Monetary policy and bank lending in the Euro area: Is there a stock market channel or an interest rate channel?

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Abstract

In this paper I compare a traditional demand oriented model of bank lending with its focus on short-term interest rates in the money market, to a non-traditional capital budgeting model of bank lending based on movements in share valuations for the Euro area. Using non-nested hypothesis tests, omitted variables tests, and Granger Causality tests, I reject the traditional demand oriented model of bank lending and fail to reject the capital budgeting model of bank lending for Monetary Financial Institutions (MFIs) in the Euro area. Even though Europe is a bank-based financial system, it appears the stock market plays a key role in the lending decisions and allocation of resources in Europe. One possible policy implication of this research is that the central bank should try and stabilize stock prices in order to achieve their goal of stabilizing bank lending and the economy.

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1. Introduction

Banks as financial intermediaries play an important role in the financial system and the real economy of countries. As the institution whose deposit liabilities represent an important component of the medium of exchange, they are well-positioned to reduce the information asymmetries that naturally arise in the transfer of resources from household savers to investing firms in a decentralized market economy. Accordingly there is a large amount of cross-sectional empirical research in banking that documents the importance of bank screening and monitoring of small and medium-sized firms where the real investments and investment returns of these firms are particularly opaque. Furthermore, there is evidence that indicates the benefits of bank screening and monitoring go beyond small and medium-sized firms. Large firms having access to external capital markets also benefit from bank screening and monitoring. When a bank grants a new loan, or, extends (or fails to extend) an existing loan to a firm, that piece of information sends a strong signal to the capital market that is reflected in the market valuation of the firm’s outstanding securities.

In addition to allocating financial resources across firms in different sectors of the economy at a point in time, there are other important questions concerning the role of bank lending in the supply of finance over time. More particularly, does aggregate bank lending amplify or dampen the business cycle? How does monetary policy affect bank lending and the economy? As for the first question the preponderance of academic research in this area suggests that bank lending does amplify the business cycle by changing the budget constraints of firms and households. The run-up in bank lending prior to the world-wide Great Recession starting in 2007 is but the most recent case prompting Basle 3 to implement a countercyclical capital buffer. As for the second question the traditional view of monetary policy is that it works through an interest rate channel and balance sheet channel for both borrowers and lenders. According to this traditional view an expansionary monetary policy has the central bank implement a countercyclical capital buffer. As for the second question the traditional view of monetary policy is that it works through an interest rate channel and balance sheet channel for both borrowers and lenders. According to this traditional view an expansionary monetary policy has the central bank purchasing financial assets in the money market that in turn reduces short-term interest rates and increases bank reserves both of which should in principle increase bank lending through supply and demand channels.

In this paper I revisit the nexus between financial markets and bank loan finance in the Euro area. Why the Euro area? I choose Europe because Europe is generally regarded as having a bank-based financial system built on the substructure of a civil law code (Levine, 1998). This presumably makes Europe’s bank oriented financial system different than the market oriented financial systems in the U.S. even though monetary policy in both have traditionally been carried out in the short-term money market. The main question raised in this paper is: What assets and markets should the central bank target when implementing a monetary policy designed to stabilize bank lending and ultimately real output and employment? Should they operate primarily in the short-term money market to influence short-term interest rates as they have traditionally done but without much success in the current Great Recession, or, should they operate directly in some other market? The market we will suggest below is not the long-term government bond market nor the market for mortgage backed securities liked the Federal Reserve has recently chosen in its “Operation Twist” and QE3, but instead the stock market. Why the stock market? Casual observation reveals that while short-term interest rates in the Euro area (and also the U.S.) have been historically low during the 2008–2012 period indicating that loan finance

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2 Early empirical research on the stock market value of a bank relationship includes James (1987), Slovin et al. (1988), James and Wier (1990), Slovin and Young (1990), and Hirshey et al. (1990). For more recent research see Ongena et al. (2007).

3 Procyclicality of bank lending has been observed in the banking literature for quite sometime. Many reasons are given for this behavior includes regulatory factors such as various versions of the Basle Accord and numerous non-regulatory factors. A partial listing of the former would include Bernanke and Gertler (1989, 1995), Rajan (1994), Bernanke et al., 1996, Kiyotaki and Moore (1997), Berger et al. (2001), Berger and Udell (2003), Gorton and He (2007), and Krainer (2009).
was quite cheap, it is also the case that bank stock prices and stock prices in general have been very low indicating that the required yield on bank equity is quite high and the expected returns on business loans are quite low. Conditions in the money market imply an abundance of available bank loan finance through the credit channel while conditions in the stock market indicate a small amount of available bank loan finance. To resolve these two conflicting conditions it would be useful to find a statistical technique to make a comparison as to which set of assets and markets have a stronger effect on bank lending; the short-term interest rate that emerges from the interaction of the supply of and demand for funds in the short-term money market, or, the valuations that emerge from the stock market.

To be more specific, this paper compares two reduced-form specifications for aggregate investments in private loans by monetary financial institutions (MFI's) in the Euro area. One specification takes the view that MFI lending is an investment decision that involves a comparison between the required yield of bank equity investors to the expected internal rate of return on loans. This view emphasizes the capital budgeting aspect of bank lending (we use the term banks and MFI's interchangeably) and the role of the market valuations of bank stocks reflecting the equity cost of capital for banks, controlling for other relevant factors. These other relevant factors – e.g., expected cash flows from the investment projects financed with bank loans – will be captured with the market valuations of stocks in general. In this specification bank and non-bank share prices incorporate all the relevant information that is needed for the capital budgeting version of the lending decision including the many bank specific control variables (e.g., size, liquidity, capital requirements, loan loss reserves, monetary policy, etc.) used in many supply/demand analyses of bank lending. Certain rare exogenous events like the reunification of Germany in 1990 and the 2001 attack on the financial district in New York City will be accommodated in the regression analysis with dummy variables. The alternative and more conventional specification looks directly to the interest rate channel and the market for bank loans, and for institutional reasons somewhat unique to Europe focuses attention on the demand side of the market. This approach to bank lending emphasizes the importance of such variables as a measure of aggregate income like GDP as a measure of the ability of firms and households to support loan finance, and the interest rate charged on bank loans. This specification will also include time dummy variables for the reunification of Germany in 1990 and the attack on the New York financial district in 2001.

