Journal of Economic Dynamics & Control 37 (2013) 1626–1640

Contents lists available at SciVerse ScienceDirect

Journal of Economic Dynamics & Control

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

Leveraged network-based financial accelerator

Luca Riccetti*, Alberto Russo, Mauro Gallegati

Università Politecnica delle Marche, Department of Economic and Social Sciences, Piazzale Martelli 8, 60121 Ancona, Italy

ARTICLE INFO

Article history:
Received 10 January 2012
Received in revised form
3 January 2013
Accepted 18 February 2013
Available online 28 February 2013

JEL classifications:
C63
E32
E52
G01

Keywords:
Leverage
Dynamic trade-off theory
Network
Bankruptcy cascades
Monetary policy
Macroprudential regulation

ABSTRACT

In this paper we build on the network-based financial accelerator model of Delli Gatti et al. (2010), modelling the firms' financial structure following the "dynamic trade-off theory", instead of the "packing order theory". Moreover, we allow for multiperiodal debt structure and consider multiple bank-firm links based on a myopic preferred-partner choice. In case of default, we also consider the loss given default rate (LGDR). We find many results: (i) if leverage increases, the economy is riskier; (ii) a higher leverage pro-cyclicality has a destabilizing effect; (iii) a pro-cyclical leverage weakens the monetary policy effect; (iv) a central bank that wants to increase the interest rate should previously check if the banking system is well capitalized; (v) an increase of the reserve coefficient has an impact similar to that produced by raising the policy rate, but for the enlargement of bank reserves that improves the resilience of the banking system to shocks.

1. Introduction

The financial accelerator (Bernanke and Gertler, 1989, 1990; Bernanke et al., 1999) is a positive feedback mechanism that can enlarge business fluctuations. Negative aggregate or idiosyncratic shocks on firms' output make banks less willing to loan funds, hence firms might reduce their investment and this leads again to lower output in a vicious circle. However, models of the financial accelerator available so far are generally limited, in our opinion, because of the Representative Agent assumption. The aggregate mainstream view of the financial accelerator abstracts from the complex nexus of credit relationships among heterogeneous borrowers and lenders that characterizes modern financially sophisticated economies. This causes one of the main problems with the current monitoring systems: they are based on the idea that micro- and macro-behavior should coincide. Then, crises are expected to require aggregate shocks, while in reality small local shocks can also trigger large systemic effects.

Delli Gatti et al. (2010) introduced the "Network-based financial accelerator": the presence of a credit network may produce an avalanche of firms' bankruptcies, then even a small shock can generate a large crisis. Indeed, bankruptcies deteriorate banks' financial condition leading to higher interest rates to all borrowers (Stiglitz and Greenwald, 2003,

* Corresponding author. Tel.: +39 0712207110.
E-mail addresses: l.riccetti@univpm.it (L. Riccetti), alberto.russo@univpm.it (A. Russo), mauro.gallegati@univpm.it (M. Gallegati).

0165-1889/$ - see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.jedc.2013.02.008

p. 145), thus increasing the weakness of the whole non-financial sector and the number of bankruptcies itself, in another vicious circle that can make banks go bankrupt too.

We want to enrich the "Network-based financial accelerator" with the standard financial accelerator mechanism, modelling the leverage cycle, because changes in leverage over the business cycle are an important amplification mechanism of shocks. Indeed, many papers recently have tried to understand the leverage process both for firms and banks: Adrian and Shin (2008, 2009, 2010), Brunnermeier and Pedersen (2009), Flannery (1994), Fostel and Geanakoplos (2008), Greenlaw et al. (2008), He et al. (2010), and Kalemli-Ozcan et al. (2011). The leverage level is a component of a more general discussion on firm and bank capital structure, such as in Booth et al. (2001), Diamond and Rajan (2000), Gropp and Heider (2010), Lemmon et al. (2008), and Rajan and Zingales (1995). In the economic literature there are many theories on capital structure, but, according to Flannery and Rangan (2006), the three most important ones are:

- "pecking order", proposed by Donaldson (1961) and revived by Myers and Majluf (1984), based on information asymmetry. It implies that investments are financed first with internally generated funds, then with debt if internal funds are not enough, and equity is used as a last resort;
- "trade-off", firstly observed in a paper concerning asset substitution (Jensen and Meckling, 1976), and in a work on underinvestment (Myers, 1977). It is based on the trade-off between the costs and benefits of debt and implies that firms select target debt-equity ratios;
- "market timing" of Baker and Wurgler (2002) founded on behavioral hypotheses. It implies that firms issue shares when the firm's market-to-book ratio is high.

The empirical literature has found contrasting evidence to support these theories. Then, a refined version of the trade-off theory was proposed: the "dynamic trade-off theory". In this theory firms actively pursue target debt ratios even though market frictions temper the speed of adjustment. In other words, firms have long-run leverage targets, but they do not immediately reach them, instead they adjust toward them during some periods. Dynamic trade-off theory seems to be able to overcome some puzzles related to other theories, explaining the stylized facts emerged from the empirical analysis and numerous papers conclude that it dominates alternative hypotheses: Flannery and Rangan (2006), Frank and Goyal (2008), Hovakimian et al. (2001), and Mehrotra et al. (2003). Moreover, Graham and Harvey (2001) conduct a survey where they evidence that 81% of the firms affirm to consider a target debt ratio or range when making their debt decisions.

To model the leverage cycle in a reliable way we apply the dynamic trade-off theory. Indeed, in this paper we build on the agent based model of Delli Gatti et al. (2010), omitting trade–credit relationships and substituting the packing order theory with the dynamic trade-off theory for firms' financial structure. Therefore, we assume that firms have a target leverage. This theory implies that a growing firm will increase its capital by increasing also its debt exposure, thus creating the basis for the subsequent crisis in good periods. Moreover, we allow for multiperiodal debt structure and consider multiple bank–firm links based on a myopic preferred-partner choice. In case of default, we also consider the recovery rate (RR) or loss given default rate (LGDR$=1-$RR) that is the second most important component of the credit risk models after the estimate of the probability of default (PD).

Our analysis is confined to the investigation of business fluctuations in the short-run given that we do not consider either the factors at the root of economic growth in the long period (technological innovations, labor productivity, population growth, and so on) or the inflation dynamics in the medium run (due to the interaction between firms' price-setting and workers' wage dynamics or the change of money supply, and so on). Nevertheless, we analyze the role of the central bank in stabilizing business cycles, in particular to prevent financial crisis due to bankruptcy cascades.

The paper is organized as follows. In the next section we present the general characteristics of our economy. Then, firms' behavior is analyzed in Section 3, while Section 4 considers the banking sector. Simulation results and sensitivity analysis to changes in the parameter values are presented in Section 5. Section 6 reports the sensitivity analysis on the parameter that controls the leverage pro-cyclicality. In Section 7 we propose some computational experiments on monetary policy and macroprudential regulation. Section 8 concludes.

2. Environment

Our economy is populated by households (final consumers and labor suppliers), firms and banks. Firms, indexed by $i=1,2,\ldots,I$, produce consumption goods. Banks, indexed by $z=1,2,\ldots,Z$, extend credit to firms.

We consider two markets: consumption goods and credit market. We will focus on the last market, making simplifying assumptions for the first one. Moreover, we do not explicitly model the labor market.[1]

In the market for consumption goods there are consumers and firms. Prices are exogenously determined: following Greenwald and Stiglitz (1993), we assume that on the market for consumption goods, prices are governed by a random process. We suppose that consumers buy all the output that firms produce and sell at a firm-specific stochastic price (fluctuating around a common average). Consider that this simplifying assumption makes us unable to analyze inflation

[1] The lack of this market does not change the theoretical framework compared to a model where the labor market is present, workers obtain a fixed slice of aggregate income and entrepreneurs set a mark-up on the labor cost.