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Endogenous money theory: horizontalists, structuralists and the credit market

Matteo Deleidi*

Abstract: This paper provides an empirical investigation of the endogenous money theory and of the internal debate between horizontalists and structuralists. To do this, SVAR models are implemented on monthly data for the euro area for the 2003–2017 period. The findings show that (i) the volume of loans is mainly affected by the level of demand rather than by credit supply conditions; (ii) the mark-up on bank loans is an exogenous variable, independent of the demand for credit and the volume of loans granted by banks; (iii) commercial banks are generally able to counterbalance a fall in profits – for example, driven by a price increase or a narrow credit supply conditions – through an increase of the mark-up; and (iv) an increase in the rate of growth of the economy reduces the mark-up by lowering the risk perceived by banks. These findings confirm both the relevant role played by demand forces in determining the banks' loans and the horizontalist approach.

Keywords: Endogenous money theory; Horizontalists; Structuralists; Eurozone; SVAR.

JEL: E40, E50, E51, G21, C32.

INTRODUCTION

According to the endogenous money theory, commercial banks act as money producers and not as pure intermediaries between investment and saving decisions. The quantity of money in the economy is considered to be endogenously determined by the demand for bank loans and by lending activities of commercial banks. Therefore, money supply is demand-determined and credit-driven and can be considered a residual of the money creation process led by banks. The endogenous money theory has been

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extensively endorsed and has gained momentum in the international debate. Recently, academics from different schools of thought (Fontana, 2007; Werner, 2014a, 2014b), as well as monetary authorities (ECB, 2011; McLeay et al., 2014; Jakab and Kumhof, 2015), have acknowledged that money supply is endogenously determined by bank lending activity and the demand for loans (Deleidi and Levrero, 2019).

Within the post-Keynesian approach, two perspectives concerning interest rates determination can be identified: the horizontalist and the structuralist approaches. Although the horizontalist–structuralist debate has been grounded on several issues related both to the credit and reserves markets and to portfolio adjustments of economic agents (Fontana 2004), the main difference between the two is based on the upward-sloping credit supply curve and the determination of the mark-up (Lavoie, 1996; Wray, 2007); namely, the rate of interest applied by banks on the rate set by the central bank. Following the horizontalist perspective, the mark-up is considered as an exogenous variable that is determined by commercial banks independently from the volume of loans demanded by and granted to their borrowers. According to this perspective, the supply of credit is regarded as a horizontal line, and the demand for loans is supposed to not affect the level of the mark-up. The structuralist view regards the mark-up as a market phenomenon that is endogenously determined by the interaction between the supply of and the demand for loans. In this view, the credit supply is an upward-sloping curve, which means that increases in credit demand positively influence the level of the mark-up. Structuralist explanations of this effect on the mark-up rest on two different theoretical pillars: (i) The principle of increasing risk (Kalecki, 1937) and its modern developments (Minsky, 1975; 1986); and (ii) the Keynesian 'liquidity preference theory' (Keynes, 1936; 1937a), embedded in the supply of money through the endogenous money-liquidity preference model (Wray, 1992). Thus, the liquidity preference theory is adopted by the structuralist approach as a supply theory of credit, incorporated in banks' lending behaviour (Dow 1996).

The present paper has two aims: (i) to empirically evaluate the effect of credit supply and demand shocks on the volume of loans provided by banks; and (ii) to assess the horizontalist and the structuralist perspectives by showing the effect of supply and demand shocks on the mark-up set by banks. To do this, monthly data provided by the European Central Bank (ECB) for the 2003–2017 period and structural vector autoregressive (SVAR) models will be used. The present paper introduces two main innovations, in terms of data and methods. In particular, the paper will: (i) analyse post-Keynesian horizontalists' and structuralists' theoretical insights by using SVAR models; and (ii) improve the identification of supply and demand shocks in the credit market by making use of new variables provided by the Bank Lending Survey (BLS) dataset.

The remainder of this paper is structured as follows. Section 2 discusses the horizontalist and structuralist perspectives in more detail. The theoretical discussion is completed by a review of the empirical literature on monetary and credit transmission channels employing SVAR methodology. Section 3 introduces data and methods, before Section 4 provides the identification strategy. Sections 5 and 6 show empirical results and the discussion of findings, respectively. Section 7 concludes.

HORIZONTALIST AND STRUCTURALIST

According to supporters of the endogenous money theory, money supply is demand-determined and credit-driven. Money supply depends on the volume of loans demanded by borrowers to banks, which create money *ex-nihilo*; that is, without drawing from prearranged savings and bank deposits or from a programmed creation of monetary reserves. Hence, the volume of money in the economic system is endogenously determined by commercial banks rather than exogenously set by the central bank.

Although all post-Keynesian economists recognise money endogeneity, two different perspectives can be identified within this school of thought: the horizontalist approach, and the structuralist perspective, also defined as 'structural endogeneity' (Pollin, 1991).[1] The difference between the two interpretations focuses on several controversial arguments related to: (i) interest rate determination, both in the credit and reserves markets; (ii) the willingness of the central and commercial banks to grant the volume of reserves and loans demanded by borrowers; and (iii) the role played by financial markets and the behaviour of the economic agents in their portfolio adjustments (Fontana, 2004).

In the current paper, the discussion will be limited to the first point.[2] As argued both in Lavoie (1996, p. 277) and in Wray (2007), the bone of contention between these two approaches lies on the interest rate determination and on the slope of the credit-money supply curve. In particular, such a debate is mainly focused on the credit market and on the determination of the mark-up; that is, the interest rate applied by commercial banks on the interest rate pegged by the central bank.[3]

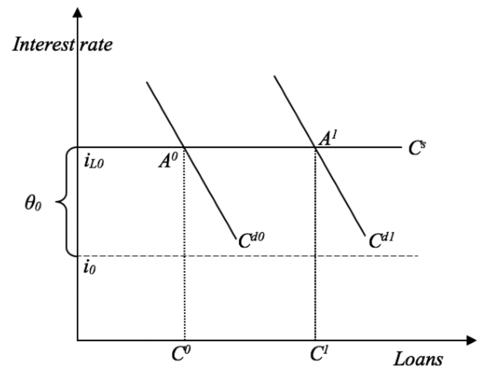


Figure 1: Horizontalist approach (source: Lavoie 1996; Rochon 1999; Fontana 2003, 2004; and Author's elaboration)

As shown in Figure 1, according to the horizontalist perspective (Kaldor, 1982; Eichner, 1987; Moore, 1988; Lavoie, 1996; Rochon, 1999; 2001), the credit supply curve (C^s) is infinitely elastic with respect to the mark-up (θ_0). Commercial banks determine their interest rates on loans (i_{L0}) (Arestis and Eichner, 1988), by applying a mark-up (θ_0) over the short-run interest rate set by the central bank (i_0).[4] The horizontalist relationship between the aforementioned rates of interest (i_{L0} and i_0) can be represented by Equation 1:

$$i_{L0} = i_0 + \theta_0(\varepsilon, c, t) \quad (1)$$

where i_{L0} – the interest rate set by commercial banks on loans – is the sum of the mark-up (θ_0) and the short-run interest rate exogenously set by the central bank (i_0). Following the horizontalist viewpoint, changes in depend on the several goals that the central bank aims to pursue (Moore, 1988; 1989)[5], whereas the mark-up (θ_0) is positively affected by the loan duration (t), the risk perceived by commercial banks (ε) and negatively influenced by the competition among commercial banks (c) (Eichner, 1987, p. 858). As a consequence, the mark-up (θ_0) set by commercial banks is exogenous with respect to the volume of loans. As shown in Figure 1, changes in effective demand for loans – for example, from C^{d0} to C^{d1} – do not affect the level of the mark-up.[6] Furthermore, some authors who belong to the horizontalist tradition claim that the interest rate is a distributional variable and the real rate is the actual target pursued by central and commercial banks (see, among others, Arestis and Eichner, 1988; Moore, 1988; 1989).[7]

The main dissimilarities between the horizontalist and structuralist models affect the relationship between the interest rate and the volume of credit provided by banks. According to the structuralist perspective (Wray 1990, 1992; Palley, 1994; 1996; Dow, 1996), the supply of loans should be represented as an upward-sloping curve showing a positive relationship between the mark-up and the volume of loans. Within this approach, bank interest rate determination can be summarised by Equation 2:

$$i_{L0} = i_0 + \theta_0(\varepsilon[C], c, t) \quad (2)$$

where the risk perceived by commercial banks (ε) is a positive function of the quantity of loans granted by banks (C in Equation 2). Accordingly, the mark-up is regarded as an endogenous variable or, in other words, as a market phenomenon that depends on the interaction between the demand (C^d) and supply of credit (C^s). In particular, as illustrated in Figure 2, an increase in the demand for loans – for example, from C^{d0} to C^{d1} – makes the mark-up increase from θ_0 to θ_1, and then the interest rate set by banks on loans from i_{L0} to i_{L1}.