These two specifications do not necessarily reflect different views regarding the supply/demand framework for analyzing bank lending in the Eurozone. The question for us is specification; namely, whether the stock market with its many eyes can see more clearly the underlying supply and demand factors determining the volume of new loans to the private sector, or, whether these factors can be better observed from the outside indirectly by economists. We compare these two specifications of bank lending using “non-nested hypothesis tests,” “omitted variables tests,” and Granger causality tests. To preview our results we find that we cannot reject the hypothesis that changing stock market valuations determine bank lending in the Euro area whereas we can reject the hypothesis that the traditional demand factors of short-term interest rates in the bank loan market and a measure of household and firm income (like GDP) determine bank lending. Furthermore we find that while our two measures of share prices Granger cause Euro area bank lending, short-term lending rates and GDP does not Granger cause bank lending. These results for Europe are similar to those found in Krainer

4 In this connection the Eonia money market rate in the Euro area averaged 3.77 percent in 2007 and then fell to .44 percent in 2010 and finally rose slightly to .87 in 2011. For MFI loans up to 1 year maturity the interest rate charged in 2007 averaged 5.35 percent. That rate fell to 3.43 percent in 2010 and then rose slightly to 3.91 percent in 2011. Interest rates fell during this period. Real GDP rose 2.5 percent in 2008 compared to 2007 falling at the rate of –2.7 percent in 2009. For 2010, 2011 the growth rates in real GDP were respectively 2.6 percent and 1.03 percent. What happened in the stock market? The price index for the Dow Jones Euro Stoxx Financials index was 408.3 in 2007 falling to 152.6 in 2011 for a 63 percent decline. For stocks in general the Dow Jones Euro Stoxx 50 index fell from 4315.8 in 2007–2611.0 in 2011 for a 60 percent decline indicating that the cost of equity capital for banks rose during this period while the expected internal rate of return on the projects financed with loans fell. MFI loans were growing at an average rate of 13.6 percent in 2007. In 2010 the rate of growth in MFI loans was a negative 1.18 percent and then rose slightly to 1.3 percent in 2011. Over the Great Recession the capital budgeting model based on stock valuations provides a better qualitative account of MFI lending in the Euro area than the demand for loans model based on lending rates. All data obtained from the European Central Bank, Statistical Data Warehouse.
(2009) for bank lending in the U.S. In this sense Europe and the U.S. may not be as different as previously supposed. A possible policy implication of these results is that the central bank might consider imposing transaction taxes and margin requirements on stock investors, and/or carrying out some open market operations in a portfolio of bank shares as well as a diversified portfolio of equities in the stock market. These regression tests are presented in Section II. Section III summarizes the statistical results, discusses some possible policy implications, and indicates possible directions for future research.

2. Bank lending in Europe

2.1. Two specifications of bank lending

What determines the asset adjustments of firms? When they are the real tangible assets of nonfinancial enterprises, economists tend to use capital budgeting models such as Q-theory implemented in practice with NPV or IRR rules that have the firm comparing the expected rates of return on the new real investment projects to the risk-adjusted cost of capital appropriate for the new investment projects. These capital budgeting rules that are widely used in practice by managers of nonfinancial firms reflect the demand for real capital by firms. Stock valuations play a major role in the demand for capital in these models Chirinko (1993), Lamont (2000), Hall (2001), Cochrane (2011), and Krainer (2014) among many others. On the other hand when the asset adjustments are paper assets like bank loans, economists ignore the observable prices in the stock market and focus directly on the unobservable supply and demand schedules for bank loans in the bank loan market. In this framework the quantity of bank loans and the interest rate on bank loans are simultaneously determined by the interaction of the unobservable factors influencing the supply schedule of loans by banks and the demand schedule for loans by borrowers. Once the supply and demand factors are identified and the equilibrium condition specified, estimation can proceed. The difficulty in implementing this approach is to find suitable empirical proxies that will identify the unobservable factors that shift the supply and demand schedules for loans. One approach that has been taken to simplify estimation is to ignore the supply side of the bank loan market and focus on demand. There are economic reasons for this strategy in that for bank-based financial systems like those in Europe and Japan there is a close and often long-term relationship between banks and their loan customers. Through this strong relationship bank loan officers come to know the economic environment and financial requirements of their loan customers, and loan customers in turn come to know the capacity of their banks to supply loan finance. The end result of this close relationship is that banks typically accommodate the informed loan requests of their customers. For these reasons factors such as Basel type risk-based capital requirements, loan losses, changes in bank risk aversion, changes in credit standards, and changes in monetary policy that shift the supply schedule are often argued to play a secondary role in determining the volume of new loans in bank-based financial systems over extended periods of time. Among other things this focus on the demand side of the loan market assumes that banks have a cushion of liquidity and/or wholesale (including central bank) borrowing capacity that can be utilized to accommodate any unexpected loan demand of their customers even in the face of a restrictive monetary policy, a point emphasized by Black et al. (2007), Cetorelli and Goldberg (2008), and Carpenter and Demiralp (2010). Traditional deposit taking banks according to this view are becoming more like shadow banks. The primary determinants of bank lending in bank-based financial systems then comes from the demand side factors

5 In a survey of 392 Chief Financial Officers of nonfinancial companies Graham and Harvey (2001) find that 75 percent of the companies use net present value (NPV) or internal rate of return (IRR) rules as their capital budgeting model in making investment decisions.

