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THE FORGOTTEN MARKETS: HOW UNDERSTANDING MONEY MARKETS HELPS US TO UNDERSTAND THE FINANCIAL CRISIS

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Recent developments in the global financial system have proved seismic in nature. At the epicentre of the ongoing financial earthquake are the money markets;[1] yet, prior research on the behaviour and structure of money markets was limited.[2] How did these "forgotten markets" come to play such a central role in recent events? And what does recent research on money markets tell us about the origins, propagation and potential resolution of the financial crisis?

Before the crisis: efficient transmission and stable markets

Chart 1 hints at one reason why research on money markets may have been neglected. Before August 2007 euro area money markets – in common with those in the other main currency areas – functioned very smoothly.[3] Small and stable money market spreads[4] facilitated the ability of the European Central Bank (ECB) to steer the overnight interest rate and efficiently implement its monetary policy. Banks were able to obtain funds readily in the market. Recourse to the ECB's standing facilities – which can be seen as indicative of the market's failure to allocate overnight funds – was, as a rule, very modest. The integration of the interbank money markets in the euro area was deeper than that of other segments.[5] All in all, such quiescent markets did not attract the attention of researchers.

Against this benign background, applied studies of the money market focused on how to perfect an already well-functioning system. Analysis centred on how to lower spreads or reduce volatilities by a few basis points, by changing the modalities of the procedures used to implement monetary policy. The results of these studies influenced the changes made to the Eurosystem's operational framework in March 2004[6] and the revision of the Bank of England's framework in 2005.

Although influential as regards the thinking of central banks, there was little response to such work in the academic research community, and studies of monetary policy and financial stability largely neglected the money market.

A "black swan" in the money market

All this changed abruptly and profoundly with the onset of the financial turmoil in early August 2007. Spreads increased in size, becoming more volatile and less predictable. Despite all the warnings that central banks had given about increasing vulnerabilities and underpricing of risk in 2006-07, the sudden emergence of these tensions took everyone, including policy-makers, by surprise. In the words of Taylor and Williams, we observed a "black swan" in the money market.[7]

This is illustrated in Chart 1, which shows the spread between the three-month EURIBOR and three-month euro overnight interest swap (OIS) rate. From an early stage, this spread was identified as a key indicator of money market tensions. It exemplified the disruptions to the transmission of monetary policy stemming from the turmoil: the rate at which banks were prepared to lend to each other (the EURIBOR, which formed the basis for bank lending

1 *See Cassola et al. (2008).*
2 *Theoretical papers on the interbank market include Bhattacharya and Gale (1987) and Freixas and Holthausen (2005). Empirical studies include Hamilton (1996 and 1997) and Furfine (1999); for the euro area, see Gaspar et al. (2008), Perez-Quiros and Rodriguez (2006) and Hartmann et al. (2001).*
3 *See Hartmann et al. (2001).*
4 *See Cassola and Morana (2009).*
5 *See Hartmann et al. (2003), Bernhardsen and Ejerskov (2005), Baele et al. (2004) and European Central Bank (2007).*
6 *For instance, the timing of open market operations and their duration was aligned with the dates of the meetings of the Governing Council of the ECB, as this allowed for better control of short-term interest rates.*
7 *See Taylor and Williams (2007 and 2009).*

Chart 1 Money market developments in the euro area

(spread between three-month EURIBOR and three-month euro OIS rate; basis points)

Source: Heider et al. (2009).

rates) no longer moved in lockstep with the expected path of policy rates determined by the Governing Council of the ECB. Moreover, since the EURIBOR involves exposure to counterparty risk whereas the OIS is cash-settled (i.e. does not involve an exchange of principal), this spread was also indicative of the premium charged on unsecured over secured lending.

Naturally, developments in prices were accompanied by corresponding developments in quantities. In parallel with the rise in spreads, transaction volumes shrank – especially at term maturities. The academic literature has identified two main causes for this: first, in an environment of heightened uncertainty, asymmetric information about other financial institutions' credit risk led to reduced lending activity in an effort to contain credit exposures; second, in the face of calls to fund related structured investment vehicles and conduits, some banks' demand for liquidity increased. As a result, these banks hoarded liquidity. With less easy access to short-term liquidity from the interbank market, other banks also began to hoard liquidity as a precautionary measure.[8] Compounded by concerns about the creditworthiness of counterparties in the face of emerging (uncertain and potentially large) losses from the sub-prime market, the liquidity in the unsecured interbank market dried up.

"...before August 2007, studies of monetary policy and financial stability largely neglected the money market..."

Asymmetric information, and credit and liquidity risk in (stressed) money markets

A key question emerging from this discussion is the relative importance of liquidity and counterparty credit risk. Not only was this issue crucial to understanding bank behaviour and its consequences for money market developments, it also had profound policy implications: to the extent that tensions in the money market reflected liquidity risk, provision of greater liquidity and/or increased intermediation of bank transactions across the balance sheet by central banks would serve to address the problem. By contrast, to the extent that tensions reflected credit risk, the provision of central bank liquidity would only treat the symptoms, not the underlying capital problem. This could only be addressed by the banks themselves, in concert with the regulators and fiscal authorities.

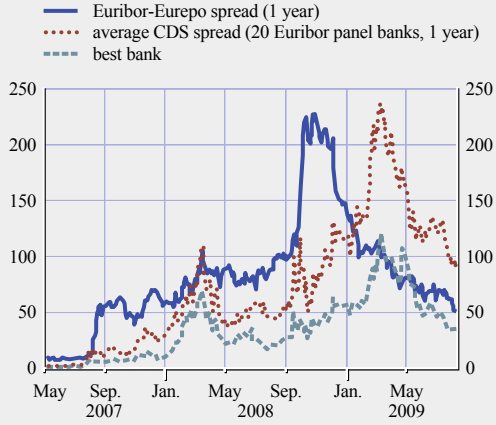
Against this background, a number of research papers attempted to decompose the spread between secured and unsecured interbank rates at term maturities into liquidity risk and credit risk components. While details varied, the essence of this approach was to identify credit risk with developments in the price of banks' credit default swaps (CDSs). The residual component of the deposit/OIS spread that did not correlate with CDS spreads was interpreted as a measure of liquidity risk. For instance, Taylor and Williams (2009) used this approach for the United States and came to the conclusion that increased counterparty risk accounted for most of the rise in the dollar LIBOR/OIS spread, at least in mid-2008. For the euro area, Chart 2 points to a different result:[9] counterparty risk –

8 *See Heider et al. (2009) for an analysis of the former, and Eisenschmidt and Tapking (2009) for an analysis of the latter reasoning.*

9 *See Eisenschmidt and Tapking (2009). The Bank of England (2007) applies a related approach to the UK experience in the second half of 2007.*

Chart 2 One-year EURIBOR/EUREPO spread and one-year CDS spread for EURIBOR panel banks

(basis points)



Sources: Eisenschmidt and Tapking (2009).

as reflected in CDS spreads – cannot explain the increase in the premium of unsecured interbank rates over secured rates in either August 2007 or September 2008, the two periods in which financial stresses intensified substantially. Moreover, rising credit risk from October 2008 onwards was associated with a *decline* – rather than the expected rise – in the one-year EURIBOR/EUREPO spread. On this basis, one can conclude that liquidity risk was the main factor behind the money market tensions in each of these periods.

