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By Kalin Nikolov

Asset price bubbles are considered to be a major risk to financial stability. In this article, we show that an asset price bubble poses a bigger risk when banks are exposed to it. This is because when the bubble bursts, banks realise losses and this may trigger bank failures and a credit crunch. In contrast, when overvalued assets are held by ordinary savers, the consequences for financial stability are less severe. We show that low bank profitability and a generous financial safety net for banks are important determinants in their decisions to take risks.

By Matteo Ciccarelli

Data revision and the uncertainty that it creates are of importance for forecasting and policy analysis. Adjusting for data revisions requires a forecaster or policy-maker to explicitly model the data measurement process, which is difficult. This short article illustrates an estimation methodology which is robust to data uncertainty due to the revision process, regardless of its exact nature and without the need to model it.

By Fiorella De Fiore and Oreste Tristani

This article studies the implications of the zero lower bound on interest rates as a constraint on monetary policy when frictions impair the functioning of financial markets. Compared to a situation without financial market imperfections, the zero lower bound may be hit more frequently when policy follows a simple interest rate rule. Following a deflationary shock, optimal policy entails that prices revert to a higher level than prior to the shock.

BOXES

BUBBLES, BANKS AND FINANCIAL STABILITY

By Kalin Nikolov

Asset price bubbles are considered to be a major risk to financial stability. In this article, we show that an asset price bubble poses a bigger risk when banks rather than other economic agents are exposed to it. This is because when the bubble bursts, banks realise losses and this may trigger bank failures and a credit crunch. In contrast, when overvalued assets are held by ordinary savers, the consequences for financial stability are less severe. We show that low bank profitability and a larger financial safety net are important determinants in a bank's decision to take risks.

The financial crisis of 2007-09 has spurred an active research agenda in integrating financial factors into macro-economic models in order to understand how crises happen and how they affect the real economy. Important facts that the literature is trying to explain include the links between low interest rates, strong output growth and buoyant credit and asset prices before the crisis and the subsequent collapse. Using euro area and Spanish data, Maddaloni and Peydro (2010) and Jimenez et al. (2011) identified a clear relationship between low interest rates and high risk-taking by banks. Reinhart and Rogoff (2009), Borio and Lowe (2002) and Alessi and Detken (2009), amongst others, documented the pre-crisis increases in credit and bank leverage and showed that such credit booms are the best predictor of future banking crises.

Our research is part of a large body of literature which tries to replicate this evidence by constructing an environment in which asset prices can deviate from fundamentals. In standard economic models, such deviations cannot arise. In a seminal contribution, Tirole (1982) showed that asset price bubbles can be ruled out in an economy in which three conditions are satisfied: (1) everyone is rational, (2) everyone shares a common prior over the value of the asset, and (3) the initial allocation is Pareto efficient. This conclusion relies on the fact that, under these assumptions, the buyer of an overvalued asset must be worse off, and therefore would not buy the asset.

Our paper[1] and the literature on "rational bubbles under credit frictions" relaxes the Pareto efficiency assumption by building environments in which individuals cannot commit to repaying uncollateralised debts ("limited commitment"). Starting from the work of Townsend (1980), this line of research shows that such limited commitment economies will suffer limits on private intermediation and, hence, a lack of safe assets that savers can invest in. Borrowers' inability to commit to repayment leads to a shortage of liquid assets for savers, pushing up the prices of scarce means of saving. High bond prices imply low equilibrium real interest rates, and if the limits on private intermediation are severe enough, the real interest rate declines below the real growth rate of the economy (one of the key stylised facts identified by the empirical literature on crises). At this point, even very unproductive investments become attractive as agents try to find ways to transfer wealth through time.

Consequently, the economy becomes "dynamically inefficient" – a specific example of Pareto inefficiency, i.e. a situation in which it would be possible to find a way to make some people better off without making anyone else worse off. Taking the example of our limited commitment economy, suppose that borrowers and savers can credibly promise to engage in a "chain-letter" scheme whereby savers at each point in time hand over a certain fraction of their wealth to borrowers. Because the identity of borrowers and savers changes randomly over time, this scheme does not involve any net transfers between individuals over long periods. Moreover, such a scheme provides participants with an effective rate of return equal to the growth rate of the economy, which is higher than the interest rate under the non-cooperative equilibrium. Inefficient investments are eliminated and everyone becomes better off as a result.