6 Evidence for this in Germany during the 2007–2009 financial crisis is provided by Kooths and Rieger (2009) where they point out that while German banks suffered losses from U.S. subprime securities, bank loans in Germany actually rose to accommodate their borrowing customers. Furthermore interest rates on loans were more or less constant over this time period. A similar result was found in Holmberg (2013) for Sweden, Campello et al. (2012) for all of Europe. In the U.S. Kahle and Stulz (2011) provide strong evidence that demand factors were primarily responsible for the reduction in bank borrowing of the nonfinancial corporate sector in the financial crisis that began in 2007.
such as GDP (a variable that proxies for business profitability and household income) and interest rates charged on loans (a proxy for the cost of loan finance). Recent empirical work on demand oriented specifications of bank lending in Europe and the U.S. using VAR and VEC techniques include Calza et al. (2003a,b), Eickmeir, Hofmann, and Worms (2006), Frommel and Schmidt (2006), Sorensen et al. (2009), and Carpenter and Demiralp (2010) among others. In these traditional demand oriented studies bank lending is typically described by the following parsimonious reduced-form linear specification.

\[ DL = b_0 + b_1(GDP) + b_2(R) + b_3(DV, 90/1) + b_4(DV, 2001/3, 4) + e \] (1)

where

- \( \Delta L \) = The investment in private loans to firms and households by MFIs.
- GDP = Gross domestic product, a proxy for business and household income.
- R = Interest rate charged on bank loans, a proxy for the cost of loan finance.
- DV = Dummy variables for the year and quarter indicated.
- e = Random disturbance term.

The demand interpretation of bank lending in (1) specifies that \( b_1 \) is positive and \( b_2 \) is negative. The coefficient \( b_1 \) is positive because an increase (or decrease) in income indicates an increased (or decreased) capacity to service debt. The coefficient on \( b_2 \) is negative because an increase (or decrease) in \( R \) increases (or decreases) the cost of loan finance and reduces (or increases) the demand for loans on the part of borrowers. The coefficient \( b_3 \) on \( (DV, 90/1) \) reflecting German reunification is assumed to be positive while \( b_4 \) on \( (DV, 2001/3, 4) \) reflecting the attack on the financial district in New York is assumed to be negative (Brounen and Derwall, 2010).

The second specification of bank lending emphasizes the capital budgeting rules that have been successfully used to analyze the asset adjustments of nonfinancial enterprises. According to this view banks should adjust their investments in loans in response to changes in the future cash flows on the projects associated with the loans of their borrowing customers, and the required yield of equity investors in banks. The Net Present Value version of the capital budgeting rule for banks is to accept investments in private loans when:

\[ NPV = -\Delta L_0 + \sum_{t} X_t/(1 + \rho)^t \geq 0 \] (2)

otherwise reject.

where

- \( \sum X = \) future expected cash flows on the bank’s investment in loans.
- \( \rho = \) the cost of capital of the bank.

The present value of the future cash flows derived from the real investments of bank loan customers is proxied by real general equity share prices, SP, reflecting the investment opportunities of firms and the wealth of households. The cost of bank capital, \( \rho \), is proxied with real bank equity share prices, \( (SP, bk) \). An increase (or decrease) in bank share prices represents a reduction (or increase) in the equity cost of capital. We ignore the cost of deposit finance since it is practically zero. In this framework a shock induced change in risk perceptions and/or risk aversion would cause bank shareholders to change their required yield (or cost of equity capital) on bank stock as they re-price risk, and thereby change the market valuation of bank shares. The change in bank share prices would then send a cost of equity capital signal for bank managers to change their investments in risky private loans because of the change in the cost of bank capital. Moreover since a sizable proportion of compensation for bank managers is tied to bank share prices, a shift in risk perceptions could send a signal for bank managers to change their investments in risky private loans.

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A change in general share prices could also have a balance sheet/wealth effect on bank lending since European banks hold equities in their portfolios.
managers comes in the form of their bank’s stock, changes in the market valuations of bank stocks changes their risk aversion which in turn influences their portfolio strategy. A change in general share prices of firms would be associated with a change in the future expected cash flows on the profitable investments of bank loan customers, possible wealth effects from the balance sheets of banks, and the wealth of households. Bank lending is then described by:

$$
\Delta L = \Phi((SP, bk), SP) \Phi'(SP, bk) > 0 \Phi'(SP) > 0
$$

(3)

Following the empirical corporate finance literature the parsimonious reduced-form linear specification for this stock market oriented view of MFI lending is then given by:

$$
\Delta L = a_0 + a_1(SP, bk) + a_2(SP) + a_3(DV, 90/1) + a_4(DV, 2001/3, 4) + u
$$

(4)

where

- $(SP, bk) =$ The stock market valuation of bank equity shares.
- $(SP) =$ The stock market valuation of shares in general.
- $DV =$ Dummy variables for the year and quarter indicated.
- $u =$ Random disturbance term.

The predictions from the capital budgeting theory of bank lending are that $a_1$ and $a_2$ are positive. The coefficient $a_1$ is positive because high levels of bank equity share valuations imply a low cost of equity capital for banks. With a low cost of equity capital banks can take on more marginal loans in terms of risk and return. The coefficient $a_2$ is positive because an increase in general equity share valuations implies that: i) firms that borrow from banks are experiencing an increase in profits (and net worth) and the collateral value of their assets which increases their capacity to borrow, and ii) households (as owners of equity shares) that borrow from banks are experiencing an increase in their net worth.