The approach taken in these studies has some flaws, however. In particular, factors other than liquidity risk may influence the residual component. Attitudes towards risk can change. Endogeneity is also a concern, since the exceptional measures taken by central banks over the past two years have been triggered by the emergence of the tensions in the money market, and it is inevitably difficult to separate the persistent dynamics of the tensions themselves from the impact of such policy measures.

"…credit risk and liquidity risk are highly related in structural terms and correlated statistically…"

Implicit in the above-mentioned decomposition of the spread between secured and unsecured rates into credit risk and liquidity risk components is the view that credit and liquidity risk are unrelated. Only such an assumption can justify the structural interpretation placed on the residual as a measure of liquidity risk. However, this assumption runs counter to the received wisdom – dating back to at least the famous analysis of Bagehot – that, especially in times of financial crisis, bank solvency and liquidity risks are intimately related.[10]

A recent paper by members of ECB staff illustrates this point. Heider et al. (2009) develop a structural model of the money market, where the existence of informational asymmetries between market participants gives rise to adverse selection among banks. While the model is inevitably highly stylised, it demonstrates how concerns about the solvency of specific banks can lead to the breakdown of interbank trading.

This model distinguishes three different regimes: first, a situation of low interest rate spreads and active interbank trading; second, a market exhibiting elevated spreads and adverse selection, with continued but lower volume trading; and third, a regime of liquidity hoarding where market trading breaks down. What determines the transition from one regime to another in this model is the extent of concerns about solvency. But the outcome of these concerns is heightened liquidity risk for all banks, not just heightened solvency risk for those banks where credit risks mount. By implication, credit risk and liquidity risk are not orthogonal, but both highly related in structural terms and correlated statistically.

Such a model thus points to a need for caution in interpreting results obtained from the reduced-form regression analysis of money market and CDS spreads. It confirms the need for a more structural analysis. A number of academic contributions have been made in this area,[11] but as yet none provide the structural framework required to produce stronger and more robust empirical results. Moreover, by revealing the close interrelationship between credit and liquidity risk, the model points to the possibility that policy interventions tailored to addressing liquidity problems may also have implications for credit risk, and vice versa.

Understanding bank behaviour in the money market

A natural starting point for developing better structural models of the money market is to establish the stylised facts of bank behaviour in times of financial stress. Two very rich datasets have been exploited for this purpose, building on work conducted prior to the onset of the financial turmoil.

10 *See also Basel Committee on Banking Supervision (2009) and Kobayashi (2007).*
11 *See, inter alia, Diamond and Rajan (2008) and Allen et al. (2009).*

First, examination of counterparties' bidding behaviour in the Eurosystem operations provides an insight into individual banks' need for central bank liquidity.[12]

A number of papers have used panel techniques to explore counterparty bidding behaviour in normal times, thereby providing a basis for comparison with the experience in times of turmoil.[13] Eisenschmidt et al. (2009) and Cassola et al. (2009) extend the analysis to the post-August 2007 sample. These papers show that, as one would expect, bidding did indeed become more aggressive once market tensions had emerged. They also demonstrate that the value of collateral and uncertainties about the amount to be allotted encourage more aggressive bidding, as do strategic interactions among banks. Such results are consistent with the emergence of adverse selection in the interbank market, even if they do not provide definitive proof.

"…bidding in the Eurosystem operations became more aggressive once market tensions had emerged…"

Second, data from electronic trading platforms provide another valuable source of information. Reynaud and Durré apply a market microstructure approach to data from e-Mid, an Italian interbank trading system, to establish a stylised view of the patterns of money market trading between banks. Both these authors and Cassola et al. (2009) investigate the impact of the crisis on such behaviour. Both papers demonstrate that, presumably because of more severe asymmetric information, the timing of interbank trading shifted from the morning to the early afternoon as the market tensions increased, consistent with the view that banks increasingly hoarded liquidity in order to avoid being forced to enter the market at the end of the day, once shocks stemming from unanticipated payments became clear.

Cassola et al. also study the impact of the financial turmoil on the integration of money markets, building on the model by Freixas and Holthausen (2005). They find that, prior to the failure of Lehman Brothers, a small number of presumably large banks continued trading at a cross-border level, thereby acting as money centres. Since October 2008, however, large premia for cross-border trades point to the increasing segmentation of the money market.[14]

Looking ahead, the challenge remains to extend the coverage of such microstudies to the crisis period and to other datasets. Using data derived from payment systems is a promising avenue.[15] By improving understanding of banks' behaviour in the money markets under stress, better structural models and hence more meaningful empirical analyses can be constructed.

Concluding remarks

No longer quiescent, no longer forgotten: money markets have been at the fulcrum of the ongoing financial turmoil.

Recent research conducted at the ECB, triggered by the recent tensions, has demonstrated that credit risk alone does not explain the observed tensions in money markets, and that liquidity and credit risk are intimately related. Empirical studies have investigated the impact of the turmoil and subsequent policy responses on behaviour in the money market. Such research has played an important role in deepening our understanding of the causes and consequences of the market turmoil and thus in shaping policy responses.

Still, much remains to be done. New data sources are being developed and exploited. Recent experience provides a rich array of potential "natural experiments" to test newly formulated structural models. Institutional arrangements have been subject to new tests and, in some cases, may need to be rethought. Bringing these elements together promises to be an exciting field of research activity in the coming years.