The rational bubbles literature shows how trade in an intrinsically worthless asset (a "bubble") can achieve the allocation described in the previous paragraph. Savers hold the overvalued asset in anticipation of capital gain, despite knowing that this asset will never deliver a dividend and that its "fundamental" value is therefore zero. While sentiment remains positive, investors expect that they will be able sell the asset to new savers in the future.

1 *Aoki, K. and Nikolov, K. (2011), "Bubbles, banks and financial stability".*

Until recently, the "rational bubbles" literature suffered from one main problem. As Tirole (1985) showed, bubbles lead to output contractions because they displace capital in agents' portfolios. Conversely, the collapse of the bubble would tend to be expansionary – the very opposite of what we observe in reality. Since the crisis, the rational bubbles literature has developed rapidly in order to address this perceived shortcoming. Caballero and Krishnamurthy (2006), Martin and Ventura (2011) and Farhi and Tirole (2011) showed how, in the presence of credit constraints, the creation of new bubbles can be strongly expansionary because it relaxes credit constraints and increases aggregate liquidity. On the flip side, the bursting of bubbles can lead to a tightening of credit constraints and a deep recession. While still not part of mainstream macro-economics, the rational bubbles framework is growing in popularity due to its ability to explain the facts listed at the beginning of this article.

Rational bubbles in a model with explicit financial intermediation

Our paper makes a contribution to this literature by adding explicit financial intermediation. Having banks in the model is important because it introduces a degree of realism previously missing in rational bubble models and because it introduces multiple types of saver with different economic roles into the model. This allows us to ask the question of who holds the overvalued "bubbly" assets and whether this matters for financial stability.

Our analysis shows that the identity of the bubble holder is crucial to how the bursting of bubbles propagates to the wider economy. Chart 1 illustrates the key point of our work in Aoki and Nikolov (2011a) using a simulation of our model economy under one scenario in which banks hold the overvalued asset (the solid line) and another in which savers hold it (the dashed line). When banks hold the bubble exposure, the correction of asset prices to fundamentals wipes out banks' net worth and causes a severe credit crunch and recession. In contrast, when savers hold the bubble exposure, the impact of the bubble's collapse is very muted.

When a bubble held by banks collapses, bank net worth falls and this leads to a credit crunch.

The key to understanding why these outcomes are so different lies in the special nature of banks in the economy. Because it is an intermediary, a bank is both a saver (it holds assets on its balance sheet) and a potentially credit-constrained borrower whose total balance sheet size depends on its highly leveraged net worth. Hence, when a bubble on the bank's balance sheet bursts, this dramatically reduces the bank's leveraged net worth (possibly even leading to bank failure), tightens the bank's credit constraint and forces it to deleverage. This has a knock-on effect on the bank's borrowers who obtain less credit (at a higher price) as a result. In contrast, ordinary savers in our model are credit-unconstrained. Unlike banks, they finance their asset purchases with their own equity without borrowing. Hence, losses on their investments have little or no knock-on effect on the net worth and financial market access of other economic agents.

Why banks hold bubbles?

The dramatic impact of asset price falls on banks' balance sheets is a strong reason why banks should not hold overvalued assets. In fact, in a baseline version of the model, banks largely refrain from investing in bubbly assets. There are two reasons for this. First, in normal times, banks' balance sheet constraints act to diminish competition in lending and deposit-taking. This creates a spread between lending and deposit rates in equilibrium, even though intermediation is costless in the model. The loan-deposit rate spread makes banking a very profitable and valuable activity. In other words, it creates a "franchise value" for the bank – the net present value of excess profits that accrue to surviving bankers over time. As a result of this franchise value, bankers rationally choose not to take the risk of buying overvalued assets. The excess return such investments deliver in good times does not compensate for the risk of a very large loss when the bubble bursts. In contrast, savers receive a very low return on their savings (the deposit rate) and this incentivises them to "search for yield" by holding bubbly assets.