To sum up we have two non-nested hypotheses describing the demand for loans.\(^8\) The linear regression specification based on capital budgeting rules and stock valuations is given by $H_1$, while the more traditional specification based on short-term interest rates in the market for private loans is given by $H_2$. They are respectively:

$$
\Delta L = a_0 + a_1(SP, bk) + a_2(SP) + a_3(DV, 90/1) + a_4(DV, 2001/3, 4) + u
$$

$H_1$

$$
\Delta L = b_0 + b_1(GDP) + b_2(R) + b_3(DV, 90/1) + b_4(DV, 2001/3, 4) + e
$$

$H_2$

According to $H_1$ the relevant financial link is from the stock market to bank lending. On the other hand the traditional $H_2$ posits that the relevant financial link is from the money market to bank lending. Both carry important implications for the conduct of monetary policy. Rejection of $H_1$ along with the failure to reject $H_2$ would confirm the conventional view of monetary policy with its focus on short-term interest rates in the money market. On the other hand rejection of $H_2$ and failure to reject $H_1$ would suggest a possible rethinking of how monetary policy should be implemented. It would of course be possible to include additional variables in the empirical test in order to synthesize both $H_1$ and $H_2$. In a limited way this is done in the omitted variables test presented below. Instead we will observe the principle of Occam’s razor by keeping the two specifications as simple and distinct as possible. While additional variables will make the models of bank lending fit the data better, they will also blur the distinction between the two specifications which in turn carry different implications for

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\(^8\) The two specifications are said to be non-nested if it is not possible to derive either one from the other by means of a set of parametric restrictions.
the conduct of monetary policy. For that reason we would repeat Lucas’ (1980, p. 709) caution to be: “… hostile towards those theorists bearing free parameters …” in the form of additional variables. Our objective for the rest of this section is to see whether we can reject one (but hopefully not both) of the two parsimonious specifications for Euro area MFI investments in private loans.

Before beginning the empirical work it is important to comment on the data. Euro area data only goes back to 1988 and before 1999 is mostly reconstructed from the original 11 countries (Greece was included after 2000). The national contributions to Euro area data on GDP, interest rates, nominal loans, and the GDP deflator were aggregated up from the individual countries using the irrevocable fixed exchange rates at the end of 1998. Moreover some of the data used in the tests in Table 1 are not official data of the ECB but instead data generated for the use by ECB economists working on problems and issues within the EU. A description of the data is given in the Appendix on Data Sources.

2.2. Empirical results

Table 1 presents the regression results for the two specifications of MFI investments in private loans in the Euro area, $\Delta(L,MFI)$. This variable is defined to be the change in the real stock of loans to the private sector made by the MFIs in the Euro area. For the H1 specification MFI loans to the private sector depends on the real market valuations of bank equity shares, $(SP,bk)$, reflecting the cost of capital or required yield of bank shareholders. The second variable is a general stock price index for all stocks in the Euro area, $(SP,MSCI)$, reflecting the expected profitability on the new investments of borrowing firms and the collateral value of their assets. A second reason for including this variable is that banks in Europe hold equities in their portfolios. A change in the market value of these equities will therefore change the risk aversion of European banks and their willingness to invest in risky loans through the wealth effect. According to the standard H2 specification MFI loans depend on GDP (as a proxy for expected business revenues and household income) and a real interest rate variable on bank loans reflecting the real cost of borrowing for the business and household sectors.

Should the rhs variables in the two specifications be in levels or first differences? A related question is whether these explanatory variables are contemporaneous with $\Delta(L,MFI)$ or lagged? If lagged, how many quarters are they to be lagged? Theory provides little guidance in answering these questions except to say that it takes time to evaluate price signals when making investment decisions. Capital budgeting theory does suggest that expected cash flows on an investment should be proxied with a flow measure of expected income like $\Delta(SP)$ or a change in GDP whereas the cost of capital $\rho$ and $R$ are ratios of flows to stocks. Whether an explanatory variable is expressed as a level or first difference along with the exact lag (up to 4 quarters were considered) will be determined by a preliminary search for the “best” specification of the two competing hypotheses in isolation. The best specification in this sense is searching for the lowest value of the Akaike–Schwarz Information Criteria. To summarize, in comparing the two specifications of bank lending for the Euro area the following two step strategy will be employed. The first step is to find the best OLS regression specification for the two non-nested hypotheses H1 and H2 in isolation by the Akaike–Schwarz Information Criteria set forth above. In the second step we perform a $j$-test on H1 and H2 to see whether it is possible to reject one of the two specifications. For H1 the bank stock market proxy for the cost of bank capital that met this criterion was the level of real bank share prices lagged two quarter, or $(SP,bk)_{-2}$. The general stock market proxy for expected cash flows that met this criteria was the change in the real MSCI EU stock price index lagged one quarter, $\Delta(SP,MSCI)_{-1}$. The prediction from the underlying theory is that the estimated coefficients for both stock market variables will be positive. For the traditional demand oriented H2 hypothesis the “best” result was obtained for the specification where bank lending depended on the change in GDP (as a flow proxy for business and household income) lagged three quarters, $\Delta(GDP)_{-3}$, and the composite lending rate of banks in the original 11 Euro countries lagged two quarter, $(R,Loan)_{-2}$. The prediction from the demand oriented theory is that the estimated coefficient on the GDP variable will be positive and the estimated coefficient on the interest rate variable will be negative. Alongside these explanatory variables for both specifications we also included a dummy variable for the first quarter of 1990 to reflect the historic reunification of East and West Germany, and the third and fourth quarters of 2001 to reflect the attack on the twin towers of the World Trade center in New York.
City. The expectation is that the estimated coefficient will be positive on DV90/1 and negative on DV2001/3,4.

