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Changes in the transmission of monetary policy during crisis episodes: Evidence from the euro area and the U.S.

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ABSTRACT

This paper proposes a bank-based theoretical model for the credit market that accommodates different types of creditors. The equilibrium relationships between monetary aggregates, credit interest rates and real income are derived from banks' optimizing behavior. This model is used to theoretically establish the effects of a crisis on the bank lending channel and, more specifically, on the equilibrium relationships between the main economic and monetary variables. The model is also used to explore the potential effects of unconventional monetary policies focused on reducing risk aversion during crisis episodes. These effects are empirically assessed applying cointegration techniques to macroeconomic data of the euro area and the United States before and after the collapse of the Lehman Brothers. The results support the efficacy of unconventional measures in restoring the conventional transmission channels between monetary aggregates but shed some doubts on the ability of these measures to boost economic activity.

1. Introduction

The official interest rate and the monetary base are the main policy instruments used by monetary authorities to influence economic variables such as output, unemployment and inflation. One of the main transmission mechanisms between these policy instruments and the real economy is the bank lending channel. According to the non-neoclassical credit view of monetary policy transmission, banks play a special role in the financial system by resolving asymmetric information problems in credit markets and acting as intermediaries between lenders and borrowers. The money multiplier effects induced by credit markets serve to finance economic projects and, hence, to boost economic activity and reduce unemployment. A side effect of expansionary monetary policies, driven by decreases of the official interest rate or rises in the monetary base, is the creation of inflationary pressures.

During the latest global crisis this transmission mechanism has failed due to an increase in banks' risk aversion. This market failure has led to the contraction of credit made available to households and firms. This period, called a 'credit crunch', has also witnessed the deterioration of asset prices used as collateral and the inability of monetary authorities to stimulate the economy using the official interest rate, it being already at the zero lower bound. The crisis has not only influenced financial markets but also real economic activity, leading to a strong contraction in worldwide output and rises in unemployment. These unprecedented phenomena have triggered the coordinated action of central banks and monetary authorities around the world. Most of the measures they have adopted consist of what has been called unconventional monetary policies (UMPs, hereafter). One of the main aims of these UMPs has been to restore the bank lending channel and, with it, to reestablish the transmission mechanisms connecting monetary policy and the real economy. Across central banks, the approaches adopted have been different and customized to their corresponding economies and structures. These alternative measures have been implemented for two main reasons. First, nominal short-term interest rates reached the zero lower bound during this period in many countries, thus losing their ability to stimulate the economy, see Reifschneider and Williams (2000). In this context, alternative monetary policy instruments include the monetary base (Krugman, 1998), long-term interest rates as discussed in McGough et al. (2005) and the exchange rate, see Svensson (2001). Second, disruptions in the financial system generated large losses and affected the liquidity and solvency of both banks and borrowers.

One noteworthy example of an UMP is the Maturity Extension Program created by the Federal Reserve (FED) and consisting of sterilized

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operations, buying long-term government bonds and, simultaneously, selling some of the short-term dated issues. The FED also followed a large-scale asset purchase (LSAP) program of mortgage-backed securities with the aim of increasing market liquidity and reducing mortgage interest rates ('credit easing'). The most popular LSAP across monetary authorities in the recent crisis has been the creation of money to buy assets ('quantitative easing', QE). While the FED bought Treasury, agency debt and agency-backed mortgage securities, the Bank of England purchased government bonds from the non-bank private sector. These measures were aimed at affecting yields in assets and, thereby, restoring liquidity in the financial system. The European Central Bank (ECB) used a different approach to QE for mitigating liquidity problems. It carried out repurchase agreements providing long-term loans in exchange for bank loans and non-government bonds as collateral.

The aim of this paper is to analyze the existence of changes in the monetary policy transmission mechanism during crisis episodes and to determine the mechanisms that fail in these periods. To do this, we propose a bank-based theoretical model for the credit market that accommodates different types of creditors characterized by a credit interest rate signaling their probability of default. Banks maximize their profit over an infinite time horizon by choosing an optimal amount of loans to each creditor type. The supply side of the equilibrium relationships between monetary aggregates, credit interest rates and real income is obtained from banks' optimizing behavior. The demand side for the amount of credit required by each creditor type is derived under standard Keynesian assumptions on the relationship between money demand, real income and interest rates. The resulting equilibrium conditions are used to theoretically assess the effects of a crisis on the bank lending channel and, more specifically, to uncover potential changes in the equilibrium relationships between the main economic and monetary variables. These changes are due to increases in risk aversion, decreases in asset prices acting as collateral that raise the cost of defaulted loans (Benes et al., 2014) or the existence of credit rationing due to a contraction in the credit supply schedule (Stiglitz and Weiss, 1981). The model is also used to explore the potential effects of UMPs focused on expanding the monetary base during a crisis period.