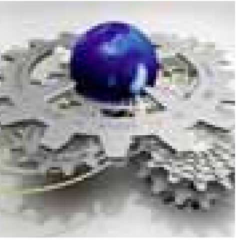
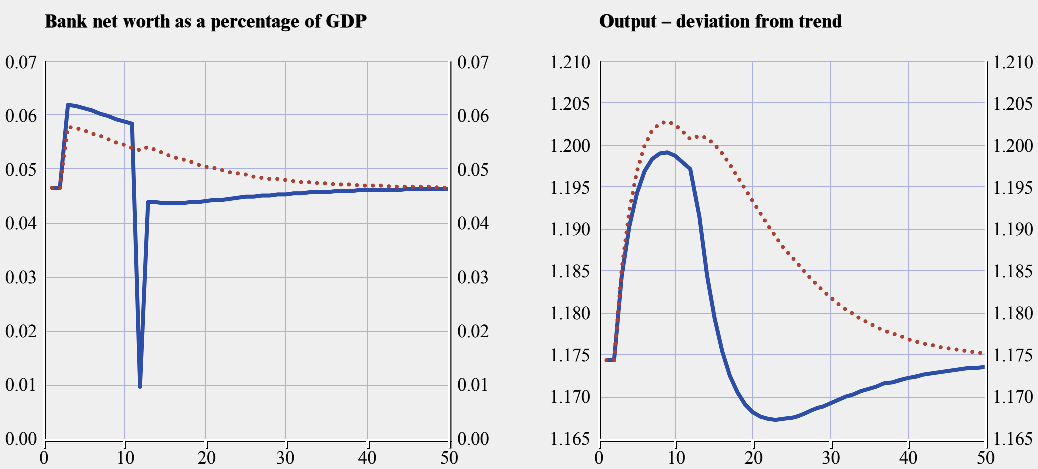


Chart 1 Comparing a bank-held bubble (solid line) and a saver-held bubble (dotted line)



Note: The bubble is worth 5% of GDP; it starts in period 2 and collapses in period 11 of the simulation.

To explain why banks may choose to take risks despite the high franchise value from traditional lending activities, we point to two key factors.

First, in Aoki and Nikolov (2011b), we document the rapid growth in non-bank intermediation over the past 20 years and simulate the model under a scenario in which banks face growing competition from the corporate bond/asset-backed security market. The simulation shows that growing competition in the financial sector reduces excess profits and diminishes banks' franchise values. This decreases the risks associated with holding bubbly assets for banks, leading to increased bank risk-taking.

Financial liberalisations reduce bank profitability and may trigger a "search for yield".

Second, in Aoki and Nikolov (2011a) we point to moral hazard. Our baseline model (in which banks choose not to hold the bubbly assets) is a *laissez faire* economy, in which no financial safety net exists for either savers or banks. In reality, of course, the situation is very different. Banks (but usually not savers) do have access to large explicit or implicit guarantees from governments. This naturally affects their incentives to take risks.

We extend the model to allow for a financial safety net, which partially compensates banks when their investments do not pay off. This significantly changes the point of equilibrium. Bubbles become larger and more fragile (i.e. they have a higher probability of bursting) and banks hold more of the bubbly assets.

Intuitively, the government guarantee drives a wedge between banks' private return from holding bubbles and the social return from doing so. In effect, the financial safety net acts as a subsidy to bubble holdings as long as they are in banks' hands. This leads to a rapid expansion of the financial system in order to absorb the bubbly asset in a way that (from a private point of view) efficiently maximises the government subsidy to risk-taking by banks. The equilibrium size of the bubble is greater, and this effect is especially significant for bubbles which are very likely to burst. Such highly risky assets would have a very low value in a *laissez faire* economy, but under a financial safety net, much of their risk is transferred to tax payers and so the equilibrium value of these assets increases dramatically.

Government guarantees make banks the natural holders of bubbly assets.

