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Inside the black box: How important is the credit channel relative to the interest and exchange rate channels?

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ABSTRACT

This paper develops a dynamic general equilibrium model to assess the importance of the credit channel relative to the interest and exchange rate channels. It is motivated by increasing theoretical and empirical evidence that credit market conditions affect the propagation of cyclical fluctuations in the economy. The relative contribution of each channel is determined by comparing the impulse responses when the relevant channel is suppressed with the impulse responses when all three channels are operating. The analysis shows that all three channels affect business cycle dynamics. But the interest rate channel has the largest effects in the transmission of shocks to the economy. The results suggest that it is substantially more important than the credit channel.

1. Introduction

This paper develops a dynamic general equilibrium model to assess the importance of the credit channel relative to the interest and exchange rate channels. The credit channel, which operates in addition to the traditional interest and exchange rate channels, focuses on the role of credit markets in transmitting shocks to the economy. The paper is motivated by increasing theoretical and empirical evidence that credit market conditions can affect the propagation of cyclical fluctuations.

The idea that credit conditions can have real economic effects is not new. It has been examined since at least Wicksell's early writings on monetary dynamics (Wicksell, 1906) and Fisher's “debt-deflation theory of great depressions” (Fisher, 1933). More recently, distressed financial and banking systems, e.g. in the United States, the United Kingdom, Scandinavia, Latin America, Japan and other east Asian countries, have rekindled interest in the role of credit markets in business cycle fluctuations. For example, based on Bernanke and Gertler's (1989) seminal contribution, Carlstrom and Fuerst (1997) and Bernanke et al. (1999) develop a closed economy general equilibrium model, in which credit market frictions (in the form of endogenous agency costs) alter business cycle dynamics. In these models, endogenous agency costs arise because of asymmetric information between borrowers and lenders and costly state verification (Townsend, 1979). When lenders delegate control over resources to borrowers, agents (borrowers) have an incentive not to perform in the best interest of principals (lenders).

The theoretical findings of credit market effects have been supported by empirical evidence. For instance, Gertler and Gilchrist (1994) show that, following economic downturns, borrowing and output by bank dependent firms often fall more than borrowing and output by firms with access to public debt markets. Gertler and Gilchrist's finding for U.S. manufacturing firms is confirmed for more than 100 countries by Braun and Larrain (2005). Another example is Mody et al. (2007), who demonstrate that regional and country specific availability of credit has a strong influence on output movements in North America and Europe.

Much of the theoretical and empirical literature to date has focused on the credit channel separately in the propagation of shocks to the economy.[1] Using a dynamic general equilibrium model this paper examines the feedbacks from credit markets to the real economy relative to the conventional exchange and interest rate channels. The contribution of this paper is to incorporate all three channels in a single model and to analyse their relative importance in transmitting shocks to the economy.

The framework of analysis is a small open economy that operates under a flexible exchange rate with imperfect competition and sticky prices. The model is calibrated for New Zealand. The choice of calibration is led by the structure of the New Zealand economy. New

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[1] An exception is Tang (2006), who analyses the relative importance of monetary policy channels in Malaysia in a structural vector autoregression (SVAR) framework.

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Zealand, a small open economy, is one of the least regulated economies in the Organisation for Economic Co-operation and Development (OECD) and without regular foreign exchange market interventions.

The paper proceeds as follows. Section 2 describes the theoretical model. Section 3 discusses the adjustment of the economy to shocks. The relative importance of the transmission channels is evaluated in Section 4. The last section summarises and concludes.

2. Theoretical model

This section develops the theoretical model that is used to assess the relative importance of the interest and exchange rate and credit channels. There are six agents in the model: financial intermediaries, households, entrepreneurs, firms, a government and an inflation targeting monetary authority.

The credit channel arises because of asymmetric information between borrowers and lenders. Entrepreneurs (borrowers) must obtain external financing from households via financial intermediaries (lenders) to produce capital goods. This leads to agency costs because entrepreneurs' production is subject to idiosyncratic technology shocks that only entrepreneurs can costlessly observe. To obtain external financing, entrepreneurs must have collateral (net worth). The credit channel arises from the impact of economic shocks on entrepreneurs' net worth and their ability to borrow.

The interest rate channel results from the central bank's response to economic shocks. To maintain its consumer price inflation target, following a shock to the economy the central bank adjusts the rate of interest rate paid on domestic bonds. A change in the interest rate is transmitted to the real economy through its impact on the cost of consumption and the rate of return to capital. A change in the interest rate also affects the exchange rate.

The exchange rate channel mainly operates through net exports. Real exchange rate changes affect the cost of commodity imports, which are an input in firms' production of consumption goods. They also impact on the price of exports and the foreign demand for firms' output. Moreover, exchange rate movements influence full capacity output.

The theoretical model that incorporates the interest and exchange rate and credit channels is developed next.

2.1. Financial intermediaries

The credit channel results because entrepreneurs must obtain external financing from households via financial intermediaries. As in Carlstrom and Fuerst (1997) entrepreneurs produce capital (investment) goods, which firms use as an input in the production of consumption goods. Each entrepreneur i borrows $(IN_t(i)-NW_t(i))$ consumption goods, where $IN_t(i)$ is the size of entrepreneur i's investment good production and $NW_t(i)$ is entrepreneur i's net worth or internal funds. After capital is produced loans are repaid in capital goods.