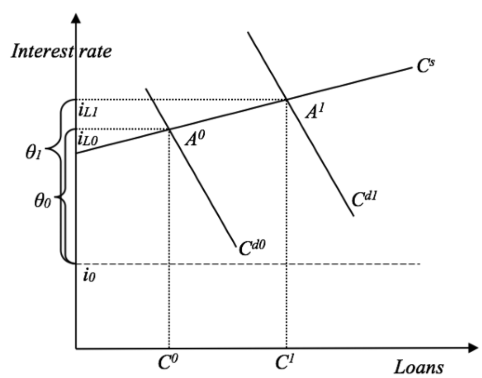


Figure 2: Structuralist approach (source: Lavoie 1996; Rochon 1999; Fontana 2003, 2004; and Author's elaboration)

Structuralist authors justify a positive relationship between the mark-up and the volume of loans and then an upward-sloping credit supply curve by means of a twofold argument: (i) the principle of increasing risk (Kalecki, 1937) further developed in Minsky's works concerning the 'Financial Instability Hypothesis' and the 'Two-Price Theory of Investment' (Minsky, 1975; 1986); (ii) the incorporation of the Keynesian liquidity preference theory applied to the supply of loans by means of 'the endogenous money-liquidity preference model' (Wray, 1992, p. 1157; Dow, 1996).

The first argument focuses on borrowers' ability to fulfil the commitments undertaken with the banking system. As the level of credit increases during the period of economic boom and euphoric expectations, the level of indebtedness of borrowers increases as well. Therefore, banks will set higher interest rates, by raising their mark-up, to counterbalance the greater perceived risk derived from a higher insolvency risk. The second argument focuses on the lenders' point of view and considers commercial banks' liquidity level that results from their lending activities. In particular, an increase in the level of loans and an expansion in banks' balance sheets are supposed to reduce banks' liquidity and 'banks will increase the supply of money to satisfy the demand for credit, but will require higher interest rates to induce them to take increasingly illiquid positions' (Wray, 1992, pp. 1160–1161). In a nutshell, the mark-up in the structuralist view is regarded as an endogenous variable determined by the interaction of the demand for and supply of credit, where the former is affected by the economic cycle. This makes the mark-up a procyclical variable (Lima and Meirelles, 2007).[8]

In the remainder of this paper, SVAR modelling is implemented to test the effect of credit supply and demand shocks on the volume of loans and on the mark-up. To the best of my knowledge, this is the first attempt to use SVAR models to validate the horizontalists' and structuralists' theoretical claims on the credit market.[9] Moreover, few works have used the Bank Lending Survey to identify credit supply and demand shocks (Ciccarelli et al., 2010). On the other hand, a number of econometric studies over the last 25 years have, based on SVAR methodology, tried to empirically estimate both the transmission channels of monetary policy (see, among others, Sims, 1992; Gerlach and Smets, 1995; Christiano et al., 1999; Sousa and Zaghini, 2007) and the dynamic of the credit market (see among others, Gambetti and Musso, 2012; Bijsterbosch and Falagiarda, 2014; Caporale et al., 2014; Darracq Paries et al., 2014).

DATA AND METHODS

Data

This empirical analysis uses aggregate monthly data for the Eurozone provided by the European Central Bank's (ECB) data warehouse and by the Deutsche Bundesbank. The euro area as a whole is considered for two main reasons. Firstly, there is currently a lively debate in Europe on the importance of identifying the factors that could stimulate the credit market. According to Draghi (2014): 'Credit weakness appears to be contributing to economic weakness in these countries. Our analysis suggests that credit constraints are putting a brake on the recovery in stressed countries, which adds to the disinflationary pressures'. Secondly, there has been very little analysis of the determinants of mark-ups and volume of loans in the European monetary union.

I make use of the Monetary Financial Institutions (MFI) Interest Rate Statistics dataset, the dataset of Short-Term Statistics and the Bank Lending Survey dataset (BLS). The MFI Interest Rate Statistics dataset provides statistics both on volumes of credit and on interest rates applied by monetary financial institutions to loans provided to non-financial corporations and households. The dataset of Short-Term Statistics offers data concerning the production indexes. Finally, the BLS dataset provides information concerning the supply and demand conditions of euro area credit markets and lending policies of commercial banks. All of the considered variables are summarised in Appendix 1 (see Table A1) and a full description of data is provided below.

In particular, bank loans provided by commercial banks to firms (LLF) with a different maturity (up to one year; from one to five years; over five years), as well as the volume of loans provided by banks for the purchase of houses (LLH) with different maturities (up to one year; from one to five years; from five to 10 years; over 10 years) are used. Moreover, starting from the rates of interest applied by commercial banks on corresponding loans (INTF and INTH) with a different maturity and the ECB interest rate for main refinancing operations (INTECB), it is possible to estimate the mark-ups set by commercial banks on each type of loan. In particular, the mark-ups (MF and MH) are calculated by subtracting from all interest rates applied by commercial banks on loans provided to firms (INTF) and for the purchase of houses (INTH). The INTECB is provided by the Deutsche Bundesbank time series dataset.[10] The series of the volume of loans as well as the estimated mark-ups are plotted in Appendix A (Figure A1 and A2).

Credit standards are applied by commercial banks to assess the willingness of the banking system to provide loans. These indexes measure the terms, standards and conditions applied by commercial banks on new loans granted to firms and households. In particular, LSH measures loans' supply conditions for the purchase of houses, while LSF accounts for loans' supply conditions applied to firms. Similarly, demand for loans measures the financing needs of households and firms. In the following analysis, the path of the loan demand of firms (LDF) and the credit demand for the purchase of houses (LDH) will be considered.[11] Finally, to take into consideration the existing relationship between real and monetary factors (that is, loans and mark-ups), the industrial production index (LIP) and the harmonised index of consumer prices (LPRI) are used as a proxy for the euro area GDP and price level, respectively.

The time series used start from January 2003 and end in December 2017 and the period considered is dictated by data availability. The BLS times series are provided as quarterly data and are transformed in monthly observations by assuming that both supply and demand conditions are constant over the quarter. All series are transformed into a logarithmic form, excluding those related to the rates of interest and the demand and supply conditions since those variables could assume negative values. As loans are not seasonally adjusted, an ARIMA X-11 procedure is carried out to remove seasonality.

Methods

In this paper, SVAR methodology is used to investigate the relationship among the considered variables. These models are estimated for all variables presented in Section 3.1.

Firstly, in order to arrange the data accurately, a standard unit root test is conducted to understand the order of integration of the variables. For this purpose, the Augmented Dickey-Fuller test is performed (Dickey and Fuller, 1979). Secondly, we conduct the optimal lag length of the VAR by minimising the Akaike Information Criterion (AIC). The lag is then increased until the serial correlation is removed. To detect serial correlation, the Lagrange multiplier (LM) serial correlation test is performed (Breusch, 1978; Godfrey, 1978) at the chosen lag. Thirdly, if the variables are I(1) or non-stationary, a first differences VAR is estimated. On the contrary, a VAR in levels will be estimated in the case of I(0) variables.

To estimate a SVAR model, a reduced-form VAR(p), shown in equation (3), has to be estimated:

$$y_t = c + \sum_{i=1}^{p} A_i \, y_{t-p} + u_t \quad (3)$$

where y_t is the kx1 vector of considered variables, c is the constant term, A_i is the kxk matrix of reduced-form coefficients and u_t is a kx1 vector composed by the error terms.

In order to detect the effect of credit supply and demand shocks on the mark-up and the volume of loans, exogenous variations in relevant variables have to be identified. To do this, an identification strategy has to be imposed to the reduced-form VAR(p) (equation 3), which in turn makes it possible to obtain a structural model, namely a SVAR. More precisely, a SVAR(p) can be represented as follows in equation (4):

$$B_0 y_t = c + \sum_{i=1}^{p} B_i \, y_{t-p} + w_t \; (4)$$

where B_0 represents the matrix of contemporaneous relationships between the k variables in y_t, B_i is the kxk matrix of autoregressive slope coefficients, and w_t is the vector of serially uncorrelated structural shocks (Kilian and Lütkepohl, 2017). The covariance matrix of structural errors is normalised: $\mathbb{E}(w_t w_t') = \sum_w = I_K$ (Lütkepohl, 2005). Once restrictions are imposed and the SVAR is estimated, an impulse response function (IRF) is calculated.[12] Because structural models are not recursively identified – that is, matrix B_0^{-1} is not lower triangular – a structural decomposition is applied to estimate the IRF, rather than a Cholesky decomposition. In the IRF, standard errors will be estimated through the asymptotic distribution and results of accumulated responses to structural shocks will be reported with two-standard error bound, namely a 95% confidence interval.[13]

Identification Strategy

In the present paper, we estimate seven alternative models (see Table 1), each composed of six different variables. As shown in Table 1, each equation in SVAR provides a different exogenous shock. In particular, Shock 1 is the loan supply shock measured by an innovation in the credit supply conditions (LS); Shocks 2 to 4 are the loan demand shocks that are measured respectively by the production index (LIP), the price index (LPRI) and by credit demand condition (LD). While LIP and LD are the pure quantity shock, LPRI represents a price shock. Shocks 5 and 6 are exogenous variations in the volume of credit provided by banks (LL) and in the mark-up (M), respectively. The isolation of many demand shocks makes it possible to understand their effects on the mark-ups and on the volume of loans. Similarly, the credit supply shock shows how narrow supply conditions affect the level of the mark-ups and corresponding loans.

