Journal of Banking & Finance 34 (2010) 1839–1848

Contents lists available at ScienceDirect

Journal of Banking & Finance

journal homepage: www.elsevier.com/locate/jbf

How resilient is the German banking system to macroeconomic shocks? ☆

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ARTICLE INFO

Article history:
Received 28 April 2008
Accepted 1 December 2009
Available online 5 December 2009

JEL classification:
C32
E44

Keywords:
Stress testing
Banking
VAR
Financial stability

ABSTRACT

Macroeconomic stress testing studies often rely on rather short sample periods due to the limited availability of banking data. They may fail to appropriately account for the cyclicality in the interaction between the banking system and macroeconomic developments. In this paper, we use a newly constructed data set on German banks' income and loss statements over the past 39 years to model the interaction between the banking sector and the macroeconomy. Our VAR analysis indicates that the level of stress in the banking sector is strongly affected by monetary policy shocks. The results rationalize the active behavior of central banks observed during periods of financial market crises.

1. Introduction

Macroeconomic stress testing of the banking system has become an important tool for financial stability analysis (Sorge, 2004). While stress testing at the level of individual banks has been widely applied by banks since the early 1990s (see e.g. Alexander and Sheedy, 2008), macroeconomic stress testing as a means to assessing entire financial systems is a more recent tool. Motivated by the financial crises in emerging markets and the increasing worldwide integration of financial markets, central banks and international institutions in the late 1990's took lead in augmenting the micro perspective at the individual bank by a macro perspective that addresses overall financial stability. Even though the weakness of individual banks possibly will be the trigger to larger crises, it is mostly the deterioration of the macroeconomic environment that makes the single bank fail and may cause chain reactions in a tightened surrounding (Gavin and Hausmann, 1995). Major crises in the financial system, therefore, cannot simply be dispatched as a result of failures in single institutions; it is the interaction between the financial system and the macroeconomy that drives the dynamics. Increasingly, central banks study this interaction to assess the resilience of the financial system, especially the banking system, to extreme but plausible shocks to its operational environment (ECB, 2006, pp. 147–153). The most extensive appliance of macroeconomic stress testing so far was accomplished by the IMF as part of its Financial System Assessment Programs (FSAPs).

As a field of academic research, macroeconomic stress testing is rather new. First publications mainly evaluated the basic analytical tools and approaches used within the FSAP launched by the IMF and the World Bank (see e.g. Blaschke et al., 2001). In more recent years, several contributions have tried to measure and analyze the influence of macroeconomic shocks on the stability of financial systems. They offer different approaches to carry out macroeconomic stress testing. Initial approaches, used e.g. by Kalirai and Schleicher (2002) and the IMF in its country FSAPs, rely on single factor sensitivity tests. They look at the impact of a marked change in one variable, say e.g. the policy interest rate, on banks' balance sheets (Hoggarth et al., 2005a,b). Kalirai and Schleicher (2002) use the aggregated loan loss provision as an indicator for the soundness of the Austrian banking sector. Using single equations and a large array of macroeconomic variables, they find, e.g., that an increase in short-term interest rates or a cutback in industrial production have remarkable impacts on loan loss provisions. The drawback of this approach is that it does not allow for interaction between macroeconomic variables. And obviously no "shock-scenarios" involving shocks to more than one macroeconomic indicator can be implemented.

Consequently, later studies are based on either larger scale structural macroeconomic models (see e.g. Hoggarth et al.

☆ The work for this paper was financially supported by Stiftung Geld und Währung.

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doi:10.1016/j.jbankfin.2009.12.001

(2005a) or Evjen et al. (2005)) or on VAR approaches. Hoggarth et al. (2005b) apply a "pure macroeconomic approach" and use a vector autoregressive (VAR) model in their stress test for UK banks. They include write-offs as financial stress indicator and (among other variables) the output gap, the short-term interest rate, and the exchange rates. Their results suggest that following unexpected increases in the output gap the ratio of write-offs to the volume of loans decreases. Recent studies which adopt the same methodology as Hoggarth et al. (2005b) are for instance Marcucci and Quagliariello (2009), who analyze the cyclical behavior of default rates of Italian bank borrowers, or Filosa (2007), who explores how adverse macroeconomic shocks may impair Italian banks' soundness. Both studies show that there are significant interactions between the health of the banking sector and macroeconomic conditions. Pesaran et al. (2006) use VAR models to assess the impact of macroeconomic variables on firms' probabilities of default in a so called micro–macro approaches, in which they use firm specific as well as macroeconomic data.

To orthogonalize the variance–covariance matrix, all of the above mentioned papers that use VAR models apply a Cholesky decomposition of the residual covariance matrix. Doing so, they have the drawback that a particular ordering of the variables must be adopted. Other identification procedures are suggested by Blanchard and Quah (1989) or recently by Uhlig (2005), whose approach was adopted by Worms et al. (2006) in the framework of modeling financial markets. Worms et al. analyze how bank lending to the private non-banking sector responds dynamically to aggregate supply and demand shocks as well as monetary policy shocks in Germany and the Euro area.