12 *Since individual bidding behaviour is not made public, recourse to the operations offers banks an opportunity to obtain liquidity without revealing this need to other market participants. At times of market stress, such anonymity may command a premium.*
13 *See, inter alia, Linzert et al. (2007) and Cassola et al. (2007).*
14 *Further supporting evidence of a disintegrating effect of the crisis on money markets is also provided in ECB (2009, charts 3 to 6).*
15 *See Farinha and Gaspar (2008) and Bech and Atalay (2008) for applications in different contexts, building on the work of Furfine (1999).*

BANK LENDING STANDARDS AND THE ORIGINS AND IMPLICATIONS OF THE CURRENT BANKING CRISIS

By Angela Maddaloni and José-Luis Peydró

This article analyses the determinants of bank lending standards in the euro area and relates them to the origins and implications of the current banking and economic crisis. First, we analyse the factors behind the easing of banks' lending standards before 2007 and the important role which these factors played in the accumulation of the banking risks eventually leading to the current banking crisis. Second, we explore the implications of the current banking crisis for the supply of bank loans and the impact on the real economy. All in all, the results support the argument that the current problems in the banking sector and the consequent credit restrictions originated from an excessive accumulation of risk on banks' balance sheets in the years prior to the start of the crisis. In addition, we show that when these risks materialised they had a detrimental impact on the supply of credit and, in turn, on GDP growth. The actions of central banks aimed at relieving credit constraints have helped considerably in reducing credit supply restrictions.

The role of bank lending standards in the origins of the crisis

The current financial crisis has had a dramatic impact on the banking sectors of most industrialised countries, has severely impaired the functioning of the interbank market and has spurred an economic crisis. What are the causes of this crisis? Several commentators and academics have suggested that the current global financial crisis originated as a result of an excessive easing of banks' lending standards prior to the crisis, owing to at least three key elements: low interest rates across the maturity spectrum; high levels of securitisation activity; and weak banking supervision.[1] Therefore, the crisis that seemed to have started in the sub-prime mortgage market in the United States may rather be the manifestation of deep-rooted problems which were not peculiar to one financial instrument and/or country, but present globally, albeit to different degrees.[2] Moreover, these root causes seem to be interrelated and mutually amplifying (see Rajan, 2006).

"…the current global financial crisis originated as a result of an excessive easing of banks' lending standards prior to the crisis…"

Analysis of banks' lending standards – i.e. the rules followed by banks when taking a decision about granting a loan to a corporation or household, including the price and non-price elements of associated loans – provides one important type of information with which to address the aforementioned question. One way to analyse these lending standards is to use the assessment of the standards provided by the lenders themselves, the banks, through the rich and comprehensive surveys conducted by central banks. The standards do not refer just to loans actually granted, but to the pool of potential borrowers approaching banks for loans. In the euro area, this information is contained in the answers to the 18 questions of the bank lending survey – a survey carried out for all euro area countries (initially 12, now 16) since its inception in the last quarter of 2002.[3]

We analysed the determinants of euro area lending standards.[4] Our first finding is that lending standards are pro-cyclical, so they tend to be eased during the upturn and tightened during the downturn. Second, both the level of and changes in short and long-term interest rates affect the way in which banks decide to grant loans to the private sector. In particular, we find that when rates are relatively "low", banks tend to relax their credit standards.[5]

1 *See, in particular, Allen (2008), Borio and Zhu (2008), Brunnermeier (2009), Calomiris (2008), Taylor (2007 and 2008) and numerous articles in the Financial Times, Wall Street Journal and The Economist.*

2 *See, in this respect, E. Botín, chairman of Banco Santander: "I believe the causes cannot be found in any one market, such as the United States. Nor are they limited to a particular business, such as sub-prime mortgages. These triggered the crisis, but they did not cause it. The causes are the same as in any previous financial crisis: excesses and losing the plot in an extraordinarily favourable environment. Indeed, some fundamental realities of banking were forgotten: cycles exist; lending cannot grow indefinitely; liquidity is not always abundant and cheap; financial innovation involves risk that cannot be ignored" (Financial Times, 17 October 2008).*

3 *For a detailed explanation of the euro area bank lending survey, see Berg, van Rixtel, Ferrando, de Bondt and Scopel (2005) and Sauer (2009).*

4 *See Maddaloni, Peydró and Scopel (2009) and Maddaloni and Peydró (2009).*

5 *One way to analyse whether short-term rates are low is to compare actual short-term rates with rates implied by a Taylor rule: see Taylor (2007 and 2008) and Ahrend, Cournède and Price (2008) for worldwide evidence of low actual interest rates relative to such "Taylor rates" prior to the crisis. Allen (2008) and Allen and Gale (2004 and 2007) argue that, in the presence of agency problems at the bank level, an overly accommodating monetary policy would induce banks to take on higher risk. In particular, if liquidity is very high in relation to the available economic opportunities, banks' managers may decide not to give the liquidity back to central banks (or to the shareholders) but to invest in riskier projects (hence taking higher risks) and/or to increase banks' leverage. The agency problems in the banking sector are associated with the presence of deposit insurance, the possibility of bank bailouts and low ratios of bank capital to total assets.*

These results hold even when controlling for the riskiness of the borrower. Moreover, we find that when rates are too low for too long, lending standards are eased even further. All the terms and conditions of loans (both price and non-price) are relaxed when rates are low, both for average and for riskier borrowers, even when controlling for macroeconomic conditions and bank and country-specific factors.[6] Finally, we find that short-term rates have more of an impact on the easing of standards than long-term rates.[7]

"…there is a link between short-term rates and the search for yield through securitisation…"

We also analysed whether the level of securitisation activity affects lending standards. Our results suggest that lending standards are eased when securitisation activity is high, thus supporting the argument that securitised assets, insofar as they can be removed from the balance sheets, reduce banks' incentive to monitor and screen borrowers.[8] More importantly, a high level of securitisation activity amplifies the impact of low overnight rates on the easing of credit standards.[9] These results suggest that there is a link between short-term rates and the search for yield through securitisation. When short-term interest rates are low, investors have more appetite for securitised assets yielding higher returns. This creates a stronger incentive for banks to ease lending standards when granting loans for which they do not bear the associated risk – loans that are securitised and removed from their balance sheet.

Finally, we looked at the impact of banking supervisory powers on lending standards, using a time-varying measure of banking supervision. We show that weak bank supervision not only leads directly to a relaxation of lending standards, but also increases the impact of low overnight rates on the easing of standards.[10] This is consistent with the argument linking the impact of low short-term rates on excessive risk-taking stemming from agency problems in the banking sector, as proxied in this case by weak bank supervisory powers (see Allen (2008), Allen and Gale (2007), Calomiris (2008) and Rajan (2006)). The effect of weak banking supervision is, however, not very strong, which may result from the way the indicator – measuring only *stringency* of capital requirements - is constructed.

In the years before the start of the financial crisis in 2007, short-term and long-term interest rates were generally at very low levels for an extended period of time; securitisation activity was very high; and, in some markets and countries, the level of banking supervision may have been insufficient. All of these factors resulted in an easing of lending standards, thereby increasing bank risk.