Table 1. Models specification, Lag and Structural shocks

Name	Variables	Lag
Model 1	LSH – LIP – LPRI – LDH – LLH1 – MH1	6
Model 2	LSH – LIP – LPRI – LDH – LLH1_5 – MH1_5	6
Model 3	LSH – LIP – LPRI – LDH – LLH5 – MH5	8
Model 4	LSH – LIP – LPRI – LDH – LLH10 – MH10	6
Model 5	LSF – LIP – LPRI – LDF – LLF1 – MF1	7
Model 6	LSF – LIP – LPRI – LDF – LLF1_5 – MF1_5	11
Model 7	LSF – LIP – LPRI – LDF – LLF5 – MF5	9
Shock 1	LS: LSH/ LSF (Credit supply shock)	
Shock 2	LIP (Credit demand shock, quantity shock)	
Shock 3	LPRI (Credit demand shock, price shock)	
Shock 4	LD: LDH/ LDF (Credit demand shock, quantity shock)	
Shock 5	LL: LLH1/ LLH1_5/ LLH5/ LLH10/ LLF1/ LLF1_5/ LLF5 (Credit shock)	
Shock 6	M: MH1/ MH1_5/ MH5/ MH10/ MF1/ MF1_5/ MF5 (Mark-up shock)	

As anticipated in the previous paragraph, an identification strategy must be imposed to isolate exogenous shocks. The identification makes it possible to generate a structural model and to detect and quantify the causal relationships among the variables of interest (Kilian and Lütkepohl, 2017).

Identification of the structural model (4) requires imposing at least $(k^2\text{-}k)/2$ restrictions on B_0 using *a priori* assumptions on the contemporaneous relationship between variables, typically based on intuitions drawn from economic theory. Our identification scheme is summarised in the system of equation (5):

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 & 0 & 0 & 0 \\ 0 & - & - & 0 & 0 & 0 \\ 0 & 0 & - & 0 & 0 & 0 \\ 0 & - & - & - & 0 & 0 \\ - & - & - & - & - & 0 \\ - & - & - & - & - & - \end{bmatrix} \begin{bmatrix} LS_t \\ LIP_t \\ LPRI_t \\ LD_t \\ LL_t \\ M_t \end{bmatrix} \quad (5)$$

where '–' indicates an unrestricted parameter and a "0" represents a zero restriction. The first equation represents credit supply conditions (LS_t) and assumes that, within the monthly observation, they are completely exogenous; for instance, determined by regulations imposed by international institutions (such as Basel 1, 2, and 3). Regulations usually take more than one month to be decided and implemented. Policymakers move at a slow pace and do not respond immediately to the state of the economy (Kilian and Lütkepohl, 2017, p. 219). Hence, LS_t, within the month, does not respond to changes in loans, prices, production, demand conditions and mark-ups. The second equation represents the industrial production index (LIP_t) and shows that production could be affected within the month by the level of market prices ($LPRI_t$). The same relationship could also be found in Sims (1992). Moreover, Equation 2 assumes that the remaining variables affect output (LIP_t) with a lag rather than within the monthly observation. Similar to several empirical works based on SVAR (Bagliano and Favero, 1998; Cheng, 2006; Vinayagathasan, 2013), it is plausible for us to assume that neither prices nor the output are affected by loans, demand and supply conditions and mark-ups within the monthly observation. For these reasons, the third equation, representing the market price level ($LPRI_t$), shows that prices are independent of all variables considered in the model within the monthly observation. Moreover, as shown in Kilian and Lütkepohl (2017, p. 221) and in Sims' seminal work (Sims, 1992), no effect of market prices in response to changes in output is assumed. This can also be justified by the costs of adjustment and short-run nominal rigidities. The fourth equation shows the credit demand conditions (LD_t). These are assumed to be independent of the supply conditions (LS_t), the volume of loans (LL_t) and the mark-up (M_t) within the monthly observation, but dependent on the level of output (LIP_t) and prices ($LPRI_t$). The fifth equation represents the volume of loans provided by banks (LL_t) and assumes that the mark-up (M_t) does not influence the level of loans within the monthly observation but with a lag (Carlin and Soskice, 2009). The same reasons why mark-ups do not influence prices or the output level in the contemporaneous relationship can also deny the relationship between the mark-up and the volume of credit within the monthly observation. It is plausible to assume that interest rates and thus mark-ups (M_t) affect the volume of loans with a lag. Finally, the last equation represents the mark-up (M_t) determination and assumes that all considered variables can affect it.

As a robustness check, restrictions imposed to the system of equation (5) will be released by assuming that, within the month, credit supply conditions affect both prices and the level of economic activity. In other words, changes in credit supply conditions affect the real economy within the month. This is summarised in the system of equation (6):

$$B_0 y_t = \begin{bmatrix} - & 0 & 0 & 0 & 0 & 0 \\ - & - & - & 0 & 0 & 0 \\ - & 0 & - & 0 & 0 & 0 \\ 0 & - & - & - & 0 & 0 \\ - & - & - & - & - & 0 \\ - & - & - & - & - & - \end{bmatrix} \begin{bmatrix} LS_t \\ LIP_t \\ LPRI_t \\ LD_t \\ LL_t \\ M_t \end{bmatrix} \quad (6)$$