Each entrepreneur i has access to a stochastic technology, $\omega_t(i)$, that transforms an input of IN_t consumption goods into $\omega_t(i)IN_t$ units of new capital. The distribution function and density of $\omega_t(i)$ are given by $\Phi(\omega_t(i))$ and $\phi(\omega_t(i))$.[2] Entrepreneurs (borrowers) can costlessly observe the stochastic technology. Lenders can only reveal it at a monitoring cost of $\alpha IN_t(i)$, where $\alpha\in[0,1]$ is a parameter. The information asymmetry creates a moral hazard problem because entrepreneurs have an incentive to underreport their true value of $\omega_t(i)$. Financial intermediaries can reduce the information asymmetry by structuring a financial contract so that entrepreneur i always truthfully reports the value of $\omega_t(i)$. The optimal contract is characterised by the size of entrepreneur i's production, $IN_t(i)$, and a critical value for $\omega_t(i)$ that triggers bankruptcy, denoted by $\varpi_t(i)$. If the realisation of $\omega_t(i)$ is below the critical $\varpi_t(i)$, the entrepreneur becomes bankrupt and defaults on the debt contract. In the event of default, the financial intermediary monitors the entrepreneur, as in Williamson (1986), confiscates all returns from the project and absorbs any losses.

To derive the optimal project size $IN_t(i)$ and the critical $\varpi_t(i)$ that triggers bankruptcy two functions, $f(\varpi)$ and $g(\varpi)$, are defined. They are the fractions of the expected net capital output received by the entrepreneur and the lender. Time and entrepreneur subscripts have been dropped for simplicity. The functions are given by $f(\varpi)=\int_{\varpi}^{\infty}(\omega-\varpi)d\Phi(\omega)=\int_{\varpi}^{\infty}\omega d\Phi(\omega)-[1-\Phi(\varpi)]\varpi$ and $g(\varpi)=\int_{0}^{\varpi}\omega d\Phi(\omega)-\alpha\Phi(\varpi)+[1-\Phi(\varpi)]\varpi$. $f(\varpi)$ and $g(\varpi)$ do not sum to one because of expected bankruptcy and monitoring costs, i.e. $f(\varpi)+g(\varpi)=1-\alpha\Phi(\varpi)$. The expected net capital output received by the entrepreneur and the lender from entrepreneur i's production is given by $f(\varpi_t(i))\,\hat{\Psi}_t IN_t(i)$ and $g(\varpi_t(i))\,\hat{\Psi}_t IN_t(i)$, where $\hat{\Psi}_t$ is the aggregate real price of capital in terms of consumption goods. The optimal contract between the entrepreneur and the lender is given by the pair $(IN_t(i), \varpi_t(i))$ that maximises the entrepreneur's net capital output subject to the lender being indifferent between loaning the funds to the entrepreneur and retaining them, i.e.

$$\max f(\varpi_t(i))\,\hat{\Psi}_t IN_t(i) \tag{1}$$

subject to

$$g(\varpi_t(i))\,\hat{\Psi}_t IN_t(i)\geq IN_t(i)-NW_t(i) \tag{2}$$

which holds as an equality at an optimum. The first-order conditions of the optimisation problem are given by

$$\hat{\Psi}_t\left(1-\alpha\Phi(\varpi_t(i))+\frac{\alpha\phi(\varpi_t(i))f(\varpi_t(i))}{f'(\varpi_t(i))}\right)=1 \tag{3}$$

and

$$IN_t(i)=\frac{NW_t(i)}{1-g(\varpi_t(i))\,\hat{\Psi}_t} \tag{4}$$

Eq. (3) determines the critical $\varpi_t(i)$ as a function of the aggregate real price of capital, $\hat{\Psi}_t$, the distribution of the stochastic technology, $\omega_t(i)$, and the monitoring cost, α. The critical $\varpi_t(i)$ is independent of i; that is, all entrepreneurs receive the same basic terms on their financial contract. Contracts only differ in terms of size — entrepreneurs with larger net worth receive a proportionately larger loan (Eq. (4)).[3] Variables specific to i can henceforth be interpreted as averages.

2.2. Households

Households are infinitely lived and a typical household values streams of consumption and leisure according to

$$E_t\sum_{k=0}^{\infty}\beta^k\left\{\ln\left(C_{t+k}^h\right)+\gamma(1-N_{t+k})\right\} \tag{5}$$

where $\gamma>0$ is a parameter, $\beta\in(0,1)$ is the household's discount factor and E_t is a conditional expectations operator with respect to information available at time t. Households' time endowment is

[2] The random variable $\omega_t(i)\in[0,1]$ is assumed to be lognormally distributed across time and entrepreneurs, i.e. $ln(\omega_t(i))\sim N\left(\tilde{\mu},\ \tilde{\sigma}^2\right)$, with a mean of unity and a standard deviation of σ.

[3] This result overcomes the heterogeneity problem with entrepreneurs that arises from the idiosyncratic technology. It follows from the assumption of linear monitoring costs and investment technology.