Financial crisis, credit supply and economic activity

The current financial crisis has been characterised by a sharp decrease in the liquidity and capital positions of banks following the materialisation of the risks accumulated over previous years. Since the banking system has a pivotal role in the functioning of the economy, especially in the

6 *The impact of the level of short-term interest rates on credit risk-taking was first analysed by Ioannidou, Ongena and Peydró (2009) and Jiménez, Ongena, Peydró and Saurina (2009a). Ioannidou, Ongena and Peydró (2009) analyse the credit register from Bolivia, which offers a natural experiment: the banking system was almost completely dollarised; the Bolivian currency was pegged to the dollar; there were no capital restrictions; and the business cycles of Bolivia and the United States did not correlate. They find strong evidence that low federal fund rates increase loan risk-taking, especially in the case of banks with higher agency problems, yet loan spreads are reduced. Using the credit register from Spain for the last 20 years and the overnight rates from the Bundesbank and the European Central Bank, Jiménez, Ongena, Peydró and Saurina (2009a) find that lower overnight rates lead banks to give credit to borrowers with a poor or no credit history and to originate loans with a higher hazard rate. On the other hand, once the loans have been originated, the hazard rate increases with short-term interest rates (see also Adalid and Detken (2007)), thus suggesting that the environment with the highest loan risk is the one with very low levels of short-term rates for a long period followed by rapid and high increases in overnight rates.*

7 *See Shin (2009), Adrian and Shin (2009) and Brunnermeier et al. (2009) for the importance of overnight rates for bank liquidity and their impact on bank risk-taking. They suggest that banks have an incentive to borrow over the short term in order to boost profits; hence short-term rates are more important than long-term rates in determining the risk taken by banks. See also the interview of US treasury secretary Geithner (Wall Street Journal, 12 May 2009, by Charlie Rose on the PBS television channel), who referred to both short and long-term rates as key root causes for the current crisis, in conjunction with weak bank supervision and bad incentives in the securitisation market.*

8 *Keys et al. (2008), Mian and Sufi (2009) and Dell'Ariccia, Laeven and Igan (2008) find similar results with US data.*

9 *We instrument securitisation by using an indicator of the regulatory environment for securitisation in each country, since securitisation activity depends not only on the regulation and development of that country's financial system, but also on short-term rates.*

10 *See also Laeven and Levine (2008).*

euro area, problems in the banking sector are likely to trigger restrictions in credit, in turn affecting the overall economy.[11]

Jiménez, Ongena, Peydró and Saurina (2009b) analyse individual monthly loan application level data matched with comprehensive firm and bank information for the period up to the end of 2008, in order to identify the effects of economic and monetary conditions on credit supply. They find strong evidence that both adverse economic and contractive monetary conditions reduce the loan supply, and that this reduction is stronger in the case of firms and banks with lower capital and liquidity (see Chart 1 for the effects of GDP growth on loan supply for different levels of firm and bank capital; for other effects, see Jiménez et al. (2009b)). In addition, *within* the set of loan applications from the same borrower to different banks in the same month (i.e. when the quality of the potential borrower is fixed), they find that banks with low capital grant fewer loans when GDP growth is lower (or short-term interest rates are higher). Hence, in bad times a capital crunch implies a credit crunch (as defined by Bernanke and Lown, 1991).[12]

"…tightening the supply of bank loans reduces real GDP growth both directly and indirectly…"

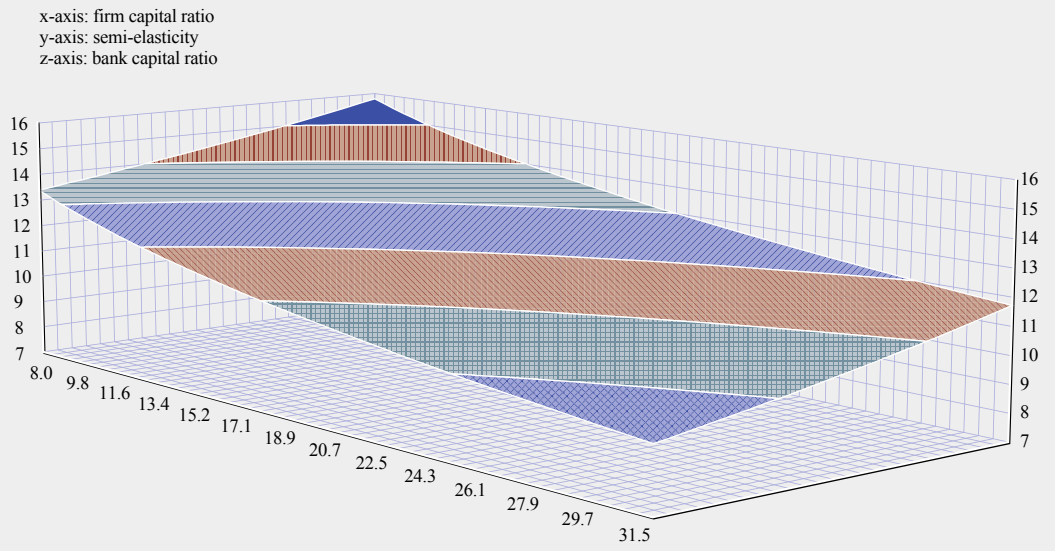
Banks' capital and liquidity problems reduce loan supply, but does a negative credit supply shock reduce GDP growth? Our recent empirical research, which uses the responses from the bank lending survey in a panel vector autoregressive model of the euro area economy, suggests that tightening the supply of bank loans reduces real GDP growth both directly and indirectly through the reduction in loan demand.[13] Especially during the first part of the crisis, lending standards were tightened largely because of constraints on the capital and liquidity positions of banks. Later, the crisis

11 Banks' capital problems may also imply systemic risk through contagion in the interbank market and other spillover effects. See Iyer and Peydró (2009) and de Bandt, Hartmann and Peydró (2009).

12 Bernanke and Lown (1991) define credit crunch as "a significant leftward shift in the supply curve for loans, holding constant both the safe real interest rate and the quality of potential borrowers"; they relate it to capital crunch and provide empirical evidence on the US economic crisis in the early 1990s.