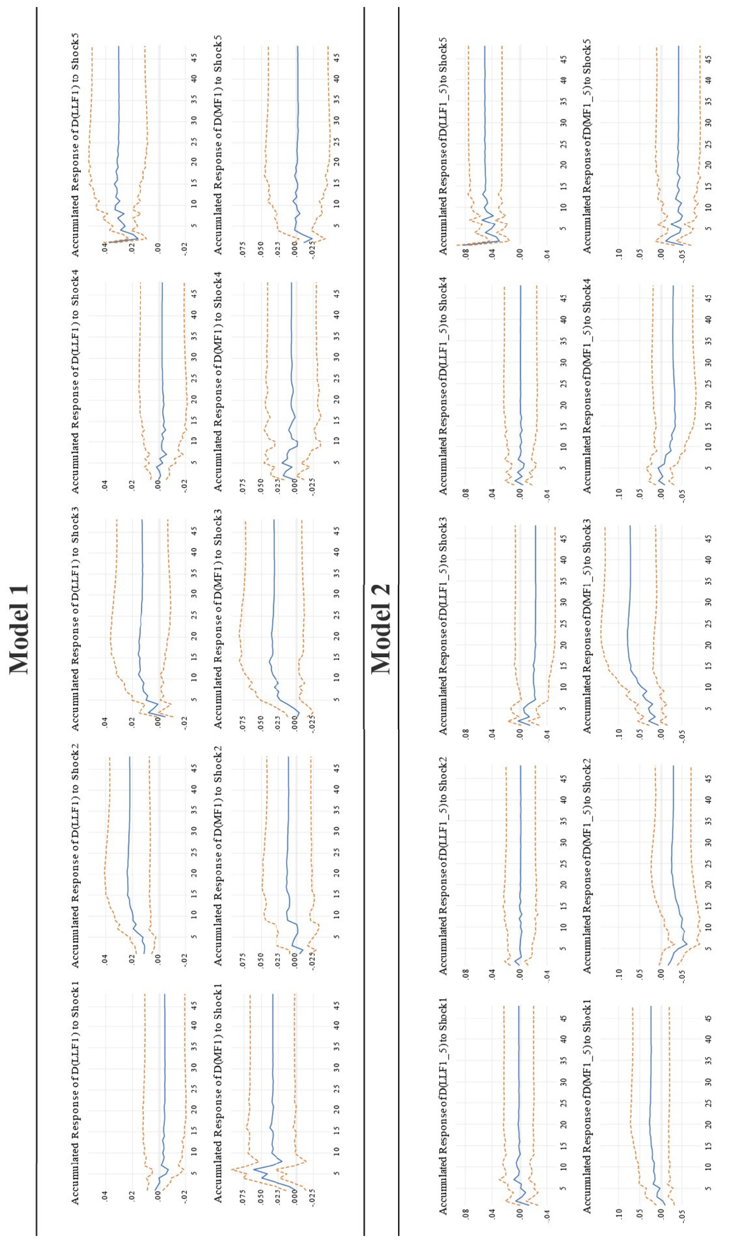
EMPIRICAL FINDINGS

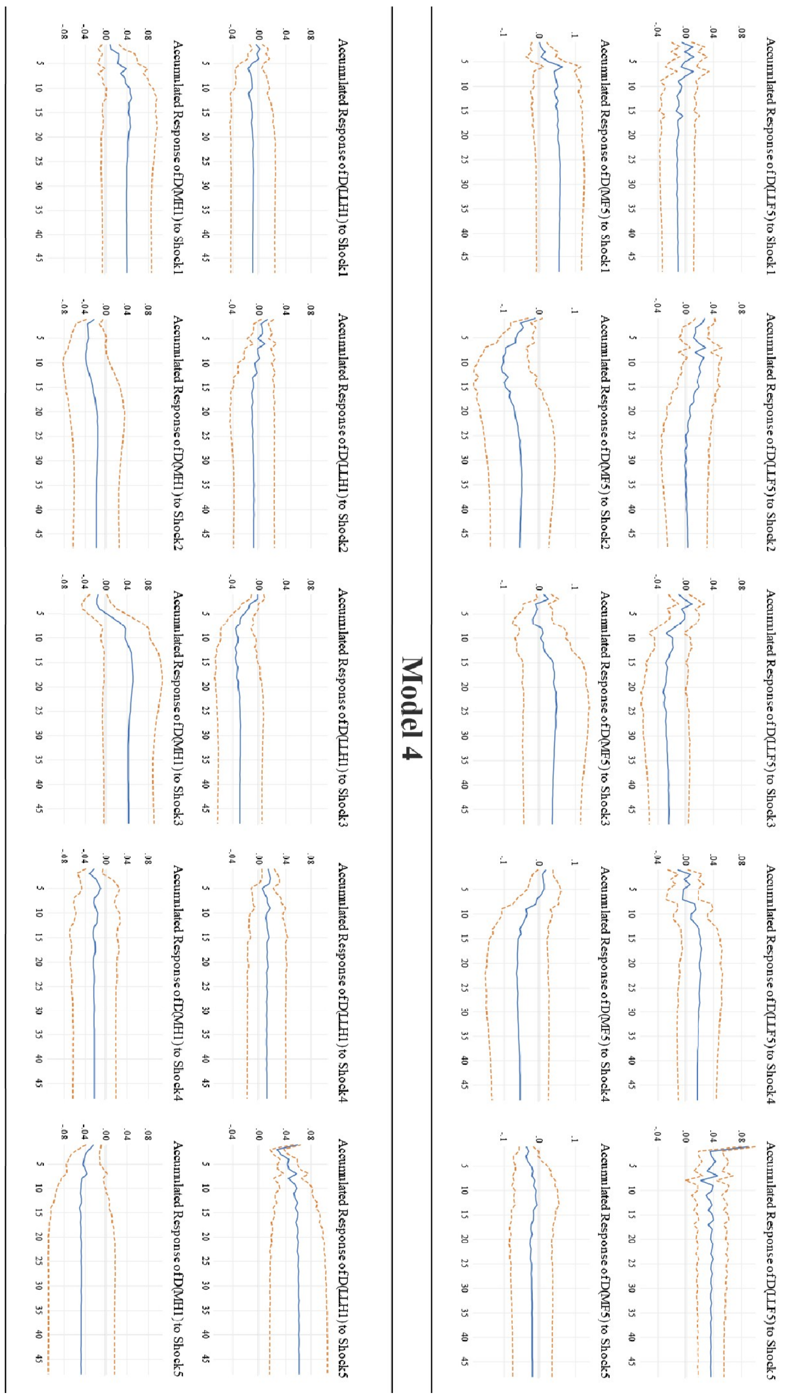
The first results concern the time series properties. Table 1 shows the lag chosen for each considered model. Results concerning the AIC and the residual serial correlation LM tests are reported in Tables A2 and A3, respectively (see Appendix 1). Moreover, in Table A4 (see Appendix 1), results of the order of integration detected through the Augmented Dickey-Fuller Test are reported. Variables are I(1) and then SVAR models at first differences are estimated.

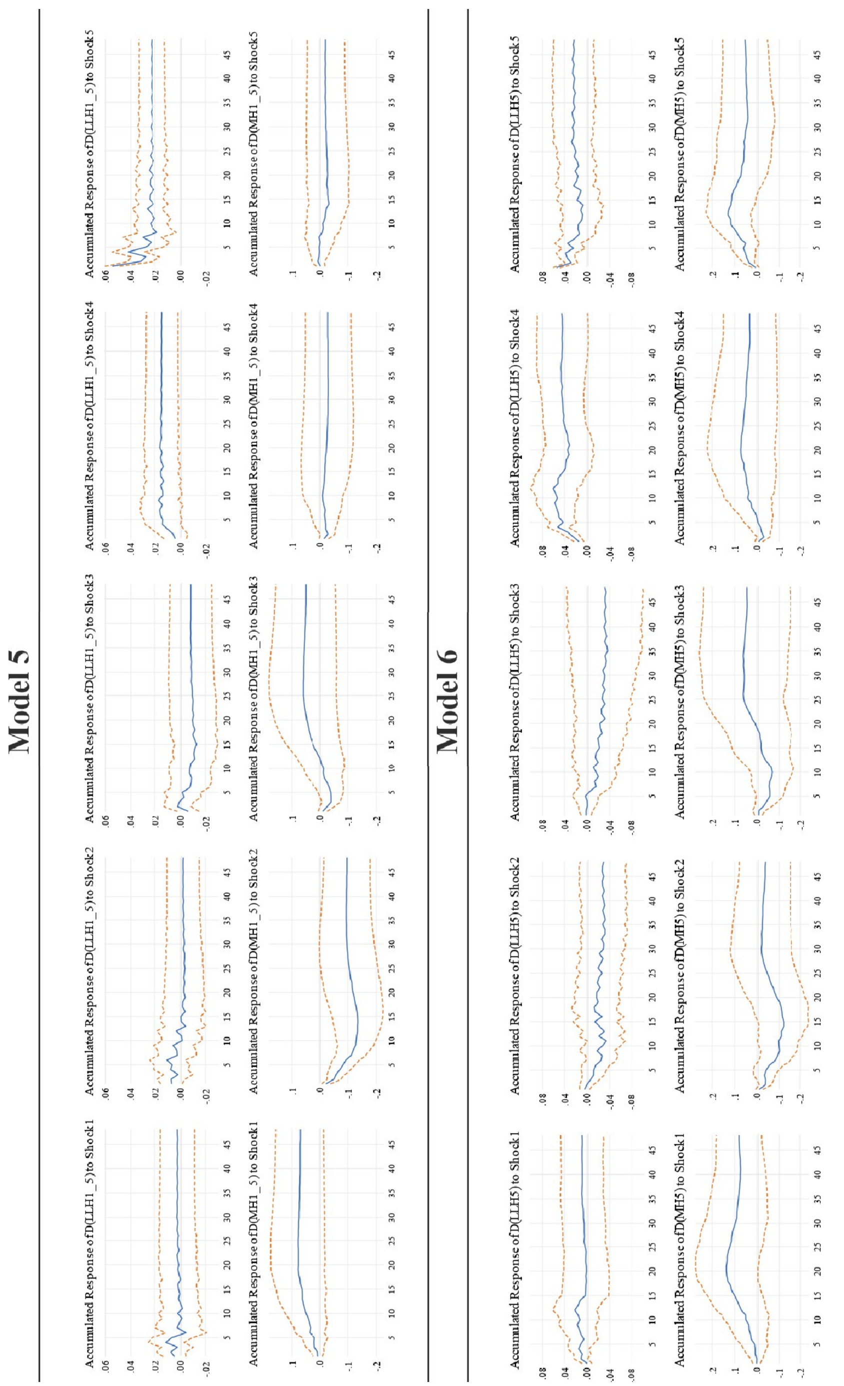
The second results regard the impulse response function (IRF) and the effects of selected shocks on relevant variables considered in the system of Equations (5) and (6). The estimation of IRF is reported in Figure 3, which shows responses of different types of loans (LL) and the corresponding mark-ups (M) to several shocks. In Figure 3, Shocks 1 to 5 are considered (see Table 1 for shocks' definition). The choice of selected shocks and corresponding responses depends on the two research questions of the present paper; that is, to analyse the effect of credit supply and demand shocks on the volume of loans granted by banks and on the corresponding mark-ups. Whereas the first analysis will shed light on the endogenous money theory and the role played by supply and demand factors in determining the level of loans, the second will assess the horizontalist and structuralist perspectives. However, for the sake of clarity, all remaining IRFs are reported in the Online Technical Appendix A1, from Figure A1 to A7. Additional results will not be discussed in detail since it goes beyond the scope of the present work.

