



EAGLE-FLI: A macroeconomic model of banking and financial interdependence in the euro area[☆]



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ABSTRACT

We incorporate financial linkages in EAGLE, a New Keynesian multi-country dynamic general equilibrium model of the euro area (EA) by including financial frictions and country-specific banking sectors. In this new version, termed EAGLE-FLI (Euro Area and Global Economy with Financial Linkages), banks collect deposits from domestic households and cross-country inter-bank market and raise capital to finance loans issued to domestic households and firms. In order to borrow from local (regional) banks, households use domestic real estate whereas firms use both domestic real estate and physical capital as collateral. These features – together with the full characterization of trade balance and real exchange rate dynamics and with a rich array of financial shocks – allow to properly assessing domestic and cross-country macroeconomic effects of financial shocks. Our results support the views that (1) the business cycles in the EA can be driven not only by real shocks, but also by financial shocks, (2) the financial sector could amplify the transmission of (real) shocks, and (3) the financial/banking shocks and the banking sectors can be sources of business cycle asymmetries and spillovers across countries in a monetary union.

1. Introduction

The recent financial crisis, which resulted in a long period of economic stagnation and extremely low inflation, especially in the euro area (EA), and the ensuing debate on policy responses (in particular by central banks) have widely increased the need for understanding how domestic and cross-country financial factors might affect macroeconomic performance in a monetary union such as the EA. Cross-country heterogeneous conditions in financial markets and banking sectors within the union can make it difficult for the common monetary policy to guarantee the union-wide macroeconomic stability, while calling for macroprudential policies to foster financial stability at a country and, hence, union level. Thus, understanding the role of country-specific structural financial and banking features, their interaction within and across regions and their effect on the transmission mechanism of monetary policy is crucial for a proper analysis of monetary and

financial stabilization issues in a monetary union, and in particular for a thorough assessment of policy responses in the EA in the aftermath of the financial crisis.

To tackle these issues we enrich a multi-country model of the EA called EAGLE (Euro Area and Global Economy) model with financial frictions, banking sectors and a cross-country interbank market.¹ This paper describes the new model setup, labeled EAGLE-FLI (Euro Area and Global Economy with Financial Linkages),² and transmission mechanism via a set of simulations, that shows the macroeconomic effects of several financial shocks, to illustrate its usefulness from a policy perspective.

The original EAGLE model is a large-scale microfounded model developed for the analysis of spillovers and macroeconomic interdependence across the different countries belonging to the EA and between them and other countries outside the monetary union. The open economy version of the New Keynesian paradigm, so called New

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¹ See Gomes et al. (2010, 2012) for the description of the standard EAGLE model.

² Jointly developed by staff of Bank of Portugal, Bank of Italy, and European Central Bank, EAGLE-FLI is a project of the EAGLE Network, under the auspices of the Working Group on Econometric Modeling of the European System of Central Banks. Nikola Bokan was affiliated to Croatian National Bank during large part of projected development and would like to thank Croatian National Bank for all the support provided.

Open Economy Macroeconomics framework, constitutes EAGLE's theoretical framework and guarantees a nontrivial role for monetary, exchange rate, fiscal and structural policy measures. The microfoundations of the model together with its rich structure allow for a quantitative analysis in a theoretically coherent and fully consistent model setup, clearly spelling out policy implications.³

EAGLE-FLI adds the following features to the original EAGLE framework. First, we introduce two types of households, namely “borrowers” and “savers”. Second, we include a banking sector that intermediates credit flows (banking loans and deposits) in each of the four regions of the model. Third, we introduce a real estate sector in the economy that provides housing services to households, a stock of collateral to borrowers and that is used as an input in production. In each region, a bank collects deposits from domestic savers, raises capital subject to a regulatory requirement and lends both to domestic borrowing households and entrepreneurs, subject to a collateral constraint written on their real estate holdings and, for entrepreneurs, also on their physical capital. In addition, only banks located in the two EA regions have access to an interbank market to exchange funds cross-country. Fourth, we enrich the model with a set of financial shocks, such as shocks to the loan-to-value (LTV) ratio, the amount of resources that banks desire to lend in the interbank market, and the bank capital requirement. The shocks are simulated under perfect foresight, so households and firms perfectly anticipate their intertemporal path, but not the value in the initial period (the “surprise”). We also report a sensitivity analysis to further show the relevance of some key financial parameters for the transmission of the shocks.

Our results aim at explaining the domestic and cross-country transmission mechanism of various shocks in a monetary union model where financial factors do matter. Even though the analysis does not aim at quantitatively explain either the EA business cycle or the recent financial crisis, the results support the views that (1) the business cycles in the EA can be driven not only by real shocks, but also by financial shocks, (2) the financial sector could amplify the transmission of (real) shocks, and (3) the financial/banking shocks and the banking sectors can be a source of business cycle asymmetries across countries in a monetary union.