The OLS results for both H1 and H2 in isolation are presented in the top half of Table 1. There it can be seen that the regression results reject neither specifications of bank lending. For H1 the estimated coefficient on lagged real bank share prices, \( (SP,bk)_{t-2} \), is positive and statistically significant. Similarly, the estimated coefficient on \( \Delta(SP,MSCI)_{t-1} \) is also positive and statistically significant. These results are consistent with the specification underlying H1. Furthermore, the dependent variable \( \Delta(L,MFI) \) has a Phillips–Perron test statistic of -6.22 which is much lower than the 1% and 5% critical values of -3.5 and -2.9. We therefore reject the hypothesis that \( \Delta(L,MFI) \) has a unit root. The Durbin–Watson statistic indicates an absence of first-order serial correlation in the residuals and the CUSUM and CUSUM of Squares tests in Fig. 1 both indicate that we cannot reject the hypothesis that the estimated coefficients

\[
\begin{align*}
\Delta(L,MFI)_t &= -33.223 + 0.140(\text{SP,bk})_{t-2} + 0.637(\Delta(\text{SP,MSCI})_{t-1} + 121.883(\text{DV,90}) - 53.871(\text{DV,2001/3,4}) & \text{H1} \\
R^2 &= 0.505 & \text{DW} = 2.26
\end{align*}
\]

\[
\begin{align*}
\Delta(L,MFI)_t &= 136.491 + 0.002(\Delta(\text{GDP})_{t-1} - 13.173(\text{R,Loan})_{t-2} + 119.877(\text{DV,90}) - 60.886(\text{DV,2001/3,4}) & \text{H2} \\
R^2 &= 0.407 & \text{DW} = 1.84
\end{align*}
\]

J-Test Results

\[
\begin{align*}
\Delta(L,MFI)_t &= -28.162 + 0.100(\text{SP,bk})_{t-2} + 0.582(\Delta(\text{SP,MSCI})_{t-1} + 81.070(\text{DV,90}) - 32.419(\text{DV,2001/3,4}) + 0.354(\Delta(L,H2) \\
R^2 &= 0.407 & \text{DW} = 1.84
\end{align*}
\]

\[
\begin{align*}
\Delta(L,MFI)_t &= -3.57 + 0.001(\Delta(\text{GDP})_{t-1} - 1.232(\text{R,Loan})_{t-2} + 11.754(\text{DV,90}) - 11.626(\text{DV,2001/3,4}) + 0.901(\Delta(L,H1) \\
R^2 &= 0.407 & \text{DW} = 1.84
\end{align*}
\]

\[
\begin{align*}
R^2 &= \text{Adjusted coefficient of determination.} \\
\text{DW} &= \text{Durbin-Watson statistic.} \\
\text{White computed t-scores and p-values are given in the parentheses beneath the estimated coefficients.}
\end{align*}
\]
in H1 are stable over the sample period 1988/3 to 2006/2.\textsuperscript{9} The same is more or less true for H2 in isolation. The estimated coefficient on $\Delta(GDP)_{t-3}$ is positive while the estimated coefficient on $(R Loan)_{t-2}$ is negative, and both estimated coefficients are statistically significant at the 5% significance level. Moreover as was the case with H1 the Durbin–Watson statistic indicates an absence of first-order serial correlation among the residuals, and with some exceptions the CUSUM and CUSUM of Squares plots of the recursive residuals in Fig. 2 lie within the 5 percent upper and lower boundaries indicating that the estimated coefficients are stable over the sample period.\textsuperscript{10} This evidence fails to reject the demand oriented specification of MFI lending underlying H2 when that specification is the only one on the table.

A second and more powerful way to compare H1 and H2 is to carry out a $J$-type non-nested hypothesis test developed by Davidson and MacKinnon (1981, 1993). In this test the first step is to run the regression in H2 and collect the fitted values of $\Delta(L,H2)$. In the second step these fitted values from $\Delta(L,H2)$ are included as an explanatory variable in the regression H1. If the estimated coefficient on the fitted values of $\Delta(L,H2)$ is statistically significant, then reject H1. If the estimated coefficient on $\Delta(L,H2)$ is not statistically significant, then we cannot reject H1. The procedure is then repeated for H2 by running the regression in H1 and taking the fitted values of $\Delta(L,H1)$ and including them in the second step as an additional explanatory variable in the regression H2. If the estimated coefficient on the fitted values from $\Delta(L,H1)$ is statistically significant, then reject H2; otherwise fail to reject H2. Four outcomes are possible: i) reject H2, fail to reject H1; ii) reject H1, fail to reject H2; iii) reject both H1 and H2; and iv) fail to reject both H1 and H2 as in iv), then the data are not rich enough to discriminate between the two competing specifications of bank lending.

The bottom half of Table 1 presents the results of the $J$-test version of the non-nested hypothesis test. There it can be seen that the estimated coefficient on the fitted values from the regression for H2, $\Delta(L,H2)$, when included as an explanatory variable in the regression for H1 are not significantly different (at the 5 percent level) from zero. In other words, the fitted values of $\Delta(L,H2)$ have no effect on $\Delta(L,MFI)$ after taking into account the stock market variables $(SP,bk)_{t-2}$ and $\Delta(SM,MSCI)_{t-1}$. We therefore cannot reject H1. Next this procedure is reversed by including in regression H2 the fitted values of $\Delta(L,H1)$. The estimated coefficient on $\Delta(L,H1)$ in regression H2 is close to unity and statistically

\textbf{Fig. 2.} Parameter stability for the H2 specification.

\textsuperscript{9} Dropping the dummy variables for 1990 and 2001 these CUSUM results for H1 were reinforced with the Parameter Instability Test of Hansen (1992). Hansen’s $L_c$ statistic was computed to be .67 > .47 indicating that we cannot reject the hypothesis that the estimated parameters of H1 are stable over the sample period.

\textsuperscript{10} For this H2 specification (without the two dummy variables) the Hansen’s $L_c$ statistic was computed to be .46 = .47 putting it on the edge of not rejecting the null hypothesis that the estimated parameters are stable over the sample period. Again this is consistent with the borderline CUSUM result for H2.
significant. What this says is that adding $\Delta(L,H1)$ in the regression H2 essentially accounts for all the explained variation in $\Delta(L,MFI)$. We therefore reject the specification for MFI lending in H2.

