Economic Modelling (xxxx) xxxx–xxxx

Contents lists available at ScienceDirect

Economic Modelling

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

Assessing the efficacy of borrower-based macroprudential policy using an integrated micro-macro model for European households☆

Marco Gross*, Javier Población

European Central Bank, Sonnemannstr. 22, 60314 Frankfurt am Main, Germany

ARTICLE INFO

JEL classification:
C33
E58
G18

Keywords:
Household balance sheets
Macro-financial linkages
Macroprudential policy

ABSTRACT

We develop an integrated micro-macro model framework that is based on household survey data for a subset of the EU countries that the Household Finance and Consumption Survey (HFCS) contains. We use the model for the purpose of assessing the efficacy of borrower-based macroprudential instruments, namely loan-to-value (LTV) ratio and debt service to income (DSTI) ratio caps, and illustrate its outcome for four European countries. The simulation results from the model can be attached to bank balance sheets and their risk parameters to derive the impact of the policy measures on their capital position. The model framework also allows quantifying the macroeconomic feedback effects that would result from the policy-induced reduction of demand for mortgage loans. An assessment as to the comparative efficacy of LTV- versus DSTI-based policy suggests that DSTI caps may be more effective in containing household risk.

1. Introduction

In the aftermath of the global financial crisis and the ensuing recessionary phase, central banks have significantly loosened monetary policy by both conventional and unconventional means. Some prominent commentators have recently argued that many advanced economies have entered a period of secular stagnation, whereby inflation would be expected to remain at low levels for long and potential output be falling for structural reasons.[1] Monetary policy is likely to remain accommodative in such an environment for a long time, to thereby help moving inflation back to target and supporting the economic recovery. The significant liquidity creation associated with loose monetary policy could, however, have unintended side effects on financial stability and to address the potential build up of financial imbalances under such circumstances, targeted macroprudential policy measures could help alleviate those. The hope is that macroprudential policy can help fine-tune, i.e. counteract the externalities arising from monetary policy action, both along a time and cross-section dimension, with the latter being relevant in particular in Europe where business and financial cycles remain de-synchronized across countries to an extent, while monetary policy is centrally defined.

Against this backdrop, the model framework that we develop is meant to help assess the impact that the use of macroprudential instruments might have, specifically by means of borrower-based measures such as Loan to Value (LTV) ratio caps or Debt Service To Income (DSTI) ratio caps. Quite some conceptual work has started to appear related to macroprudential policy and the channels through which it is expected to work; starting inter alia with Unsal (2011), Christensen (2011), Nier et al. (2012), and Kuttner and Shim (2012). Dynamic stochastic general equilibrium (DSGE) model applications as in Collard et al. (2012), Kannan et al. (2012) and Angeloni and Faia (2013) present a general discussion of how monetary and macroprudential policy can complement each other and they all took as a basis, in one form or another, the earlier DSGE model extensions with collateral constraints tying to real estate and the presence of debt as developed by Kiyotaki and Moore (1997) and Iacoviello (2005). Overall, this collection of papers conveys the conclusion that macroprudential policy can imply stabilization benefits.[2] An additional

☆ The authors would like to thank Niamh Hallissey, Yvonne McCarthy, Luca Onorante, Peter Lindner, Mario Pietrunti, Christoffer Kok, Oreste Tristani, Jirka Slacalek and Miguel Ampudia Fraile for valuable discussions, comments and suggestions. The paper has, moreover, benefited from useful comments and suggestions from the participants of various seminars, including those of an ECB-internal seminar on borrower-based macroprudential policy instruments organized in the DG Macroprudential Policy and Financial Stability in May 2015, an ESCB/HFCN workshop in June 2015 at the ECB, a thematic seminar organized by DG-Research of the ECB in July 2015, and of a seminar series taking place at the IMF (MCM department) in October 2015. We also thank three anonymous referees for their useful comments and suggestions.

* Corresponding author.
E-mail addresses: marco.gross@ecb.europa.eu (M. Gross), francisco_javier.poblacion_garcia@ecb.europa.eu (J. Población).