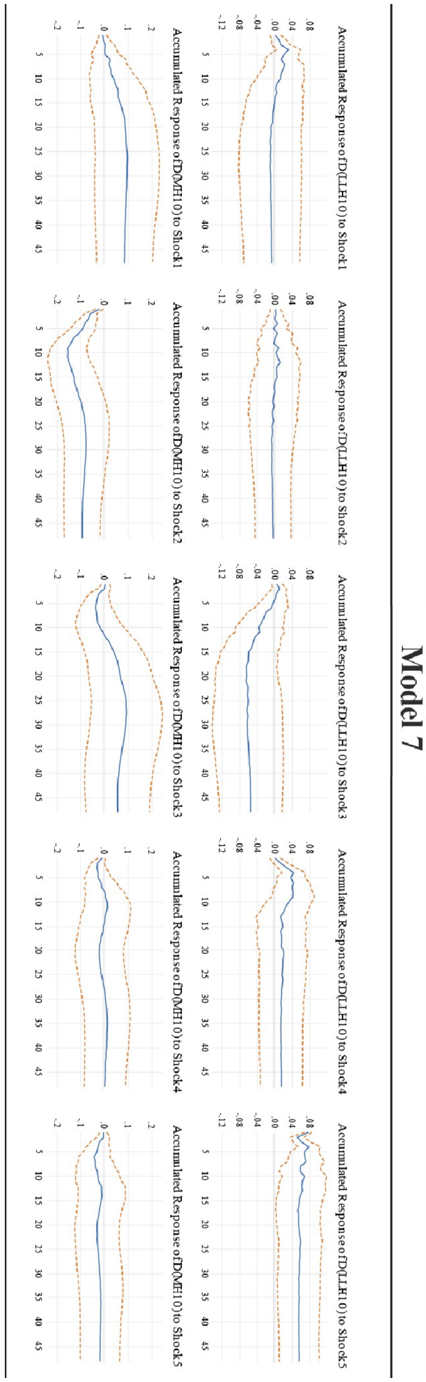
In Figure 3 (Models 1–3), the response of loans granted by banks to firms (with different maturities) and the corresponding mark-ups to Shocks 1 to 5 are represented. Results show that tighter credit supply conditions (Shock 1) do not affect the volume of loans granted by commercial banks, whereas they do raise the level of the mark-up. At the same time, an increase in the quantity of loans supplied by banks (Shock 5) does not generate any increase in the mark-up set by banks. On the contrary, a decrease in the level of the mark-up occurs only in the first months after the initial shock. Credit demand shocks (Shocks 2, 3, and 4) act in a different manner both on the volume of credit granted by banks and on the level of the mark-ups. Shock 2 (LIP) has a positive influence on the volume of loans in Model 1 and 3, but a not significant effect in Model 2.[14] Simultaneously, Shock 2 does not generate a significant effect on the level of the mark-up in Model 1 and does not generate a negative significant effect up to the 13th and 15th months in Models 2 and 3, respectively. The price shock (Shock 3) does not affect the volume of loans but does have a positive effect on the mark-up in Model 2. In Model 1, Shock 3 seems to have a positive effect both on the mark-up and the volume of loans granted by banks as the lower dotted band is close to zero.[15] Finally, a rise in the demand for credit (Shock 4) does not increase either the volume of loans or the mark-ups in all three considered models.

Figure 3. Accumulated Impulse response function




Model 3
Accumulated Response of D(LLF5) to Shock1
Accumulated Response of D(LLF5) to Shock2
Accumulated Response of D(LLF5) to Shock3
Accumulated Response of D(LLF5) to Shock4
Accumulated Response of D(LLF5) to Shock5
Accumulated Response of D(MF5) to Shock1
Accumulated Response of D(MF5) to Shock2
Accumulated Response of D(MF5) to Shock3
Accumulated Response of D(MF5) to Shock4
Accumulated Response of D(MF5) to Shock5
Model 4
Accumulated Response of D(LLH1) to Shock1
Accumulated Response of D(LLH1) to Shock2
Accumulated Response of D(LLH1) to Shock3
Accumulated Response of D(LLH1) to Shock4
Accumulated Response of D(LLH1) to Shock5
Accumulated Response of D(MH1) to Shock1
Accumulated Response of D(MH1) to Shock2
Accumulated Response of D(MH1) to Shock3
Accumulated Response of D(MH1) to Shock4
Accumulated Response of D(MH1) to Shock5


Model 5
Accumulated Response of D(LLH1_5) to Shock1
Accumulated Response of D(LLH1_5) to Shock2
Accumulated Response of D(LLH1_5) to Shock3
Accumulated Response of D(LLH1_5) to Shock4
Accumulated Response of D(LLH1_5) to Shock5
Accumulated Response of D(MH1_5) to Shock1
Accumulated Response of D(MH1_5) to Shock2
Accumulated Response of D(MH1_5) to Shock3
Accumulated Response of D(MH1_5) to Shock4
Accumulated Response of D(MH1_5) to Shock5
Model 6
Accumulated Response of D(LLH5) to Shock1
Accumulated Response of D(LLH5) to Shock2
Accumulated Response of D(LLH5) to Shock3
Accumulated Response of D(LLH5) to Shock4
Accumulated Response of D(LLH5) to Shock5
Accumulated Response of D(MH5) to Shock1
Accumulated Response of D(MH5) to Shock2
Accumulated Response of D(MH5) to Shock3
Accumulated Response of D(MH5) to Shock4
Accumulated Response of D(MH5) to Shock5


Model 7
Accumulated Response of D(LLH10) to Shock1
Accumulated Response of D(LLH10) to Shock2
Accumulated Response of D(LLH10) to Shock3
Accumulated Response of D(LLH10) to Shock4
Accumulated Response of D(LLH10) to Shock5
Accumulated Response of D(MH10) to Shock1
Accumulated Response of D(MH10) to Shock2
Accumulated Response of D(MH10) to Shock3
Accumulated Response of D(MH10) to Shock4
Accumulated Response of D(MH10) to Shock5

Models 4–7 represented in Figure 3 show the response of loans granted by banks for the purchase of houses (with different maturities) and the corresponding mark-ups to selected shocks. Changes in the credit supply conditions (Shock 1) do not affect the volume of loans provided by banks. Regarding the mark-ups, although lower dotted bands are negative but close to zero, Shock 1 seems to generate a positive influence on the level of the mark-up (see footnote 14).

Regarding Shock 5, an increase in the volume of loans for the purchase of houses generates different effects on the level of the mark-up. In particular, in the case of Model 4, a rise in the volume of loans decreases the level of the mark-up. Results are significant until the ninth month. In the case of Models 5 and 7, the quantity of loans does not influence the mark-up. Finally, in Model 6, the effect of the volume of loans on the mark-up is positive and significant up to the 16^{th} month.

With respect to demand shocks, Shocks 2–4 affect the level of loans and the corresponding mark-up in different ways. The output shock (Shock 2) does not affect the level of loans granted for the purchase of houses but it does generate a negative effect on the level of the mark-up. In the case of Models 5 and 7, the effect is negative and significant for almost the entire period in which the IRF is estimated. On the contrary, Models 4 and 6 show a negative effect on the mark-up caused by Shock 2 only within the ninth and 14^{th} months, respectively.

The price shock (Shock 3) generates a negative effect on the volume of loans in Model 4 and IRF results are significant up to the 16^{th} month. Shock 3 seems to generate a positive effect on the level of the mark-up as the lower dotted band is close to zero (see footnote 14). In Models 5 and 6, Shock 3 does not show a significant effect on either loans or the level of the mark-ups. In Model 7, Shock 3 seems to have a significant negative effect on the volume of credit as the upper dotted line is close to zero. Furthermore, Shock 3 does not generate significant and relevant pressures on the level of the mark-up.

Finally, a rise in the demand for loans (Shock 4) generates a positive, significant and permanent effect on the volume of loans provided by banks for the purchase of houses. In Models 4 and 7, such a positive effect of the demand for loans on the volume of loans is significant up to the fourth and eighth months, respectively. Conversely, the credit demand shock does not show any influence on the level of the mark-up. Only in Model 4 does Shock 4 negatively affect the mark-up up to the second month.

As a robustness check, an identification strategy (as shown in (6)) is implemented to obtain additional IRFs. Results are represented in the Online

Technical Appendix A2 (from Figure A8 to A14) and do not show any substantial difference with the baseline model estimated with the identification (5). For these reasons, results can be considered robust to the different identification strategies implemented in this paper.

DISCUSSION OF RESULTS

The obtained results make it possible to derive some theoretical conclusions about the role played by demand and supply shocks in determining the volume of loans. The ongoing debate between the horizontalist and structuralist perspectives is then reassessed in light of those results.

First, pure quantity demand shocks (Shocks 2 and 4) generate a positive effect on the volume of loans granted by banks to their borrowers and do not cause any positive pressure on the level of the mark-up. While Shock 2 (LIP) has a greater effect on the volume of loans granted to firms, Shock 4 (LD) causes increases in the volume of loans provided by banks for the purchase of houses. This implies that the demand for credit matters more than supply conditions in determining the volume of loans provided by commercial banks. This result confirms one of the main insights of the post-Keynesian endogenous money theory: that the volume of loans in the economy is demand-determined. Furthermore, findings show that the volume of loans is procyclical and the response of volume of loans to pure quantity demand shocks (Shocks 2 and 4) occurs with a delay of few months.