These effects are empirically assessed applying cointegration techniques to macroeconomic data of the euro area and the U.S. before and after the collapse of the Lehman Brothers. We formalize the existence of different regimes around this landmark by statistically testing for the presence of a structural break in the residuals of the vector error correction model (VECM), which is applied to assess the long-run cointegration relationships between interest rates (official, credit and government debt), monetary aggregates (money stock and monetary base) and real income. The presence of a structural break around the collapse of the Lehman Brothers is confirmed for both monetary areas by the implementation of statistical Chow-type tests. The second period determined by the collapse of the Lehman Brothers coincides with the implementation of UMPs by the FED and the ECB, implying that the comparison of the VECM parameters before and after this event can be a useful exercise to assess the impact of these unconventional measures on the monetary policy transmission mechanism and the real economy. The VECM characterization of the equilibrium conditions corresponding to this period is consistent with the insights of the theoretical model corresponding to the implementation of UMPs. More specifically, the empirical relationships between the monetary aggregates and the macroeconomic variables support the efficacy of UMPs in restoring the conventional transmission channels between monetary aggregates but shed some doubts on the ability of these measures to boost economic activity.

The rest of the article is structured as follows. Section 2 develops the bank-based theoretical model for the equilibrium in the credit market. Section 3 analyzes the effects of a crisis episode and the implementation of UMPs' equilibrium relationships. Section 4 presents the empirical analysis of the long-run relationships between money aggregates, interest rates and real output, and Section 5 concludes. Some analytical derivations have been included in a mathematical appendix.

2. A bank-based model for the credit market

The money supply process reflects the interface between the central bank and the commercial banks. Central banks or, more generally, monetary authorities are monopolistic suppliers of the monetary base. The creation of the money stock is determined by the interplay between the central bank, commercial banks and the non-bank sector. For simplicity, in what follows, it will be assumed that the supply of money is the supply of loans,[1] abstracting from the role of monetary authority interventions in the foreign sector as a means of creating monetary base.

2.1. Bank behavior

In period t, a commercial bank's balance sheet satisfies that

$$Q^s_{B/NB_t} + R_t = Q_{CB/B_t} + D_t, \tag{1}$$

where Q^s_{B/NB_t} is the quantity of loans to the non-bank sector and Q_{CB/B_t} is the amount of credit from the central bank. D_t is the deposits made by customers and R_t is the level of reserves held in the central bank, such that $R_t = R_t^{min} + ER_t$. Denoting the minimum reserve ratio as $0 < r < 1$, we have that $R_t^{min} = rD_t$. ER_t refers to the level of reserves held in excess.

There is a conventional wisdom in monetary economics according to which the demand for money is a positive function of real income and a negative function of the interest rate; the latter represents the opportunity cost of holding money. In the present context, we consider the existence of different credit interest rates for borrowers with different credit histories and facilities for obtaining credit from the banking system. This borrower heterogeneity and the corresponding existence of more than one credit interest rate offered by banks for their loans entail different loan demand functions from creditor types. A standard way to model these demand functions and, more specifically, the relationship between money demand, real income and interest rates is by means of a linear function, which in our context applies equally to the demand for loans ($Q^d_{B/NB_{j,t}}$) and the demand for money ($M^d_{j,t}$) from that market segment:

$$M^d_{j,t} = Q^d_{B/NB_{j,t}} = \mu_j + \gamma_j Y_t - \alpha_j i^j_{c,t}, \tag{2}$$

where Y_t is real income and $i^j_{c,t}$ is the credit interest rate for creditor type j, with $j = 1, \ldots, k$. Hence, k is the number of creditor types. The parameters in expression (2) satisfy that $\mu_j > 0$ and $\gamma_j Y_t - \alpha_j i^j_{c,t} \geq 0$. The aggregate demand for credit is the sum of the demand functions over the set of creditor types. Furthermore, using the above identity between the demand for loans and money, it follows that

$$M^d_t = Q^d_{B/NB_t} = k \sum Q^d_{B/NB_{j,t}}. \tag{3}$$

The demand functions in (2) characterize a market for loans that is completely segmented by creditor types. Therefore, the demand for credit from a specific type of creditor only depends on the interest rate applied to it and not on the interest rates offered to the other creditor types. Consequently, the different demand functions for loans across markets are only related to each other through real income. It is further assumed that the banking system is made up of n identical banks which act as if they were in the presence of perfect competition, taking the set of loan rates ($i^j_{c,t}$) as given. For simplicity, and given that our interest lies in studying credit rates, we also take as given the

[1] Accordingly, the demand for money is equivalent to the demand for loans.