13 See Ciccarelli, Maddaloni and Peydró (2009) and De Bondt, Maddaloni, Peydró and Scopel (2009).

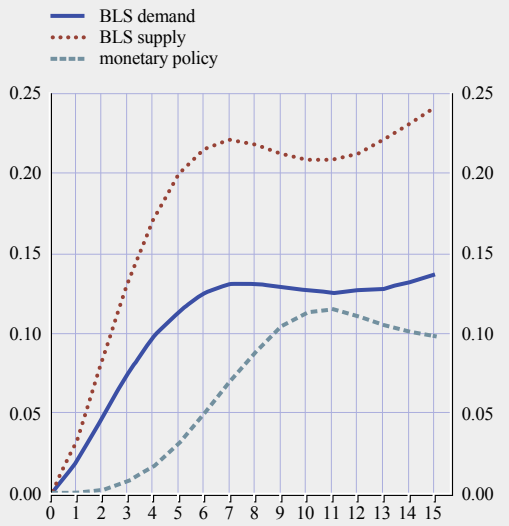
Chart 1 The impact of positive GDP growth on loan supply increase



Sources: Jiménez, G., S. Ongena, J.-L. Peydró and J. Saurina (2009b).
Note: The chart plots the percentage change in the probability of granting loans for a decrease of one standard deviation in GDP growth (-0.93 percentage point) in the 25th to 75th percentile range of firm and bank capital ratio. Otherwise, all the other variables are set equal to their mean. The sample period is from February 2002 to December 2008. The average reduction in the probability of granting loans is -12%, and the effects are stronger for firms and banks with a lower level of capitalisation.

Chart 2 Variance decomposition of GDP growth

(as a percentage)



Sources: Ciccarelli, M., A. Maddaloni and J.-L. Peydró (2009).

having spread to the real sector, factors related to borrowers' risk became predominant, thus creating a further feedback loop on the capital position of banks. Both these effects have a detrimental impact on economic growth, with a lag of a few quarters. Moreover, we find that loan supply shocks have more of an impact on GDP growth than loan demand and monetary policy shocks, although, in absolute terms, loan supply explains no more than 25% of the variance decomposition of GDP growth (see Chart 2). However, credit supply shocks are likely to affect output more significantly during economic downturns. Thus, since GDP growth was mostly positive during the period (from the fourth quarter of 2002 to the fourth quarter of 2008) covered by the analysis, the estimated explained variance of GDP due to credit supply shocks may be an underestimation owing to the non-linearity of the credit channel.

At the same time, monetary policy can play an important role by managing policy rates and helping to ease credit conditions. Our evidence supports the existence of a strong credit channel in the euro area. We find clear evidence that an accommodative monetary policy eases the supply of bank loans for businesses, mortgages and consumers, which in turn has a significant impact on GDP growth.

Conclusions

The evidence presented above suggests that banks tend to accumulate risk in good times by easing their lending standards. This result is amplified if, at the same time, interest rates are relatively low, the level of securitisation is high and (somewhat less robust) banking supervisory powers are weak, since all of these factors reinforce one another.

Once the risks have materialised, banks react by tightening their standards, thereby reducing the supply of bank loans to the private sector. This has been one of the factors negatively affecting GDP growth, since it reduces the funds available for investment and consumption.

FINANCIAL CONDITIONS AND MONETARY POLICY

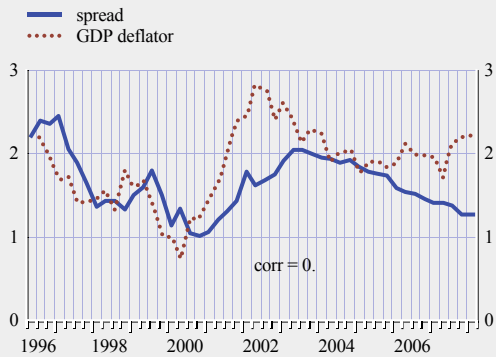
By Fiorella De Fiore and Oreste Tristani

The recent financial crisis raises important questions as to the role of banking and financial markets for the conduct of monetary policy. What are the main channels through which financial shocks have an effect on the real economy? Should a central bank react to financial developments in its pursuit of price stability? How should monetary policy respond to shocks which originate in financial markets? This article surveys a few research papers which address these questions in the context of a dynamic general equilibrium analysis.

In the new-Keynesian model, a standard tool for monetary policy analysis, it is assumed that financial markets are perfect.[1] As a result, there is no liquidity or credit risk, all borrowing and lending rates of the same maturity coincide, and nothing limits the ability of borrowers to obtain credit. Financial conditions – such as measures of liquidity and credit risk, or collateral requirements – do not play a role in the transmission of shocks, nor do they affect the conduct of monetary policy. In spite of this strikingly simplified assumption, the new-Keynesian model has proven very effective in accounting for the behaviour of aggregate macroeconomic variables. Therefore, at first sight, it is not obvious that financial conditions should play a role in the explanation of variables such as inflation, consumption, investment and GDP.

However, the recent financial crisis has focused renewed attention on the role of financial markets in the macroeconomy. Chart 1, for example, highlights the positive correlation between (a measure of) credit spreads and inflation in the euro area. This correlation suggests that there may be a link between credit spreads (the cost of firms' external finance) and price developments.

Chart 1 Credit spreads and inflation



Source: Area-wide model database (see Fagan, Henry and Mestre, 2005), and Lombardo and McAdam (2009).
Note: "Spread" denotes the difference between the interest rate on short-term loans (i.e. with maturity up to one year) to non-financial corporations and the three-month interbank rate.

Some of the links between financial markets and the macroeconomy remain imperfectly understood, notably the link between interbank markets and aggregate economic dynamics. Nonetheless, some progress has recently been made on two fronts: the empirical analysis of the macroeconomic effects of financial shocks and the monetary policy implications of incorporating imperfect financial markets into dynamic stochastic general equilibrium (DSGE) models. This article describes some of the authors' main findings within the second line of research.[2]

The analysis is conducted using a DSGE model in which firms need external funds to finance the payment of the factors of production. Both asymmetric information between banks and firms and default risk lead banks to charge a higher lending rate than the risk-free rate. Reflecting a key feature of the financial system, financial contracts are denominated in nominal terms. Thus, changes in the nominal interest rate affect the cost of external finance for firms.

Financial markets and the transmission of shocks

It is well-known that the standard new-Keynesian model with staggered nominal price rigidities can be characterised by an aggregate demand (or IS) equation and a type of Phillips curve. When asymmetric information and default risk are introduced into this model, economic dynamics can again be characterised by an aggregate demand equation and a Phillips curve. However, these equations

[1] *See, e.g. Woodford (2003).*
[2] *See De Fiore and Tristani (2007 and 2008) and De Fiore, Tristani and Teles (2009). There is a fast-growing body of literature that incorporates imperfect financial markets into DSGE models, taking either the positive or the normative perspective. Among the contributors to this literature are Christiano, Motto and Rostagno (2003 and 2006), Ravenna and Walsh (2006), Cúrdia and Woodford (2008) and Lombardo and McAdam (2009). See also the related article in this issue of the Research Bulletin.*

become more complex and financial market conditions appear explicitly as determinants of the output gap, or inflation. The most straightforward way in which financial market conditions play a role is through their effect on the spread between the lending and risk-free rates, which we refer to as the "credit spread".