[1] See e.g. http://voxeu.org/content/secular-stagnation-facts-causes-and-cures for a compilation of articles related to the topic of secular stagnation.

[2] See also Bailliu et al. (2015) and Rubio and Carrasco-Gallego (2016) for two recent DSGE-model-based assessments and the potential for macroprudential measures to imply welfare gains specifically for Canada and Spain, respectively.

http://dx.doi.org/10.1016/j.econmod.2016.12.029
Received 6 July 2016; Received in revised form 23 December 2016; Accepted 24 December 2016

follow-up stream of DSGE models has emphasized the potential for a *countercyclical* use of LTV ratio-based policy to be beneficial potentially. Lambertini et al. (2013) argue that its countercyclical use in response to credit is Pareto improving for both borrowers and savers; conditional on the structure and the assumptions they build into their model. Mendicino and Punzi (2014) develop a two-country DSGE with heterogeneous households and collateralized debt in which a countercyclical LTV policy is beneficial when responding to house price changes. Gelain et al. (2013)'s DSGE model features housing and moving-average forecast rules and they illustrate that debt-to-income ratio-based policy measures can be more effective than LTV caps; a results that squares with the findings from our model. In addition to the DSGE-based research, agent-based models (ABMs) are recently gaining more prominence; for a recent application and as an entry point to ABMs for housing market-related analyses see Babtista et al. (2016) and references therein. See also Geanakoplos et al. (2012) who promote their ABM for the Washington DC area. The point they aim to emphasize is that leverage, not interest rates, are to be seen as the driving force that fuels booms and busts.[3]

On the empirical model side research is evolving though still scarce. Lim et al. (2011) use data from 49 countries to evaluate the effectiveness of macroprudential instruments such as LTV caps in reducing systemic risk over time and across markets. Their results suggest that many of the frequently used instruments are effective in reducing procyclicality and the effectiveness being sensitive to the type of shock that the financial sector faces. The paper identifies conditions under which macroprudential policy is most likely to be effective. Crowe et al. (2011) find a positive relation between LTV at origination and subsequent price appreciation using state-level data in the US; while otherwise this paper is rather devoted to discussing policy options that can help reduce vulnerabilities that lead to house price busts. Their discussion includes monetary and fiscal policy instruments, along with macroprudential measures, and the authors argue that the latter can be particularly useful due to their narrower focus which shall reduce their costs and make it easier to circumvent tendencies for regulatory arbitrage effects. Almeida et al. (2006) seek to find empirical support for financial accelerator effects to highlight how financial constraints can amplify asset price and credit demand fluctuations. Based on a series of panel models built on data from 26 countries they find that house prices are more sensitive to aggregate income shocks in countries with higher maximum LTV ratios. Moreover, new mortgage lending, expectedly then, is more sensitive to aggregate income shocks where maximum LTV ratios are higher; third, they find that the empirical relation between LTV ratios and income sensitivities is stronger in countries in which income constraints are less binding. Lamont and Stein (1999) find that in cities where a greater fraction of households have high LTV ratios, house prices respond more sensitively to economic shocks, in particular, to changes in per-capita income. Hong Kong is an example of a country that has been subject to close scrutiny and impact assessments for some time. A list of related studies includes e.g. Gerlach and Peng (2005), Ahuja and Nabar (2011), Wong et al. (2011), Funke and Paetz (2012), and Wong et al. (2014). The evidence suggests that LTV cap tightening in Hong Kong since 2009 has dampened both borrowers' leverage and credit growth and that lower leverage has played a role in strengthening banks' resilience to property price shocks.