While the latter study is not primarily concerned with stress testing, another recent contribution, which deals with the stability of the German banking sector and uses the sign-restriction method, is presented in De Graeve et al. (2008). In this paper the authors investigate how monetary policy shocks affect financial stability. Furthermore, they quantify the importance of feedback mechanisms between the real and financial sector using an integrated micro–macroeconomic approach.[1] Thereby, they extend the methodological work of Jacobsen et al. (2005), who analyze interactions between the Swedish macroeconomy and the corporate sector. The macroeconomic part of their model consists of a standard VAR. The banking sector is modeled at the micro level using bank specific data. Using a logit model, probabilities of bank distress are linked to bank specific variables and the macroeconomic environment. The two parts of the model are then combined to yield an integrated "micro–macro" model which takes into account bi-directional feedback effects.

A general problem, which all of the mentioned approaches face, is the availability of only a scarce amount of data on the banking system. Using quarterly data, aggregate balance sheet information usually is available for not more than 15 years (Hoggarth et al., 2005a). In addition it is questionable if the allocation of balance sheet entries to specific quarters reflects the true occurrence of events along the time dimension. Specific information on data for individual banks is usually available even more sparsely. Consequently, much of the existing empirical literature is based on rather small samples which typically cover only a very limited number of business cycles.

This is where the present paper adds to the literature. We present an assessment of how the German banking sector reacts to macroeconomic shocks based on a long history of macroeconomic and banking data. The newly constructed data set stretches over 39 years and includes four complete business cycles. As our main indicators for stress, we use data from the banks' income statement, in particular the write-off ratio and return on equity.

The empirical work is based on the Bayesian estimation of a structural VAR which requires imposing only a minimum of sign-restrictions to identify the structural shocks (Uhlig, 2005). We identify a contractionary monetary policy shock, a negative demand shock, and a negative supply shock by imposing short-run sign-restrictions on the vector of the impulse responses. The advantage of using a VAR model is that we avoid modeling the exact structure of the economy, the banking sector and the transmission channels. In addition, the identification of structural shocks via the sign-restriction approach is very convenient because our results do not depend on e.g. the order of the variables or similar restrictive assumptions. In addition, the VAR approach allows for potential feedback effects from the financial sector onto the real economy. Following an adverse macroeconomic shock, banks could for instance restrain credit volumes due to asymmetric information problems which could – in an extreme case – lead to a credit crunch scenario (Yuan and Zimmermann, 2004) that would amplify the initial negative shock on the real economy.[2]

Our results suggest that especially contractionary monetary policy shocks significantly worsen the soundness of the banking sector. This is reflected in a quite strong increase in write-offs and a considerable decrease in return on equity. In contrast, supply shocks as well as demand shocks cause less vehement declines in return on equity and do not provoke remarkable changes in the level of write-offs. The results indicate, hence, that the way how monetary policy is conducted is of utmost importance for the financial stability of the banking sector.

The remainder of the paper is organized as follows. Section 2 provides information on the new data set and the empirical model that is used for the analysis. Section 3 briefly describes the applied identification technique for the structural VAR model. Section 4 presents the empirical results and their interpretation. Finally, Section 5 concludes the paper.

2. The empirical model

A number of modeling choices have to be made when the interaction between the banking sector and the macroeconomy is to be studied. The macroeconomy can either be modeled by a traditional structural macroeconomic model or as an identified VAR model.[3] The banking sector can be modeled using bank balance sheet data, financial market prices or data on "trouble" if not outright default in the banking sector.[4] We choose a combination of an identified VAR macro-model with the bank balance sheet data approach. The choice of the latter owes to the fact that this type of data has not been analyzed before for Germany and is – on an aggregate level – available for a large time span. The choice of the identified VAR approach is motivated by the fact that we do not have to impose many restrictions that imply particular assumptions about the exact working of the macroeconomy.

The particular VAR model we use is a slightly augmented version of the standard monetary VAR (see e.g. Christiano et al., 1999). The standard monetary VAR comprises three variables, real GDP, consumer prices (CPI), and the 3-months interest rate. We augment this standard setup by including US GDP as an exogenous variable to account for the fact that Germany is a rather open economy and by a variable that represents the state of the aggregate banking sector. The latter variable is treated as an additional

[1] Linkages between the stance of the banking system and economic growth are also highlighted in Hasan et al. (2009) or Ramírez (2009).

[2] See also Hubbard (1995) or Bernanke et al. (1999) among others for a discussion on how the banking sector might propagate business cycle shocks.

[3] Bardsen et al. (2008) compare various macroeconomic modeling approaches for financial stability analysis. They emphasize the use of structural (identified) models.

[4] See De Graeve et al. (2008) for this approach.