Moreover, focusing on Shock 2, an increase in the rate of growth of the economy[16] is able to decrease the level of the mark-up. These results are in line both with the horizontalist view and with the pure Keynesian perspective, with the latter grounded on the liquidity preference theory. According to Keynes (1937b, p. 218), 'The same circumstances which lead to pessimistic views about future yields are apt to increase the propensity to hoard'. The two views do not have to be considered as rivals, but the latter can be embedded in the former. As a matter of fact, a permanent increase in the rate of growth of the economy, by generating optimistic expectations, influences the liquidity preference of several economic agents, including the banking system. This, in turn, could lead credit institutions to consider the lending activities less risky and therefore to lower mark-ups. In Figure 1, a downward shift of the horizontal credit supply (C^s) might occur due to reductions in banks' perceived risk (ε in equation 1). This view is strongly related to the horizontalist perspective, according to which "In contractions, the real costs of credit may rise just when the demand for liquidity is […] urgent" (Moore 1988, p. 146). On the contrary, findings related to Shock 2 (LIP) do not support the structuralist perspective, for two reasons. The first reasons is that, according to this view, and in particular following the Minskian financial instability hypothesis, the credit and thus the mark-up should be regarded as procyclical variables rather than counter-cyclical, because an increase in the rate of growth of economic activity is supposed to increase the demand for loans and eventually the mark-up, rather than decrease it. Instead, estimations presented in Figure 3 show a negative effect of LIP, suggesting that the movement of the mark-up is counter-cyclical. The second reason is that, even disregarding the sign assumed by the cumulative IRF, according to the structuralist view, an increase in the rate of growth of the economy, by generating an ever-growing output level effect (considered in absolute value), should lead to a permanent increase of the mark-ups. Such a result does not occur in the accumulated IRF (Figure 3) since the mark-ups stabilise after several months at a lower level. This implies that the differences between the estimated mark-ups are zero and are not constantly growing.

Second, an increase in the volume of loans (Shock 5) does not generate a univocal result. Most of the considered models show both a non-significant and a negative effect on the level of the mark-up. These results do not make it possible to back the structuralist view since an increase in the level of loans provided by banks should increase the mark-up, through the alleged negative effect of a rise in the level of loans on the liquidity positions of banks. According to the endogenous money-liquidity preference model, the banking system should increase the mark-up to counterbalance greater illiquidity positions achieved during its lending activity in order to counterweigh the increasing illiquidity by means of a higher rate of interest. As shown here, the empirical evidence does not confirm this view.

Third, tighter credit supply conditions (Shock 1), which lead to narrow credit policies, have a positive effect on the level of the mark-up rather than leading to a decrease in the volume of loans provided by commercial banks to their borrowers.

Fourth, regarding the level of price (LPRI) shock, Shock 3 generates mixed results on the volume of loans. These puzzling effects remain even when a differentiation between credit granted by banks to firms and for the purchase of houses is considered. Conversely, although not all estimations are significant, Shock 3 generates a positive effect on the level of the mark-up, meaning that commercial banks consider the level of prices when they set the mark-up.

The third and fourth results above confirm that commercial banks pursue a real target in setting the mark-up. By considering the current level of prices and current supply conditions, banks try to offset positive price shocks and narrow credit supply conditions by means of an increase in the level of mark-ups. A possible explanation for this behaviour is that a rise in the price level would cause the ratio between current nominal profits and prices to decrease, letting banks' profits decrease as well (in real terms). Analogously, tighter credit supply conditions affect banks' capital ratios and the structure of banks' assets and liabilities, thereby influencing revenues and costs of the banking system, which affects its profitability. Hence, banks – considered at the aggregate level – are able to counterbalance current and expected profit reductions through increases of the mark-ups. In sum, the findings presented confirm the horizontalist idea according to which 'Banks are price setters and quantity takers both in retail deposit and lending market, the quantity of deposits and loans is necessarily always demand determined' (Moore, 1989, p. 27). Moreover, interest rates are 'a set of politically administered rather than a set of market-determined prices. Indeed, the short-term interest rate is simply another of the distributional variable' (Eichner, 1987, p. 858). 'The central bank sets the discount rate and commercial banks, their rates' (Arestis and Eichner, 1988, p. 1009).

CONCLUSION

According to the post-Keynesian endogenous money theory, banks are not mere intermediaries between investment-saving decisions. Instead, they create money *ex-nihilo*; that is, without the need for a prearranged volume of savings and deposits. From this perspective, money and credit are determined by the demand for bank loans and by lending activities of commercial banks. Within the post-Keynesian school of thought, two approaches on the interest rate determination exists: the horizontalist and the structuralist views. The former argues for a horizontal supply curve and an exogenous mark-up, while the latter claims for an upward-sloping credit supply curve and an endogenous mark-up determined as a procyclical variable by the interaction between the supply and the demand for loans. Structuralist authors justify the positive slope assumed by the credit supply curve through two theoretical pillars: (i) the Kaleckian principle of increasing risk (Kalecki, 1937) and its modern developments (Minsky, 1975; 1986), and (ii) the Keynesian liquidity preference theory extended to the bank behaviour through the endogenous money-liquidity preference model (Wray, 1992).

This paper provides an empirical contribution to the post-Keynesian theory by answering the following research questions: (i) Is the volume of loans provided by banks affected by demand or supply shocks?; (ii) Is the horizontalist or the structuralist view better at explaining the determination of the interest rate in the credit market?

By using a SVAR modelling on monthly euro area data for the 2003–2017 period, the study yielded the following results:

- Tight credit supply conditions increase the level of the mark-up and do not influence the volume of loans granted by banks.
- The volume of loans is mainly driven and determined by the nominal demand for loans, which is approximated in the empirical analysis by the level of economic activity, prices and through the credit demand index provided by the BLS. The volume of loans granted by commercial banks is found to be procyclical.
- The growth of the volume of loans does not generate positive effects on the mark-up.
- An increase of the industrial production index generates a decrease in the level of the mark-up likely by decreasing the risk perceived by the banking system.
- An increase in the level of prices leads to a rise of the mark-up set by banks; however, univocal results were not found on the effect of prices on the volume of loans.

In contrast to Draghi (2014), these findings suggest the relevant role played by demand factors in determining the volume of loans provided by banks. In particular, economic weakness appears to be contributing to credit weakness, rather than the opposite way round. Furthermore, these results confirm the post-Keynesian idea of a volume of loans mainly determined by the demand for credit.

Additionally, findings do not confirm the structuralist perspective, given that neither the demand for credit nor the volume of loans generate a positive effect on mark-ups. Instead, these are affected by credit supply conditions and price level: banks appear to be able to counterbalance profit decreases – arising from a price level increase or narrow credit supply conditions – by increasing the mark-up. These findings suggest that the actual target of commercial banks is the real mark-up rather than nominal one, confirming the horizontalist perspective and the idea of an exogenously set mark-up that plays the role of a distributive variable. In addition to this, higher economic growth allows mark-ups to decrease, through effects that economic growth generates on the risk perceived by banks. Contrarily to what structuralists have advocated, the mark-up tends to move counter-cyclically rather than procyclically. Additional development of this analysis will be focused on European data broken down by countries. This will allow us to use national interest rates in order to explicitly consider what occurred in the different euro area countries during the financial and sovereign bond crisis.

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NOTES

1 The structuralist approach is supported by, among others, Wray (1990, 1992), Palley (1994, 1996) and Dow (1996). For an in-depth review of the debate between the two approaches and critiques to the structuralist perspective, see among others Lavoie (1996), Rochon (2001) and Deleidi (2019).

2 For a deeper review on these arguments, see among others, Moore (1988, 1989, 1991), Wray (1990), Dymsky and Pollin (1992), Rochon (1999, 2001), Fontana (2003, 2004, 2009) and Deleidi (2016; 2019).

3 Wray (2007), a prominent structuralist scholar, has recently backed the horizontal view for the reserves market. At the same time, he has continued to support the structuralist view for the credit market (Wray 2007). A similar idea can be found also in Wray (1990) and Dymsky and Pollin (1992).

4 The horizontal dotted line represents the level of the interest rate set by the central bank (i_0).

5 According to Moore (1989, p. 487) the discount rate depends on: '(1) the future state of the domestic economy (demand factors), (2) the responsiveness of system behavior to interest rate changes, (3) their [i.e., central banks'] ultimate goals (full employment, price stability, growth, balance of payments, terms of trade, exchange rates, the distribution of income), (4) the effects of interest rate changes on the viability, prosperity, and liquidity of the financial system, and (5) in democracies at least the implications of interest rate change for the governing party in the next election.'

6 As argued in Deleidi (2018), the demand for loans is positively affected by the expectations of the economic growth, by the rate of interest (only in the case of loans granted for the purchase of houses) and negatively on bank lending policy instruments (for example the demand for collaterals). Moreover, prices generate a positive influence on the nominal demand for loans.