The second specification test for comparing H1 to H2 for the Euro area is to carry out an omitted variables test. To do this we add $\Delta(GDP)_{t-3}$ and $(R,Loan)_{t-2}$ to the regression specification in H1 to get an unrestricted regression for the H1 specification. It is then possible to see whether adding these two demand variables from H2 makes a significant contribution to explaining $\Delta(L,MFI)$ over and above the stock market variables from H1. The Null hypothesis is that the additional two demand regressors are not jointly significant and therefore do not belong in the H1 specification. The F-statistic generated by this test is 2.22 with a $P$-value of .12. We therefore reject (at the 5 percent level) the hypothesis that these two demand variables are omitted variables from the specification given in H1. On the other hand adding $(SP,bk)_{t-2}$ and $\Delta(SPMSCI)_{t-1}$ to the specification given in H2 yields an F-statistic of 9.00 and a $P$-value of .00 indicating that these two stock market variables are omitted variables from the H2 specification of bank lending. These results for the omitted variables test reinforce the results obtained in the $J$-tests. Our empirical work suggests that for the entire Euro area the stock market variables do a better job tracking MFI investments in private loans over the 1988:3 to 2006:2 time period than the more traditional demand factors of interest rates on loans and an income measure like GDP.\(^{13}\)

Finally, what about causation in H1 and H2 in the statistical sense? To answer this question we carry out a bivariate Granger causality test. The lag assumed in the test is 4 quarters since all of the lags in both the H1 and H2 regressions in Table 1 were less than 4 quarters under the Akaike–Schwarz criteria for selecting the lags on the different explanatory variables. The results for H1 are as follows. At the 5% significance level we can reject the null hypothesis that $(SP,bk)$ with a $Prob = .01$ and $\Delta(MSCI)$ with a $Prob = .02$ does not Granger cause $\Delta(L,MFI)$. On the other hand we cannot reject at the 5% significance level the null that $\Delta(L,MFI)$ does not cause $(SP,bk)$ with $Prob = .06$ or $\Delta(MSCI)$ with a $Prob = .07$. Causation suggested by this test goes from stock prices to MFI loans and not vice-versa. For H2 we have the following. At the 5% significance level we cannot reject the null hypothesis that $\Delta(GDP)$ with $Prob = .26$ or $(R,Loans)$ with $Prob = .09$ does not Granger cause $\Delta(L,MFI)$. Moreover, we also cannot reject the null that $\Delta(L,MFI)$ does not Granger cause $\Delta(GDP)$ with $Prob = .5$ or $(R,Loans)$ with $Prob = .41$. For H2 there appears to be no causal relationship among the dependent and independent variables. In terms of Granger causality H1 appears to be a better match between the underlying theory and the data than H2.

3. Summary, policy implications, and direction for future research

3.1. Summary

In this study we compare two non-nested and parsimonious reduced-form specifications on the determinants of inter-temporal bank lending in the Euro area. The traditional view of bank lending in Europe focuses attention on the demand for loans by borrowers in the bank loan market. This traditional view is presented as the H2 reduced-form specification of bank lending where these demand variables are approximated with GDP (as a proxy for expected income and the ability to repay loans) and short-term interest rates, $R$, as a measure of the cost of loan finance. The policy implication of H2 is one where the monetary authority targets short-term money market interest rates that get arbitraged out to bank lending rates that are relevant for the spending decisions of households and firms. In this way the central bank attempt to stabilize that part of aggregate demand financed with bank loans. This

\footnote{In an earlier and longer version of this paper we also included France and Germany in the study. The results for French MFI’s were more or less the same as the results for the Euro area for both the $J$-tests and the omitted variables tests. For Germany the results were mixed. For MFI’s it turned out that the $J$-test rejected both H1 and H2. This might have been the result of a severe problem of autocorrelation in the residuals which we tried to correct with a Cochrane–Orcutt autoregressive process. However for the commercial bank sub-sector of MFI’s the results were essentially the same as they were for the Euro area reported in this paper. The results for France and Germany present an interesting possibility for the ECB if banks in other countries in the Euro area invest in loans in the same way. If that were the case the ECB could uniquely tailor monetary policy towards the needs of each individual Euro area country that has a stock market avoiding the problem of ‘one policy fits all.’ That paper is now available in Krainer (2013).}
is the approach currently followed by the ECB and central banks in other financially developed countries. Previous empirical studies and the one carried out here were unable to reject the H2 specification of bank lending in Europe when that was the only hypothesis on the table. This paper proposed an alternative specification of bank lending indicated by H1 based on capital budgeting theory and stock market valuations. We then proceeded to compare H1 to the more traditional H2 hypothesis. The view taken here was that bank investments in private loans, like investments in any asset undertaken by firms in general, have to meet a cost of capital hurdle. That cost of capital hurdle in this paper was approximated by the market valuation of bank equity shares. To complete the capital budgeting analysis we include a general stock price index to proxy for the present value of the expected future cash flows of business borrowers and the wealth of household borrowers. Changes in general stock valuations reflect changes in expected cash flows, the IRR on the assets of bank borrowing customers, and all other information relevant for the bank lending decision. These two reduced form specifications of bank lending were then compared using non-nested hypothesis tests, omitted variables tests, and Granger causality tests. The non-nested hypothesis tests in Table 1 indicated that we were able to reject the more traditional demand oriented bank lending specification in H2, but unable to reject the stock market/capital budgeting specification of bank lending in H1. Omitted variables and Granger causality tests reinforced this conclusion. The causality tests indicated that the two share price variables in H1 Granger caused MFI investments in private loans, but that investments in private loans did not Granger cause the two share price variables. For H2 we rejected the hypothesis that GDP and interest rates on loans Granger cause MFI lending. Finally for the omitted variables test GDP and interest rates on loans were found not to be omitted variables in the H1 specification of bank lending, but the two share valuations were found to be omitted variables in the H2 specification. Of course this is not to say that there isn't some other potential and as yet unknown third specification, H3, of bank investments in private loans that could beat H1. If a non-nested H3 does arise sometime in the future, it should then be compared to H1. However it seems doubtful that this unknown H3 would be devoid of an important role for equity valuations.

