Economic Modelling 42 (2014) 77–93

Contents lists available at ScienceDirect

Economic Modelling

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

Macro effects of capital requirements and macroprudential policy

Q. Farooq Akram *

Research Department, Norges Bank, Bankplassen 2, P.O. Box 1179 Sentrum, 0107 Oslo, Norway

ARTICLE INFO

Article history:
Accepted 23 May 2014
Available online 2 July 2014

JEL classification:
C52
C53
E52
G38

Keywords:
Basel III
Capital requirements
Macroprudential policy

ABSTRACT

I investigate macro effects of higher bank capital requirements on the Norwegian economy and their use as a macroprudential policy instrument under Basel III. To this end, I develop a macroeconometric model where the capital adequacy ratio, lending rates, asset prices and credit interact with each other and with the real economy. The empirical results suggest that changes in capital requirements are primarily transmitted via lending rates to the other variables in the model. The proposed increases in capital requirements under Basel III are found to have significant effects especially on house prices and credit. I also derive optimal paths for the countercyclical capital buffer in response to various shocks. The buffer is found to equal its imposed ceiling of 2.5% in response to most of the shocks considered while its duration varies in the range of 1–12 quarters depending on the shock and its persistence.

1. Introduction

I investigate macroeconomic effects of higher capital requirements on the Norwegian economy and their use as a macroprudential policy instrument. Macroprudential policy aims at promoting financial stability partly by e.g. managing growth in asset prices and credit. Excess growth in these variables over extended periods may be seen as a necessary condition for financial instability (e.g. Borio and Lowe, 2002; Reinhart and Rogoff, 2009; Schularick and Taylor, 2012). A number of studies have argued for time-varying capital requirements to avoid destabilizing credit growth (e.g. Bank of England, 2009; Brunnermeier et al., 2011). I investigate in particular possible effects of the capital requirements recently proposed by the Basel Committee on Banking Supervision (BCBS), which are referred to as Basel III (BCBS, 2010a). The new regulatory framework proposes a permanent increase in the common equity ratio of 2.5 percentage points (conservation buffer) and a systemic-risk dependent variation in the common equity ratio in the range of 0–2.5 percentage points (countercyclical buffer).[1] Furthermore, I shed light on the implementation of the countercyclical capital buffer in response to various shocks with different persistence.

I employ a quarterly macroeconometric model of the Norwegian (mainland) economy to conduct the analyses. The model includes empirical relationships between several real and financial variables, including those between house prices and credit to households, and between banks' capital adequacy ratio and lending rates. The latter relationship is among the novel features of this model, as an explicit account of capital requirements in macroeconometric models is rare (see Angelini et al., 2011; BCBS, 2010b and the references therein). To my knowledge, this is the first such model based on Norwegian data. The model employed is essentially a smaller version of a model that has been maintained by

* Tel.: +47 22316692.
E-mail address: farooq.akram@norges-bank.no.

[1] Basel III also entails more stringent requirements for the level and the quality of a bank's core capital. It also proposes restrictions on the maturity structure of banks' assets and liabilities to ensure sufficient liquidity and hedge against particularly large withdrawals of liabilities. These restrictions are formulated as two quantitative liquidity requirements: a liquidity coverage ratio (*LCR*) and a net stable funding ratio (*NSFR*). The liquidity coverage ratio concerns the required level of liquid assets a bank must have in order to be able to withstand periods of stress in the markets for funding while the net stable funding ratio concerns the composition of sources of funding or the stability of the funding. These restrictions may have additional effects on banks' funding costs and thereby lending rates which are not accounted for in the following analyses. Basel III is expected to be phased in gradually over the period 2013–2019, see www.bis.org/bcbs/basel3.htm for more details.

http://dx.doi.org/10.1016/j.econmod.2014.05.033

Norges Bank. However, it has been further developed, updated and adapted to conduct the analyses of interest to this paper.[2]

The literature on the design and effectiveness of macroprudential policy tools as well as the development of appropriate models for their investigation is still in its infancy. In general, there is a lack of theoretically well founded models for policy analyses that account for key relationships between the financial economy and the real economy in a satisfactory way (see e.g. Galati and Moessner, 2013; Tovar, 2008 and the references therein). Obtaining precise estimates of how the economy would have performed or how it will perform under alternative capital requirements is inherently difficult. It is not possible to say whether and to what extent the model's parameters will shift with new policy changes. However, I proceed under the assumption that the macroeconomic effects of changes in capital requirements will be comparable to those observed historically.

In the analysis of the countercyclical capital buffer as a macro prudential policy tool, the policymaker is assumed to minimize excessive fluctuations in aggregate credit growth while taking into account the effects of policy decisions on economic activity (cf. Haldane, 2012). I use aggregate credit growth as an indicator of systemic risk, for the sake of simplicity and because growth rates of credit and GDP are relatively more robust to data revisions than their levels (e.g. Edge and Meisenzahl, 2011; Orphanides and Norden, 2002). In response to a given shock, the policymaker is assumed to minimize the loss function by deciding on a future path for the countercyclical capital buffer. The path is defined by the size and duration of the countercyclical capital buffer. I derive such paths in response to various shocks for different degrees of persistence. I also investigate the sensitivity of such paths to the strength of the policymaker's concern for fluctuations in economic activity, and alternatively for fluctuations in the inflation rate.

