account for around 10% of it. These studies underscore the empirical importance of the financial accelerator in business-cycle analysis.

KM-style agency costs and BGG-style financial accelerators need not be confined to the household and corporate decision problem, respectively. For example, Carlstrom et al. (2010) integrate collateral constraints on the corporate side, by assuming that labor demand must be partly financed by borrowing, which is itself constrained by entrepreneurial net worth and profits. This set-up generates a feedback loop between asset prices and productive inputs, with interesting amplification and propagation features. Conversely, Aoki et al. (2004) introduce the financial accelerator in a framework with housing investment, where home buyers are the ones to face an external finance premium. This mechanism amplifies and propagates the effect of monetary policy shocks on housing investment, housing prices and consumption. Cúrdia and Woodford (2010) also play the same mixing game, by introducing a time-varying wedge between the interest paid on household debt and earned on household saving. The set-up yields two sources for a credit-spread: financial intermediation