Further sorting along the geography of the applications, research has been done for the Irish case. Cussen et al. (2015) conduct a micro-simulation exercise based on loan-level data to quantify the impact of various caps on loan volumes, to then employ a BVAR to simulate the macro impact for Ireland. Further related work for Ireland can be found in Kelly (2011), Lydon and McCarthy (2013), Hallisey et al. (2014), Kelly et al. (2015) and Cassidy and Hallissey (2016). For New Zealand, see e.g. Price (2014) and Bloor and McDonald (2013), who use a BVAR to conduct *ex ante* counterfactual analyses prior to the introduction of borrower-based policies; with the approach being adopted by Cussen et al. (2015). For Korea, Igan and Kang (2011) find that LTV and debt to income ratio caps help contain house price growth and transaction activity and the imposed limits work, notably, via expectations. The importance of an expectation channel is also highlighted in Lambertini et al. (2011) who develop a model of the housing market that incorporates expectation-driven cycles to then show that countercyclical LTV rules responding to credit growth can reduce the volatility of loans and the loan to GDP ratio. A useful recent paper summarizing the experiences with *ex ante* impact assessments of macroprudential instruments can be found in CGFS (2016).

The contribution of our paper, seen against this evolving strand of the literature, is to develop a fully integrated micro-macro model, to which we refer as the Integrated Dynamic Household Balance Sheet (IDHBS) model. To the best of our knowledge it is the first model of its kind to assess the efficacy of borrower-based instruments, such as LTV or DSTI caps. We employ household-level survey data which forms the basis for the micro component of the model and demonstrate how the model works and discuss the findings for four European countries (Austria, Belgium, Germany, and Portugal). Similar use of borrower-level data has been made only in the aforementioned model for Ireland (Cussen et al., 2015) and in Michelangeli and Pietrunti (2014). The difference to our framework is that Michelangeli and Pietrunti (2014) look at the evolution of household indebtedness and debt service ratios, while not aiming to obtain risk measures such as probabilities of default or loss given default, which is an essential output from our model. Likewise for Cussen et al. (2015); the authors use micro data to calibrate a policy-induced loan volume shock whose impact is assessed with the BVAR. The impact goes only from the micro shock to macro but not vice versa.

The novel features of our model can be summarized as follows: Primary outputs are measures of probability of default and loss given default at the household level. The risk parameter estimates can be obtained either with or without the imposition of LTV or DSTI caps, thereby allowing for a quantified impact assessment of the caps at self-defined thresholds. The household-level risk parameters are a function of macroeconomic and financial factors which drive the size and structure of households' balance sheets. It is a structural model approach in that sense. Interest rates, unemployment rates, income, house and stock prices, and others, are used to steer the household members' and household parameters and thus their implied PDs and LGDs. Policy cap-induced loan demand shocks are allowed to influence macroeconomic and financial variables which in turn are allowed to feed back to households' risk parameters. We allow for a two-way interaction between the macro and micro sphere. At this point, the macro model engine is designed in a way to allow for cross-country spillovers through trade and the credit supply channel. The macro model contains 28 EU countries, not only the four "focus" countries to which we apply the policy instruments, and rests on some ten macro-financial variables, covering a quarterly data sample from 1999Q1-2014Q4. Finally, the household-level risk parameters can in the end be aggregated to household sector (country) level and be attached to bank

[3] Our model can to some extent be seen as being agent-based as it comprises individual household agents from a large-scale micro survey dataset for households as well as individual bank balance sheets and risk parameters for individual bank agents. In that sense it drives the heterogeneity feature very much forward, a lot more than DSGE model extensions with heterogeneous agents. Our model is not, however, as comprehensive in terms of behavioral rules for the various agents that ABMs meanwhile contain and for this reason we refrain from assigning the ABM label to our model. ABMs, moreover, are meant to capture the detailed interactions of agents, in particular between firms and households that are employed at the firms, while this agent connection will be captured in our model in a more reduced-form, empirical manner by relating, for example, unemployment rates and other macroeconomic variables in the macro model engine of the IDHBS. We see this rather reduced-form capture of this element as advantageous over ABM model structures because ABMs are usually fully calibrated models, that do not quite match—from a quantitative perspective—various macroeconomic dynamics which is key, however, for the policy assessment we aim to conduct with the model.