In closing there has been much research in the legal, finance, and corporate governance literature indicating that there are important differences between the financial systems in Europe and the U.S., and the way corporate investments are financed in those countries. The former is classified by this research as a bank-based financial system and the latter a market oriented financial system. In both financial systems capital budgeting theory tells us that real corporate investment should respond to changes in expected real corporate cash flows and the cost of capital. The job of the public corporation is to generate a rate of return on their assets that is at least equal to the required rate of return of their equity investors. It should be no different for banks. It would therefore seem that if capital budgeting rules can evaluate the merits of tangible investments by nonfinancial companies, they could in principle be used to evaluate the merits of investments in paper assets like private loans by financial companies. Under these conditions bank lending should then respond to both changes in the market valuations of bank stocks reflecting their cost of capital, and the market value of stocks in general reflecting the change in expected cash flows on real investment projects of bank loan customers. Our research indicates that even though much of the financing of firms passes through banks in Europe, they are in fact guided by the stock market when it comes to determining their investments in private loans. However, it must still be remembered that this is only one time series study of bank lending based on an informational efficient stock market. Hopefully future research using panel data on both borrowing firms and lending banks across the Euro area countries (along the lines of the Jimenez et al. (2012) study of Spain) can shed more light on the link between the stock market and bank lending.

3.2. Policy implications and directions for future research

If there is a stock market channel for bank lending in Europe, what implications might this have for the conduct of monetary policy? Bank lending decisions changes the budget constraint of the private sector and can therefore influence the demand for real output. In this way any fluctuations in bank lending can potentially amplify fluctuations in real economic activity. If this is the case the central bank might want to consider ways of stabilizing share prices. Selective controls are one possible way to achieve this goal within the present regulatory framework. One selective control mechanism would be
for the central bank to impose margin requirements on all stock investors, both individuals and institutions. A second selective control mechanism would be to vary transaction taxes on stock purchases and sales. The margin requirements and transactions taxes could be varied over different stages of the stock market cycle; rising when stock prices are rising above some measure of intrinsic value, and falling when stock prices are falling below their intrinsic value. Of course borrowing abroad and/or foreign investors could prove to be an obstacle. Moreover economists in general eschew selective controls as interfering with the allocation of resources preferring instead monetary and fiscal instruments that affect all categories of economic output.¹²

Still another way of stabilizing stock prices is for the central bank to carry out some open market transactions in a set of well diversified (i.e., portfolios that minimizes non-systematic risk) index mutual funds containing stocks of all financial and nonfinancial companies. The idea would be to change the level of share prices but leave the structure of relative share prices unchanged. Central bank purchases and sales of equities are not a particularly new idea having been previously suggested in Tobin and Brainard (1977), Fischer and Merton (1984), and Krainer (2003, 2013a,b). Moreover actual central bank purchases of equity shares and other risky assets are also not without precedent. The monetary authorities of Hong Kong, Japan, and South Korea are examples of cases where governments have purchased equities to prop up a sagging stock market during a crisis. Hong Kong presents a particularly important case study of central bank intervention in the equity market. The background for Hong Kong’s intervention was the Asian financial and economic crisis in 1997/98 during which short selling in the spot and future markets by foreign hedge funds drove the Hang Seng stock index down by 40 percent over the period June 1997–June 1998 while the economy was in the midst of a severe recession (Goodhart and Dai, 2003). Starting in August 1998 the Hong Kong monetary authority in 10 separate trading days purchased 118 billion HK dollars of equities in the Hang Seng index. The end result was that this investment soared to 200 billion HK dollars at the end of 1999 yielding a capital gain of 69 percent for the government. More importantly this policy was credited with pulling the Hong Kong economy out of the recession at the time.

A policy of conducting open market operations repeatedly in equity markets might appear to be drastic to some and even irresponsible to others. And yet drastic but innovative monetary and fiscal policies were implemented during the Great Crisis. For example in the Great Crisis Japan, Europe, the U.K., and the U.S. governments have made substantial investments in risky assets such as ETF’s, REIT’s, mortgage-backed securities, and equity investments in individual financial enterprises and even non-financial enterprises experiencing financial difficulties where there was a great deal of unsystematic risk. These investments by governments were made in the hope of stabilizing the financial system and the economy during the crisis. In general these non-traditional policy interventions were thought to be successful in preventing a further collapse in the financial system and contributing to the economic recovery.¹³ In Europe and the U.S. the unconventional monetary policies have for the most part been restricted to the debt markets. If these non-traditional policies in the debt markets were deemed to be successful in the crisis, it would seem that a policy of stabilizing bank loans by stabilizing shares valuations through margin requirements, transaction taxes, and central bank open market operations in equities in non-crisis periods is one that merits further consideration by researchers and policymakers.

The above mentioned unconventional policies including those implemented by Hong Kong, Japan, and South Korea were one-off policies designed to address a specific crisis. Once the crisis passed, the unconventional policy usually lapsed. One important question then is how a monetary authority would implement a more continuous policy of open market operations in equity markets. One way is for the central bank to target several broad based stock indexes and then invest in mutual funds that track the

¹² Of course even general controls tend to have selective results in specific sectors. Even so it would seem that selective controls have a useful role to play in stabilization policies when business fluctuations are triggered by ‘irrational exuberance’ in a small number of specific markets such as the real estate market and stock market.