If the need for external finance is mostly felt by firms, as assumed for simplicity in the models described in this article, then the most important impact of credit spreads is on the Phillips curve. Given firms' need to finance their factors of production, marginal costs will be sensitive to changes in financing costs. Inflationary pressures will therefore arise not only due to excess aggregate demand – i.e. the opening of a positive output gap – but also when lending rates to firms go up. In turn, ceteris paribus, lending rates can increase for two reasons: first, as a result of an increase in risk-free interest rates, e.g. owing to a monetary policy action – for given credit spreads, such an increase would be transmitted one-to-one to lending rates; and second, because credit spreads become larger – in this case, financing conditions would become tighter even if risk-free rates remained unchanged. In practice, credit spreads change all the time, either endogenously – e.g. in reaction to changes in firms' leverage ratios – or exogenously, as a result of unforeseen shocks.

Hence, the model highlights two macroeconomic implications of an increase in credit spreads. The first is the generation of inflationary pressure through the aforementioned effect on firms' marginal costs. The second is the depression of economic activity, either directly – e.g. by discouraging production when it requires external finance – or indirectly, because of the increase in firms' prices.

When the increase in credit spreads occurs as a result of an exogenous shock, the shock is of the "cost-push" type, namely it generates inflationary pressure and economic slack at the same time. Such a shock generates a trade-off between output and inflation stabilisation, which makes it difficult for the central bank to maintain price stability without inducing larger output volatility.

Financial market variables and monetary policy

The richer transmission channels highlighted above make the analysis of monetary policy in the context of DSGE models less straightforward and more realistic. When setting policy interest rates, the central bank should not simply assess the direct implications of its decision on aggregate demand, but also bear in mind that its decision will lead to changes in financing conditions and leverage ratios, which have additional effects on the macroeconomy.

In spite of the more complex transmission of monetary policy, however, it remains possible to consider inflationary pressures as arising from deviations of the real interest rate from a summary indicator, the "natural rate of interest". More specifically, in a theoretical economy with nominal price rigidities and financial frictions, price stability can be maintained *at all times* through commitment to a "natural rate rule", which ensures that the policy interest rate moves one-to-one with an appropriately defined concept of the natural rate of interest.

Because of the aforementioned trade-off between output and inflation stabilisation, however, maintaining price stability at all times, rather than over the medium term, may generate excessive volatility in output and in nominal interest rates. Models with financial frictions suggest that, when setting the policy stance, a central bank should avoid an exclusive focus on inflation over the very short run. Allowing adverse shocks to produce short-lived inflationary spillovers may help reduce the consequences of the shocks for aggregate demand and, in addition, for credit spreads.

"...monetary policy should take into account its repercussions for financial conditions...."

At the same time, this concern to avoid excessive volatility in output, nominal interest rates and credit spreads should have a

[3] *The well-known practical limitations of the natural rate rule remain valid. The natural rate of interest is an unobservable variable and its precise measurement in practice is challenging.*

quantitatively minor impact on a central bank's policy actions. Under normal circumstances, the models suggest that maintaining price stability should remain the central bank's overriding objective. This concern may, however, become more relevant when macroeconomic fluctuations arise as a result of financial shocks.

Reaction of monetary policy to financial market shocks

When financial factors are relevant for aggregate production, a theoretically optimum response to shocks on the part of monetary policy should take into account its repercussions for financial conditions. For example, an increase in policy interest rates will not only tend to curb aggregate demand, but also to lead to a tightening of credit conditions for firms, to the extent that it is not systematically offset by a fall in credit spreads. Providing precise quantitative policy guidance is beyond the scope of the simple models summarised in this article. These models are however useful insofar as they highlight effects that are also likely to play a role in richer frameworks.

"...a shock that increases credit spreads may require a commensurate reduction in the policy rate"

For example, a shock that affects intermediation activity and increases credit spreads may require an aggressive easing of monetary policy, namely a reduction of the policy rate commensurate to, or even larger than, the increase in credit spreads. The shock will tend to generate an undesirable fall in aggregate demand and also to exert some degree of inflationary pressure through its impact on firms' financing costs. If monetary policy reacted by focusing purely on inflation, it would want to tighten the policy stance. However, this response would exacerbate the adverse implications of the shock on economic activity, without necessarily reducing the inflationary consequences of the shock, owing to the repercussions of higher interest rates on firms' marginal costs.

By contrast, an aggressive interest rate cut may be much more effective in minimising deviations from price stability without worsening the economic outlook. On the one hand, it would help sustain demand in the face of an adverse shock; on the other, it would not necessarily lead to more pronounced inflation, because it should also bring about a fall in firms' marginal costs through its direct impact on their financing conditions.

An additional consideration which may be relevant when setting monetary policy relates to possible "debt deflation" effects, i.e. to the fact that inflation, or deflation, will also have an impact on the real value of firms' nominal debt. The empirical importance of this effect is unclear and depends on the extent to which firms' assets are also denominated in nominal terms. In theory, however, a short-lived period of inflation in response to a negative financial shock may not only be tolerated, as argued above, but would also have the desirable effect of helping firms to reduce leverage. A faster deleveraging process would allow for a swifter adjustment process after the shock, and thus a speedier recovery of economic activity.

Conclusions

This article summarises the findings of a number of research papers which attempt to provide normative guidance on the appropriate policy response to financial market developments in the context of DSGE models. While these models incorporate many realistic features, including, for example, endogenous time-varying bankruptcy rates and credit spreads, they remain highly stylised compared with the sophistication of modern financial markets. They also fail to incorporate features which may have played a relevant role in the transmission of the recent financial turmoil to the real economy, such as the possibility of disruptions in the interbank market. The analysis of the most effective way to incorporate such features into a macroeconomic model is currently an area of active research.

INCORPORATING FINANCIAL FRICTIONS INTO NEW-GENERATION MACRO MODELS

By Giovanni Lombardo and Peter McAdam

The recent financial turbulence has underscored the importance of implementing an informative but tractable set of financial channels in structural, general equilibrium policy models. This article describes some recent work to extend the New Area-Wide Model (NAWM) of the ECB[1] to incorporate such channels, drawing on Lombardo and McAdam (2009). We find that supplementing the benchmark model with frictions on both the household and firm level markedly modifies the response of the economy to shocks.