The EAGLE-FLI setup builds on several earlier contributions.⁴ The distinction between borrowers, entrepreneurs and savers follows Iacoviello (2005). As in that contribution, we assume that entrepreneurs and a fraction of households (the “borrowers”) are more impatient than remaining households (the “savers”), i.e. the former have a lower discount rate than the latter. Thus, the corresponding borrowing constraints are binding in the steady state and in its neighborhood. The banking sector is akin to the one in Iacoviello (2015).⁵

Regarding the capital requirement ratio, we follow Kollmann (2013) and Kollmann et al. (2013), and impose that in every period the bank capital should not be less than a (possibly time-varying) fraction of the bank loans to domestic households and entrepreneurs in the same period.

Kollmann (2013) and Kollmann et al. (2013) consider the case of a

³ The EAGLE setup builds on the New Area Wide Model (NAWM, (Coenen et al., 2008)). See also the IMF's Global Economy Model (GEM, Laxton and Pesenti, 2003 and Pesenti, 2008), the Bank of Canada's version of GEM (Lalonde and Muir, 2007), the Federal Reserve Board's SIGMA (Erceg et al., 2006), the European Commission's QUEST (Ratto et al., 2009), and IMF's Global Integrated Monetary Fiscal Model (GIMF, Kumhof and Laxton, 2007).

⁴ In line with these contributions, we assume a cashless economy, so there is no explicit role for money. The monetary policy rate, set according to a Taylor rule, is linked to the other interest rates, including the one holding in the interbank market, via no-arbitrage conditions obtained from banks', households' and entrepreneurs' maximization problems.

⁵ We follow Iacoviello (2015) and assume that entrepreneurs borrow against real estate and physical capital. This is different from Iacoviello (2005), where both borrowers and entrepreneurs use real estate as collateral.

global bank lending domestically and abroad. Different from them, we do not have a “global” bank that originates cross-border loans. Instead, we have country-specific banks that lend to and receive deposits from domestic agents and that, in the case of EA blocs, lend to each other in the EA interbank market. Allowing banks to lend and borrow at international level is different from allowing households to do the same, as they maximize different objectives subject to different constraints, such as the capital requirement. EAGLE-FLI features financial spillovers that directly affect banks behavior, and only indirectly (via banks) the foreign borrowers while in Kollmann (2013) and Kollmann et al. (2013) there is a direct spillover from bank to foreign borrowers.

The “region-specific” banking sector setup is also used in Brzoza-Brzezina et al. (2015), who develop a monetary union model of the EA featuring two regional banking sectors. Guerrieri et al. (2013) consider a two-region model calibrated to the EA featuring regional banks and sovereign debt default. Different from these contributions, we introduce a “region specific” banking sector in a large-scale open-economy New Keynesian dynamic general equilibrium model. Thus, the model includes several ingredients needed for the quantitative assessment of cross-country financial and banking spillovers in a monetary union.⁶

The paper is organized as follows. Section 2 shows the setup of the banking and financial sectors. Section 3 reports the calibration. Section 4 contains the results of simulating financial shocks and the sensitivity analysis. Section 5 concludes.

2. The model

In this section we report the novel features that characterize the EAGLE-FLI setup. The model features the world economy, whose size is normalized to one. It consists of four blocs (each bloc represents a country or a region). $s^H, s^{REA}, s^{US} > 0$ are respectively the sizes of Home, REA and US blocs, and $s^H + s^{REA} + s^{US} < 1$. For each bloc, the size of the economy corresponds to the size of population (sum of households, bankers, entrepreneurs) and to the size of each firms' sector (intermediate tradable, intermediate nontradable, final nontradable sectors). We assume that two blocs, labelled Home (H) and rest of the EA (REA), are members of a monetary union, the EA. Thus, they share the monetary policy authority and the nominal exchange rates against the remaining two blocs, assumed to represent the U.S. (US) and the rest of the world (RW).

In what follows we focus on a description of the H bloc of the EA. We describe the banking sector, households' and entrepreneurs' behavior, the monetary authority, market clearing conditions, net foreign asset position and international relative prices. Other blocs are similar, so we do not report the related equations to save on space. The exception is that the US and RW blocs differ from those of the EA because their banking sectors do not lend/borrow in a cross-border interbank market.

2.1. The banking sector

The Home economy is populated by a continuum of banks that act under perfect competition and, hence, maximize profits taking interest rates as given and choosing the optimal amount of assets and liabilities.⁷ The banks are a fraction $0 < \omega_B < 1$ of the H bloc population. They have the same preferences, constraints and initial asset

⁶ Gerali et al. (2010) estimate a model of the EA as a whole featuring a banking sector. Lombardo and McAdam (2012) estimate a model of the EA as a whole with financial frictions.

⁷ The assumption of imperfect competition would imply instead that the banks optimally set the interest rate on loans and/or deposits. For example, banks could optimally set the interest rate on loans following a markup rule, according to which the rate on loans would be equal to a markup over the interest rate on deposits. Reducing the markup, which is inversely related to the degree of competition in the banking sector, would allow us to evaluate the macroeconomic and financial effects of increasing competition in the sector. We leave these issues for future research.

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