7 This view is also endorsed by Sraffian scholars, according to which the actual target of monetary authorities is the real rate of interest rather than the nominal one. The central bank is able to set the real interest rate by changing the nominal rate of interest on the base of actual and expected inflation rate

(Ciccone 1990; Pivetti 1990; Stirati 2001).

8 The Kaleckian principle of increasing risk, the Minskian analysis and the endogenous money-liquidity preference model were critically discussed by means of the paradox of debt (Lavoie 1996; Lavoie and Seccareccia 2001) and the paradox of illiquidity (Deleidi, 2016).

9 Cifter and Ozun (2007) demonstrated the horizontalist view by using VAR models in the market of reserves.

10 Alternatively to the INTECB, others interest rates can be used, namely the EONIA rate of interest or even the government bond yields (1-3 or 10 years). Furthermore, as the analysis is focused on the euro area as a whole, we estimate average mark-ups. However, especially during the sovereign bond crisis – which produced the increase of the spread between southern and northern European countries government bonds –, the level of mark-ups could be increased more in the southern countries than in northern ones. Since our analysis does not explicitly consider data broken down by euro area countries, such a divergence is partially captured (on average) when aggregate mark-ups are estimated.

11 BLS indicators are measured by the weighted diffusion indexes that assume values that move from -100 to +100. Regarding the credit supply conditions, if the index moves towards the value 100, a tight approval criterion occurs. On the contrary, regarding the credit demand conditions, if the several indexes move towards the value 100, an increase in the credit demand takes place.

12 SVAR models allow to estimate additional analysis such as the historical and the variance decomposition (Kilian and Lütkepohl, 2017). For the sake of simplicity, in this analysis only the IRFs will be estimated.

13 Concerning the choice of standard-errors bands, see Sims and Zha (1999) and Kilian and Lütkepohl (2017, p. 334)

14 The influence of Shock 2 on the volume of loans in Model 3 is positive and significant up to the 10th month.

15 In this paper, conservative IRF bands have been chosen (95% confidence interval) compared to relevant empirical literature based on SVAR models (see among others, Blanchard and Perotti, 2002).

16 LIP is a first-difference log variable. This implies that a shock of one standard deviation leads to a change in the rate of growth of LIP.

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APPENDIX 1

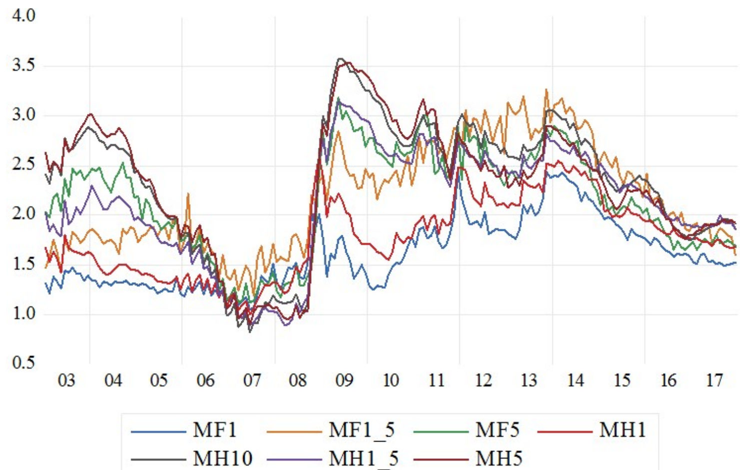

Figure A1. Mark-ups

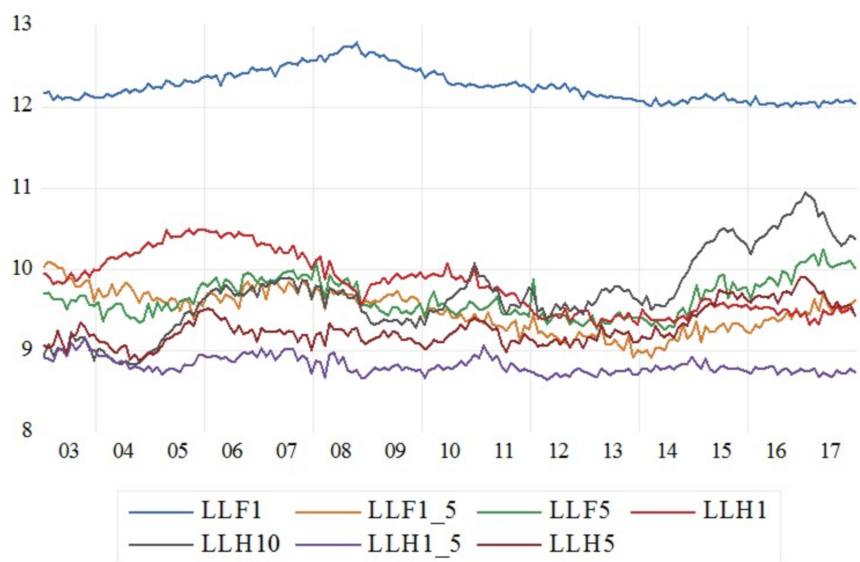

Figure A2. Volume of loans

Table A1. Data and Description

Variables	Description and calculation	Series Key
Loans		
LLH1	Bank business volumes – loans to households for house purchase with a floating rate and an IRF period of up to one year (new business)	MIR.M.U2.B.A2C.F.B.A.2250.EUR.N
LLH1_5	Bank business volumes – loans to households for house purchase with an IRF period of over one and up to five years (new business)	MIR.M.U2.B.A2C.I.B.A.2250.EUR.N
LLH5	Bank business volumes – loans to households for house purchase with an IRF period of over five and up to 10 years (new business)	MIR.M.U2.B.A2C.O.B.A.2250.EUR.N
LLH10	Bank business volumes – loans to households for house purchase with an IRF period of over 10 years (new business)	MIR.M.U2.B.A2C.P.B.A.2250.EUR.N
LLF1	Bank business volumes – loans to corporations with a floating rate and an IRF period of up to one year (new business)	MIR.M.U2.B.A2A.F.B.A.2240.EUR.N
LLF1_5	Bank business volumes – loans to corporations with an IRF period of over one and up to five years (new business)	MIR.M.U2.B.A2A.I.B.A.2240.EUR.N
LLF5	Bank business volumes – loans to corporations with an IRF period of over five years (new business)	MIR.M.U2.B.A2A.J.B.A.2240.EUR.N
Interest rates		
INTH1	Bank interest rates – loans to households for house purchase with a floating rate and an IRF period of up to one year (new business)	MIR.M.U2.B.A2C.F.R.A.2250.EUR.N
INTH1_5	Bank interest rates – loans to households for house purchase with an IRF period of over one and up to five years (new business)	MIR.M.U2.B.A2C.I.R.A.2250.EUR.N
INTH5	Bank interest rates – loans to households for house purchase with an IRF period of over five and up to 10 years (new business)	MIR.M.U2.B.A2C.O.R.A.2250.EUR.N
INTH10	Bank interest rates – loans to households for house purchase with an IRF period of over 10 years (new business)	MIR.M.U2.B.A2C.P.R.A.2250.EUR.N
INTF1	Bank interest rates – loans to corporations with a floating rate and an IRF period of up to one year (new business) – euro area	MIR.M.U2.B.A2A.F.R.A.2240.EUR.N
INTF1_5	Bank interest rates – loans to corporations with an IRF period of over one and up to five years (new business)	MIR.M.U2.B.A2A.I.R.A.2240.EUR.N
INTF5	Bank interest rates – loans to corporations with an IRF period of over five years (new business)	MIR.M.U2.B.A2A.J.R.A.2240.EUR.N
INTECB	ECB interest rates for main refinancing operations (End of month)	BBK01.SU0202
Mark-ups		
MH1	INTH1-INTECB	
MH1_5	INTH1_5-INTECB	

MH5	INTH5-INTECB	
MH10	INTH10-INTECB	
MF1	INTF1-INTECB	
MF1_5	INTF1_5-INTECB	
MF5	INTF5-INTECB	
Loan supply and demand conditions		
LSH	Credit standards-Household-Loans for house purchase	BLS.Q.U2.ALL.Z.H.H.B3.ST.S.BWDINX
LSF	Credit standards-Overall-Enterprise	BLS.Q.U2.ALL.O.E.Z.B3.ST.S.BWDINX
LDH	Loan Demand-Household-Loans for house purchase	BLS.Q.U2.ALL.Z.H.H.B3.ZZ.D.BWDINX
LDF	Loan Demand-Overall-Enterprise	BLS.Q.U2.ALL.O.E.Z.B3.ZZ.D.BWDINX
Production Index		
LIP	Industrial production for the euro area	STS.M.I8.Y.PROD.NS0020.4.000
Price Index		
LPRI	HICP – Overall index 2015 = 100	ICP.M.U2.Y.000000.3.INX