It is well known that financial markets are imperfect. This reflects, e.g. information asymmetries between lenders and borrowers, costly verification of financial contracts and the possibilities of bankruptcies. Given this uncertainty, lenders may demand a premium (or spread) over risk-free interest rates as compensation. That premium, moreover, is likely to be counter-cyclical. Another way that financial uncertainty may manifest itself would be if lenders place a limit on the amount available to borrowers.

The strength of such "financial frictions" and the soundness of the financial system have implications for how central banks conduct monetary policy and assess inflationary pressures and risks. For instance, the recent widening of spreads and deterioration in private lending prompted a number of central banks to loosen monetary policy and take non-standard measures to provide liquidity to banks. This reflects concerns that tensions in financial markets would spill-over to the wider economy and the financial position of households and firms.

"...It is well known that financial markets are imperfect..."

Nevertheless, many policy models largely assume frictionless financial markets (with a few notable exceptions, Christiano et al. (2003)). This reflects, inter alia, controversy as to their importance. Some analyses stress them as a key amplifier and source of business-cycle fluctuations (see e.g. Bernanke et al. (1999), Jermann and Quadrini (2009) and Gilchrist et al. (2009)) whilst others suggest their impact may be relatively minor (see Meier and Müller (2006)) or strongest during extreme financial distress such as the Great Depression and the Asian Crisis (see, Bernanke (1983), Gertler et al. (2006)).

Modelling financial frictions: approaches in the literature

There are two common ways of modelling financial constraints: i) via costly state verification and default risk and ii) via limited enforceability of contracts and collateralised debt.

The first is commonly modelled as a *financial accelerator*, see e.g. Bernanke et al. (1999). Lenders necessarily have incomplete information on borrowers' ability to repay. Given the possibility of default and its associated monitoring costs, lenders charge a (external finance) premium over the risk-less interest rate. This premium is an increasing function of firms' leverage ratio, i.e. their debt to net worth. The higher is a firm's leverage, the higher potentially is the risk of default.

The second emphasises collateral constraints, see e.g. Kiyotaki and Moore (1997). Here financial frictions take the form of limited enforceability of contracts. Repayment can only be ensured by restricting the amount of loans to some fraction of the value of the borrower's collateral. The specification still implicitly produces a financial accelerator through movements in price (e.g., be it in house prices or the price of capital equipment).

Both financing schemes generate a link between the net worth of agents and their creditworthiness, and would be equally suitable to describe both households' and firms' finances. The collateral constraint model generates quantitative rationing leaving the cost of funds at the risk-less rate level. The costly-state-verification model, instead does not limit the level of debt, but generates a cost of funds that exceeds the risk-less rate.

[1] *Christoffel et al. (2008).*

In the model of Lombardo and McAdam (2009), the financial accelerator mechanism is assumed to pertain to firms. We follow Bernanke et al. (1999): every period leveraged firms are hit by a common and idiosyncratic shock and thus alongside surviving firms, there is a turnover of entering and exiting ones. On the household side we largely follow Iacoviello (2005) and assume there are two consumer types: "patient" and "impatient". The latter (whose share is calibrated at 15%) faces collateral constraints in its house purchases and its sole source of income is from its labour services.

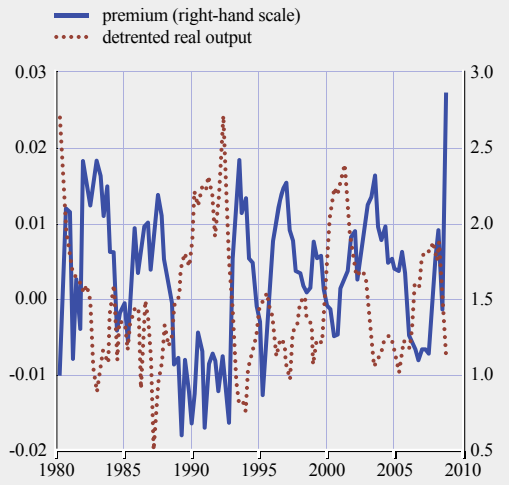
Data

On the data side there is the difficulty of constructing euro area financial variables such as spreads and property prices given heterogeneity in data and differences in institutional structures and policy regimes.[2]

In augmenting the NAWM with financial frictions, we added four new time series: *Residential House Price Index*; *Real Residential Investment*; *(Nominal) Loans to Non-Financial Corporations*; and the *External Finance Premium*. Prior to the EMU period, synthetic values of these variables have been calculated as GDP-weighted averages of the available country data. The growth rates of this synthetic data were then used to create the backtracked history for a given official starting point.

Chart 1 plots a definition of the external finance premium defined as the rate for short-term loans of Monetary Financial Institutions to Non-Financial Corporations minus the aggregated 3-month Treasury-bill rate. This definition is attractive since it captures the premia both firms and financial intermediaries pay over the government bill yield. The strong counter-cyclicality of this premia can clearly be observed.

Chart 1 Cyclical variation of the euro area external finance premium



Note: Output expressed as deviation from HP trend.

Modelling financial frictions: a model illustration

Chart 2 depicts the dynamic responses of selected variables to a positive transitory productivity shock evaluated at the posterior mean of the model with and without financial frictions on the housing and firm side. A transitory technology improvement, other than being a useful modelling benchmark, also reminds us that a model with financial frictions has implications for the transmission of *non*-financial shocks as well as financial ones.