¹³ For an assessment of the effectiveness of the unconventional monetary policy of the ECB during the economic crisis starting in 2007 see Lenza et al. (2010), Fahr et al., 2013, Carpenter et al. (2013), and the review of the literature by Pattipeilohy et al. (2013) among others.
targeted indexes.\footnote{An alternative would be for the central bank to form a mutual fund or market portfolio itself rather than carry out its purchases and sales in existing and privately owned and controlled mutual funds. The advantage of the central bank forming the portfolio itself is that it could be more inclusive and closer to a true market portfolio than privately owned mutual funds. The disadvantage would be that with ownership comes control in the form of voting rights on various corporate matters. It is not clear that central banks interests and private stockholders interest would be aligned in a market portfolio partly owned by the central bank and private investors. On the other hand if the central bank would buy and sell existing privately owned mutual funds as part of their open market operations, then fund managers would vote the shares with the view of maximizing the wealth of their shareholders including the central bank.} When would the monetary authority buy and sell the index mutual funds that it is tracking? One possibility is to set upper and lower filter bands centered on some measure of long-run intrinsic value for each stock index. For example, suppose that the long-run median price-earnings ratio for a broad-based index of stocks was 12. The central bank might then set a lower price-earnings band of 8 at which they would buy the mutual fund(s) tracking the index, and sell when the upper band of 16 was reached. The \((\pm) 4\) change in the \(P/E\) ratio bands would presumably reflect transitory variations in the earnings of the firms in the index. Of course these numbers are for illustrative purposes only. Obviously much research would have to be done to set the upper and lower bands that would trigger central bank sales and purchases of the mutual fund(s) tracking the targeted indexes.

Would a policy of central bank buying and selling equities with the view of keeping a targeted index of equity prices within some upper and lower band be feasible? Do central banks have the resources to achieve the goal of determining the level of share prices? Historically the most frequent central bank intervention has been in the foreign exchange market. Their success in that market is mixed at best (Sarno and Taylor, 2001). For equity markets the example of Hong Kong in 1998 would indicate that central bank purchases can drive share prices up to some desired level. But what about preventing stock prices from rising above some predetermined price-earnings ratio band? We have less evidence on this side of the filter band. One thing seems certain and that is central banks would be under enormous political pressure not to intervene in the equity market and drive share prices down to a level between some upper and lower filter band. Besides political pressure markets would also have to believe that the central bank is credibly committed to reducing volatility in the stock market. Once that credibility is attained rational private investors transacting in markets would keep stock valuations between the two filter bands.

Open market operations in equities on a continuous basis are not part of the standard policy toolkit of central banks. This suggests that there could be problems both in implementing this policy and unforeseen and unintended consequences were the policy to be implemented by central banks. We will conclude by briefly discussing some of the more obvious problems and propose them for future research.

One potential problem would be whether the central bank in its attempt to restrict fluctuations in the level of stock prices would induce an increase in the volatility of relative prices of the stocks within the targeted stock index. To the extent it did it would create additional risk for individual firms within the index thereby reducing production and investment. The evidence while limited suggests that this would not be a problem. Parsley and Popper (2004) find that changes in the level of stock prices are positively associated with changes in the volatility in the cross-section of relative stock prices. To the extent open market operations of a central bank achieved its goal of reducing the magnitude of the volatility of the targeted stock price index, it would also reduce the volatility of relative stock prices within the index. This would be a direct benefit to borrowing firms in addition to the benefit of smoothing bank lending. However more research validating the Parsley and Popper research is needed.

A second potential problem centers on the inclusiveness of the targeted index. No actual stock index covers all the companies whose shares are publicly owned and traded. This problem is particularly acute in Europe where a larger share of GDP is generated by non-listed companies compared to the UK and the US. The problem is that central bank open market operations in listed companies within a targeted index may result in a distortion in the cost of capital and the allocation of investment between companies within the index and those outside the index. If the companies outside the index are publicly traded in the market, then rational traders would arbitrage any discrepancy in share prices.
between the two due solely to central bank open market operations. The problem is more severe for companies outside the index that are privately owned. Rational arbitrage can play no role here. However to the extent these privately owned companies look to publicly traded firms whose returns are highly correlated with their own; the cost of capital signal for investment decisions may not be distorted between the two as a result of central bank open market operations in the targeted index. This is an empirical question and one that deserves more study.

Finally, will central bank open market operations in the stock market discourage the so-called ‘smart money’ from trading? There always is the risk that a central bank could without notice change the upper and lower filter bands posing an additional risk to smart traders. If it did then more trading would be in the hands of the uninformed or ‘noise’ traders who would have a larger impact on relative share prices. If this would occur then the relative prices of shares would not necessarily reflect all the relevant information pertaining to their intrinsic valuation. The end result here is that real investment might be inefficiently allocated across the different sectors in the economy. How important if at all this might be should be the subject of future research.

These caveats remind us that the case for central bank open market operations in equity markets is far from complete. While it is premature to recommend this policy change on the basis of one statistical study, it is not premature to call for further research in this important area.

Appendix on data source

**Euro area**

MFI = Monetary financial institutions excluding central banks and mutual funds in the Euro area. MFI's include resident credit institutions and other financial institutions that issue deposits and/or close substitutes, and grant credit and/or make investments in securities.

\[(\text{LMFI}) = \text{The stock of MFI loans outstanding to other Euro area residents deflated by the GDP deflator. Source: ECB Monetary Statistics, October 2006, pp. 1C*-6C*}.\]

\[(\text{SP,bk}) = \text{The quarterly stock price index of Euro area banks deflated by the Euro area GDP deflator. Source: Datastream, EU-DS Banks; Code, BANKSEU}.\]

\[(\text{SP,MSCI}) = \text{The quarterly MSCI European Union general stock price index deflated by the Euro area GDP deflator. Source: Datastream}.\]

\[(\text{R,loan}) = \text{The composite lending rate of banks in the original 11 Euro countries. This lending rate was deflated by the GDP deflator for the Euro area. Source: Unofficial data provided to the author by the European Central Bank}.\]

\[(\text{GDP}) = \text{Real gross domestic product for the Euro area. Source: Unofficial data provided to the author by the European Central Bank}.\]

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