Table A2. Lag selection, Akaike Information Criterion

Lag	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
0	-10.86037	-8.510568	-8.648036	-9.473860	-9.563206	-8.987519	-8.743597
1	-11.16320	-9.025657	-9.172628	-9.748024	-9.904221	-9.326758	-9.069760
2	-11.25570	-9.307986	-9.222029	-9.767814	-9.945758	-9.287001	-9.039028
3	-11.43083	-9.398980*	-9.311883*	-10.02207*	-10.24173*	-9.778180*	-9.464509*
4	-11.38390	-9.307546	-9.135865	-9.926900	-10.05977	-9.649624	-9.332385
5	-11.29770	-9.126296	-8.940875	-9.726213	-9.973250	-9.492323	-9.159068
6	-11.57814*	-9.314866	-9.080429	-9.811212	-10.04163	-9.654826	-9.155317
7	-11.56198	-9.274965	-9.020932	-9.672344	-9.939433	-9.639911	-9.110032
8	-11.41143	-9.079640	-9.014580	-9.678106	-9.820510	-9.611521	-9.085032
9	-11.31803	-8.879655	-8.874470	-9.632152	-9.793520	-9.707469	-9.057283
10	-11.24671	-8.800189	-8.826233	-9.383325	-9.700232	-9.633413	-9.007077
11	-11.21236	-8.843885	-8.726270	-9.298010	-9.726377	-9.737055	-9.105292
12	-11.18412	-8.752440	-8.733587	-9.176301	-9.676867	-9.637558	-9.035337

Table A3. Residual Serial Correlation LM Tests

Model 1						
Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	41.03370	36	0.2593	1.146622	(36, 551.7)	0.2598
2	38.97495	36	0.3374	1.087101	(36, 551.7)	0.3380
3	32.20875	36	0.6496	0.892992	(36, 551.7)	0.6500
4	44.25410	36	0.1625	1.240161	(36, 551.7)	0.1629
5	33.82745	36	0.5723	0.939219	(36, 551.7)	0.5728
6	29.82135	36	0.7564	0.825051	(36, 551.7)	0.7568
7	32.80734	36	0.6212	0.910071	(36, 551.7)	0.6217
Model 2						
Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	46.49081	36	0.1131	1.305441	(36, 551.7)	0.1134
2	30.29970	36	0.7360	0.838641	(36, 551.7)	0.7364
3	28.94743	36	0.7918	0.800252	(36, 551.7)	0.7921
4	35.95292	36	0.4709	1.000119	(36, 551.7)	0.4714
5	40.44943	36	0.2803	1.129708	(36, 551.7)	0.2808
6	27.22178	36	0.8538	0.751396	(36, 551.7)	0.8540
7	32.37375	36	0.6418	0.897698	(36, 551.7)	0.6423

Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
Model 3						
1	42.53698	36	0.2102	1.191233	(36, 490.2)	0.2108
2	48.25120	36	0.0833	1.359006	(36, 490.2)	0.0837
3	30.33775	36	0.7344	0.839321	(36, 490.2)	0.7349
4	43.81459	36	0.1739	1.228581	(36, 490.2)	0.1744
5	49.86621	36	0.0620	1.406767	(36, 490.2)	0.0623
6	48.03064	36	0.0867	1.352495	(36, 490.2)	0.0870
7	26.88230	36	0.8646	0.741170	(36, 490.2)	0.8649
8	41.04825	36	0.2588	1.147833	(36, 490.2)	0.2594
9	45.89054	36	0.1250	1.289466	(36, 490.2)	0.1255
Model 4						
Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	25.52542	36	0.9030	0.703514	(36, 551.7)	0.9032
2	46.43717	36	0.1141	1.303872	(36, 551.7)	0.1145
3	43.30430	36	0.1878	1.212518	(36, 551.7)	0.1882
4	33.12773	36	0.6059	0.919220	(36, 551.7)	0.6064
5	40.27312	36	0.2868	1.124607	(36, 551.7)	0.2873
6	32.17282	36	0.6513	0.891967	(36, 551.7)	0.6517
7	25.22012	36	0.9106	0.694912	(36, 551.7)	0.9108
Model 5						
Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	34.74014	36	0.5284	0.965343	(36, 520.9)	0.5290
2	29.76057	36	0.7589	0.823116	(36, 520.9)	0.7593
3	49.06749	36	0.0719	1.381983	(36, 520.9)	0.0722
4	44.70005	36	0.1515	1.253800	(36, 520.9)	0.1520
5	36.68073	36	0.4371	1.021128	(36, 520.9)	0.4377
6	47.71378	36	0.0916	1.342140	(36, 520.9)	0.0920
7	36.82449	36	0.4306	1.025269	(36, 520.9)	0.4312
8	27.72144	36	0.8370	0.765253	(36, 520.9)	0.8373
Model 6						
Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	37.54431	36	0.3983	1.046814	(36, 398.0)	0.3993
2	41.74747	36	0.2351	1.170011	(36, 398.0)	0.2360
3	38.37901	36	0.3622	1.071181	(36, 398.0)	0.3632
4	48.57852	36	0.0786	1.372915	(36, 398.0)	0.0791
5	38.43961	36	0.3596	1.072952	(36, 398.0)	0.3606
6	45.31952	36	0.1372	1.275696	(36, 398.0)	0.1379
7	29.78367	36	0.7580	0.822598	(36, 398.0)	0.7587
8	31.77190	36	0.6700	0.879642	(36, 398.0)	0.6708
9	47.02684	36	0.1032	1.326531	(36, 398.0)	0.1038
10	42.60885	36	0.2080	1.195414	(36, 398.0)	0.2089
11	39.45943	36	0.3180	1.102793	(36, 398.0)	0.3190
12	37.83102	36	0.3857	1.055179	(36, 398.0)	0.3867
Model 7						
Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	38.49653	36	0.3572	1.073998	(36, 459.5)	0.3580
2	49.89001	36	0.0617	1.408861	(36, 459.5)	0.0621
3	34.84882	36	0.5232	0.968470	(36, 459.5)	0.5240
4	43.43328	36	0.1842	1.218110	(36, 459.5)	0.1848
5	34.95511	36	0.5181	0.971533	(36, 459.5)	0.5189
6	41.87168	36	0.2311	1.172363	(36, 459.5)	0.2318
7	31.64055	36	0.6760	0.876320	(36, 459.5)	0.6767
8	34.54824	36	0.5376	0.959810	(36, 459.5)	0.5384
9	31.98004	36	0.6603	0.886042	(36, 459.5)	0.6609
10	22.96299	36	0.9548	0.630165	(36, 459.5)	0.9549

Table A4. Unit root test

Augmented Dickey-Fuller Test								
	Intercept				Trend and Intercept			
	Level		1st difference		Level		1st difference	
Variables	t-Statistic	p-value	t-Statistic	p-value	t-Statistic	p-value	t-Statistic	p-value
LDF	-2.2246	0.1984	-4.3568	0.0005	-2.2693	0.4481	-4.3369	0.0035
LDH	-2.2948	0.1748	-13.2679	0.0000	-2.3482	0.4055	-13.2415	0.0000
LSF	-2.4317	0.1345	-13.2890	0.0000	-2.3776	0.3900	-13.2718	0.0000
LSH	-1.6219	0.4693	-10.9476	0.0000	-1.7648	0.7177	-10.9431	0.0000
LLF1	-0.7485	0.8304	-8.3147	0.0000	-1.7291	0.7343	-14.7844	0.0000
LLF1_5	-2.3116	0.1695	-16.5494	0.0000	-1.0406	0.9346	-16.8672	0.0000
LLF5	-1.1729	0.6858	-14.5306	0.0000	-1.3225	0.8790	-14.5613	0.0000
LLH1	-0.6686	0.8505	-7.6040	0.0000	-2.5723	0.2936	-7.6445	0.0000
LLH1_5	-3.1150	0.0272	-7.7135	0.0000	-3.7876	0.0194	-7.6919	0.0000
LLH5	-2.0847	0.2512	-6.5185	0.0000	-2.9054	0.1634	-6.5030	0.0000
LLH10	-1.6729	0.4433	-5.2270	0.0000	-2.8537	0.1804	-5.2113	0.0001
MF1	-2.2214	0.1995	-14.8856	0.0000	-2.5185	0.3189	-14.8745	0.0000
MF1_5	-1.0465	0.7361	-16.1148	0.0000	-0.0826	0.9948	-16.3084	0.0000
MF5	-1.8038	0.3778	-16.3268	0.0000	-1.7464	0.7264	-16.3177	0.0000
MH1	-1.8254	0.3673	-13.8045	0.0000	-2.1021	0.5407	-13.7786	0.0000
MH1_5	-1.4691	0.5471	-11.8215	0.0000	-1.3378	0.8751	-11.8120	0.0000
MH5	-2.0116	0.2817	-6.3674	0.0000	-2.0044	0.5946	-6.3500	0.0000
MH10	-1.9292	0.3184	-6.3799	0.0000	-1.9212	0.6392	-6.3626	0.0000
LIP	-2.9170	0.0454	-4.1923	0.0009	-2.9131	0.1609	-4.1912	0.0057
LPRI	-2.1912	0.2103	-8.9245	0.0000	-0.7105	0.9702	-9.2460	0.0000