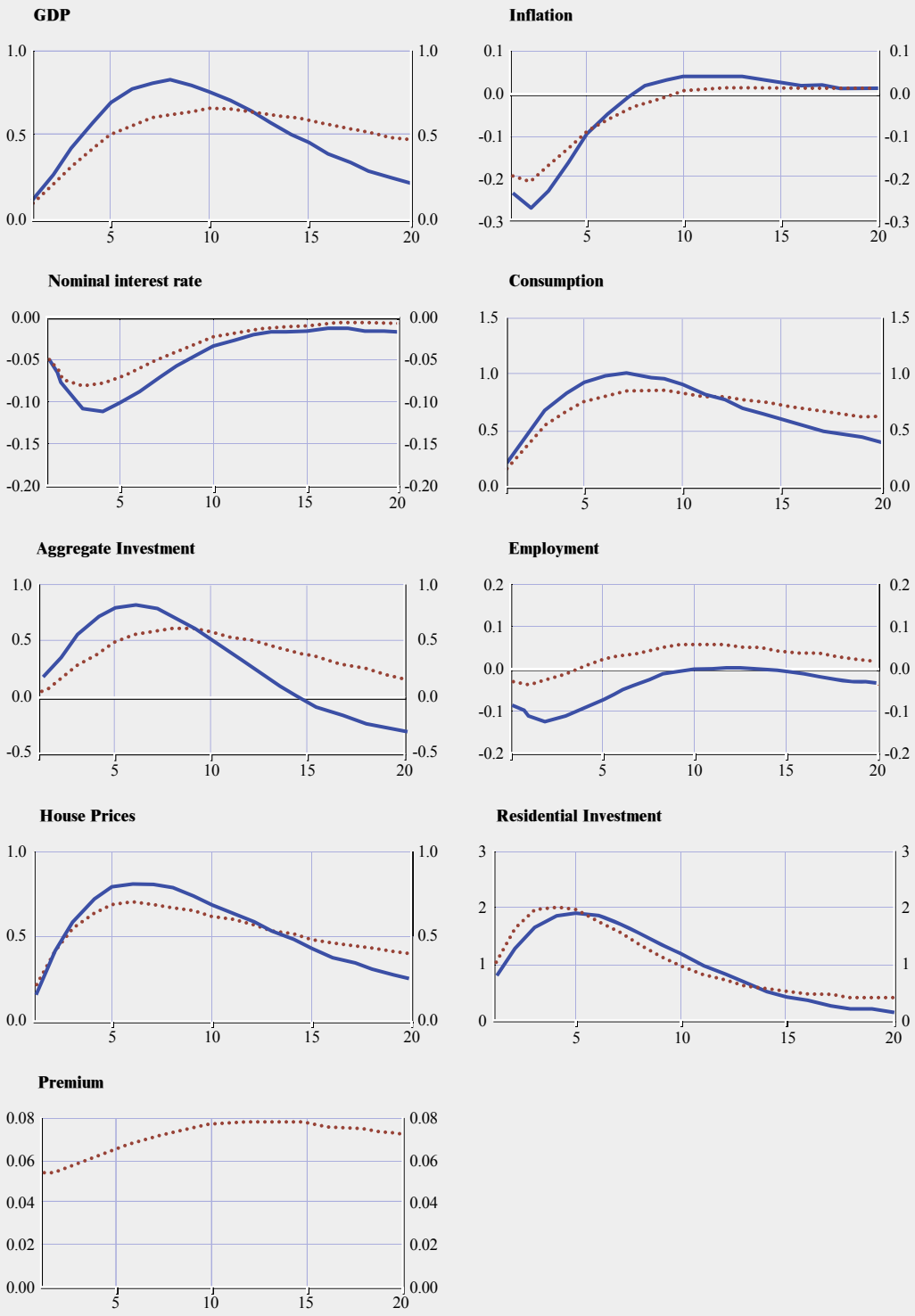
"...The strength of such "financial frictions" have implications for how central banks conduct monetary policy and assess inflationary pressures..."

The qualitative predictions across model versions are similar: output, consumption, and investment rise following the positive technology shock, while employment initially declines (consistent with the predictions of standard sticky-price New Keynesian models). The rise in productivity reduces marginal costs (not shown) and thus inflation, implying that the nominal interest rate falls to counteract the disinflationary effect. Given the extra demand, house prices and investment activity pick up.

Though we may think of financial-frictions models as amplifying shocks, here the effect is to dampen and slow the transmission of the productivity improvement. With financial

[2] *For example, the loan-to-value ratio in the housing market has varied widely over euro area countries (Kok-Sørensen and Lichtenberger (2007)).*

Chart 2 Impulse responses to a transitory technology shock



Note: All dynamic responses are reported as percentage or percentage-point deviations from steady state. The solid line denotes the model with financial frictions and the dashed line represents the model without financial frictions.

frictions, firms' additional leveraging produces a small but persistent rise in the premium. The reason being that the shock induces a strong and rapid investment boom, whereas existing net worth is slower to react. Additionally, although in both models real interest rates rise (thus curtailing the expansion) the rise becomes more important in a financial-friction model since – in line with Fisher's (1933) debt deflation account – the real value of firms' and households' debt obligations (lending contracts are typically denominated in nominal terms) rises when inflation falls. In turn, real resources are transferred from entrepreneurs to unconstrained households.

Conclusions

Many existing macro models have limited coverage of financial variables and frictions. The academic literature is inconclusive on their impact. This particular specification and model estimation, suggests however that, whilst they do not radically alter the qualitative predictions of models, the incorporation of extensive financial frictions can modify and accelerate the effect of shocks to a strong degree.

"...incorporation of extensive financial frictions can modify and accelerate the effect of shocks..."

Box

RESEARCH AWARDS BY STAFF MEMBERS

The paper "Liquidity Hoarding and Interbank Market Spreads: The Role of Counterparty Risk" by Florian Heider, Marie Hoerova and Cornelia Holthausen has been awarded two prizes in September 2009: the best paper prize of the conference on "Business Models in Banking: Is There a Best Practice?" hosted by Bocconi's CAREFIN (Center for Applied Research in Finance) and the Marjolin prize of SUERF (the European Money and Finance Forum). The latter is awarded to the best contribution to the SUERF Colloquium "The Quest for Stability", which was hosted by the Utrecht School of Economics. It is restricted to papers whose authors are under 40. The paper studies the functioning and possible breakdown of the interbank market due to asymmetric information about counterparty risk. The model generates predictions that mirror observed developments in the interbank market during the 2007-09 financial crisis. The authors use the framework of the paper to discuss various policy responses.

The paper "'Real Time' Early Warning Indicators for Costly Asset Price Boom/Bust Cycles: A Role for Global Liquidity" by Lucia Alessi and Carsten Detken has won the CEPR/ESI 2009 Prize for the best Central Bank Research Paper submitted to the 13th CEPR/ESI Annual Conference on "Financial Supervision in an Uncertain World" which took place at Venice International University on 25-26 September. The paper finds evidence that a global private credit indicator performs best compared to a host of other real and financial indicators to predict asset price booms, which are followed by serious recessions. Global credit is shown to also be useful in absolute terms, i.e. with respect to type I and type II errors as long as policy makers' preferences between the two types of errors are relatively balanced (see also ECB Research Bulletin, No. 8).

The paper "Interbank Market Integration, Loan Rates, and Firm Leverage" by Alexander Popov and Steven Ongena (Tilburg University) has won the 2009 Bankscope prize for the best paper in banking at the 22nd Australasian Banking and Finance Conference in Sydney, Australia. The paper studies the effect of interbank market integration on small firm finance in the build-up to the current financial crisis, using a comprehensive data set that contains contract terms on individual loans to 6,000+ firms across 14 European countries between 1998:01 and 2005:12. The authors find that integration of interbank markets resulted in less stringent borrowing constraints and in substantially lower loan rates. They also find that in the most rapidly integrating markets firms became substantially overleveraged during the build-up to the crisis.

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