The paper is organized as follows. Section 2 presents the empirical framework, while Section 3 employs the model to investigate the effects of increases in capital requirements on the Norwegian economy. In Section 4, capital requirements are used as a macroprudential policy tool within the Basel III framework in response to various shocks. Section 5 contains the main conclusions. Finally, the appendices contain data definitions, model documentation and sensitivity analyses.

2. The empirical framework

I first develop a system of dynamic econometric equations for the capital adequacy ratio, lending rates, house prices, credit to households and credit to (non-financial) firms to characterize their interaction with one another.[3] This equation system is then integrated into a macroeconometric model briefly presented in Section 2.4. This model contains dynamic equations for a number of other financial and real economic variables including short-term interest rates, equity returns, the nominal effective exchange rate, inflation and output. It was not feasible to develop a closed system of dynamic equations for a relatively large number of variables of interest to investigate how changes in capital requirements may be transmitted to the economy. The macro econometric model is therefore composed of a few small equation systems as well as single equation models, while conditioning on variables such as oil prices, foreign interest rates and foreign GDP (see e.g. Bårdsen et al., 2005, ch. 2, for a discussion of blockwise composition of macroeconometric models). Efficient inference about the parameters of interest in a partial model requires, however, that the conditioning variables are weakly exogenous with respect to the parameters of interest (Engle et al., 1983). Appendix B presents evidence of this with respect to key parameters in the (partial) system of dynamic equations for the capital adequacy ratio, lending rates, house prices, credit to households and credit to firms.

2.1. Capital ratio, lending rates, house prices and credit

The system of dynamic econometric equations for the capital adequacy ratio, lending rates, house prices, credit to households and credit to firms has been developed in two steps using quarterly data over the period 1992 q4–2010 q4. First, long-run relationships between a given set of variables in levels were established by testing for cointegration between the variables. The variables in levels were found to be unit-root non-stationary. Upon finding evidence of cointegrating relationships between the variables, a Vector Equilibrium Correction Model (VECM) was formulated, estimated by FIML, tested and, if required, respecified to satisfy a number of statistical model diagnostic tests and economic intuition (cf. Hendry, 1995).

In the following, I first present the estimated long-run relationships and then the VECM in Table 1. Unless stated otherwise, variable names in small letters denote the natural log of the corresponding variables, while Greek letters without subscript t represent parameter values. Δ and Δ_4 denote first- and fourth-difference operators, respectively.

2.2. Long-run relationships

The equilibrium value of the capital adequacy ratio (CAR) may be decomposed into the minimum common equity ratio required by Basel regulations and the equilibrium value of other capital components including hybrid capital, Tier 2 capital and additional capital held by banks beyond that required by capital adequacy rules. Banks may choose to hold capital in addition to that required by regulations as a hedge against credit and liquidity risk (Booth et al., 2001; Flannery and Rangan, 2006; Peura and Keppo, 2006).

The actual ratio of capital adequacy may temporarily deviate from its equilibrium value owing to prevailing regulatory and market conditions as well as banks' response to them. Such a characterization of the capital adequacy ratio is consistent with its quarterly time series suggesting that CAR fluctuates around a fairly stable value over the sample period 1992 q4–2010 q4. The null hypothesis of a unit root in CAR is rejected by an augmented Dickey Fuller test at the 5% level of significance. The long-run relationship for capital adequacy ratio may be described as:

$$CAR_t = \kappa + \varepsilon_{1,t}, \tag{1}$$

where κ represents the equilibrium value of CAR while $\varepsilon_{1,t}$ represents a zero mean stationary process. Accordingly, CAR_t deviates temporarily from κ. I estimate κ by taking the sample average of CAR_t, which equals 12.5% (see Eq. (1)).

When modeling lending rates (i^L), I assume that they reflect banks' funding costs in the long run, which depend on (short-term) money market rates (i) and costs of equity. The latter costs are assumed to depend on banks' return on equity and other possible costs of equity associated with e.g. issuing equity, monitoring and asymmetric information (e.g. Bolton and Freixas, 2006; Holmstrom and Tirole, 1997; Jensen, 1986; Kashyap et al., 2008; Repullo and Suarez, 2000). The following long-run relationship for lending rates may be specified:

$$i_t^L = (1-\mathrm{CAR}_t)i_t + \mathrm{CAR}_t(\Delta_4\mathrm{be}_t) + \gamma\mathrm{CAR}_t + \alpha + \varepsilon_{2,t}. \tag{2}$$

This equation expresses that lending rates (per annum) reflect a weighted average of money market rates (i) and return on bank equity ($\Delta_4 be$). The weights depend on the capital adequacy ratio, which is also

[2] The model used at Norges Bank is documented in Hammersland and Træe (2014) and is mainly based on Bårdsen et al. (2003, 2005).

[3] Capital adequacy ratio is defined as the sum of common equity, hybrid equity and additional equity (Tier 2), divided by risk-weighted assets. I also made an attempt to develop econometric models of the main subcomponents of the capital adequacy ratio but without much success.