Conclusions

Our paper sets out to investigate the issue of whether policy-makers should worry about all asset price bubbles. Our main finding is that bubbles held by banks are dangerous for financial stability, while bubbles held by ordinary savers are surprisingly benign in their impact. We show that moral hazard combined with intense financial sector competition provides the lethal combination that drives risky assets on to banks' balance sheets, creating financial fragility in the process.

Our work should not be necessarily taken as a rejection of the financial safety net or of policies to improve competition in the financial industry. An explicit safety net exists for good reasons, such as bank run prevention (Diamond and Dybvig, 1983). Implicit safety nets are also hard to avoid, given the severe consequences of systemic banking crises for the real economy. Finally, financial liberalisations improve welfare in the long run, even if they increase risks in the immediate aftermath of the reform.

Rather, our paper is working towards building a framework in which financial instability and macro-prudential policy can be analysed. In our environment, systemic risk arises from the exposure of the banking system to boom-bust cycles in asset prices. Our analysis shows that, in some situations, market discipline would be enough to prevent the build-up of systemic risk, while in others it would not. In particular, we argue that government guarantees and competitive pressures weaken market discipline and may lead to financial fragility.

REFERENCES

Alessi, L. and Detken, C. (2009), "Real time early warning indicators of costly asset price boom/bust cycles – a role for global liquidity", *Working Paper Series*, No 1039, ECB.

Aoki, K. and Nikolov, K. (2011a), "Bubbles, banks and financial stability", mimeo, University of Tokyo and ECB.

Aoki, K. and Nikolov, K. (2011b), "Financial market competition and rational bubbles", mimeo, University of Tokyo and ECB.

Borio, C. and Lowe, P. (2002), "Asset prices, financial and monetary stability: exploring the nexus", *BIS Working Papers*, No 114, Bank for International Settlements.

Caballero, R. and Krishnamurthy, A. (2006), "Bubbles and Capital Flow Volatility: Causes and Risk Management", *Journal of Monetary Economics*, Vol. 53(1), pp. 35-53.

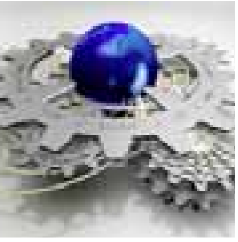
Diamond, D. and Dybvig, P. (1983), "Bank runs, deposit insurance, and liquidity", *Journal of Political Economy*, Vol. 91(3), pp. 401-419.

Farhi, E. and Tirole, J. (2011), "Bubbly Liquidity", *Review of Economic Studies*, forthcoming.

Jimenez, G., Ongena, S., Peydro, J-L. and Saurina, J. (2011), "Credit supply – identifying balance sheet channels with loan applications and granted loans", *Working Paper Series*, No 1179, ECB.

Maddaloni, A. and Peydro, J-L. (2010), "Bank Risk-taking, Securitization, Supervision and Low Interest Rates: Evidence from the Euro-Area and the U.S. Lending Standards", *Review of Financial Studies*, Vol. 24, No 6, pp. 2121-2165.

Martin, A. and Ventura, J. (2011), "Economic Growth with Bubbles", *American Economic Review*, forthcoming.



Reinhart and Rogoff (2009), *This Time Is Different: Eight Centuries of Financial Folly*, Princeton University Press.

Tirole, J. (1982), “On the Possibility of Speculation under Rational Expectations”, *Econometrica*, Vol. 50, No 5, pp. 1163-81.

Tirole, J. (1985), “Asset Bubbles and Overlapping Generations”, *Econometrica*, Vol. 53, No 6, pp. 1499-1528.

MONETARY POLICY ANALYSIS AND DATA REVISIONS – VINTAGE COMBINATION FROM A REAL-TIME DATASET

By Matteo Ciccarelli

This article illustrates a real-time estimation strategy that accounts for the uncertainty stemming from data revisions. The strategy makes use of all the data available from a real-time data matrix and averages model estimates across data releases. The advantages of this simple estimation approach are illustrated in a macroeconometric model typically used for monetary policy analysis.

Statistical agencies revise macroeconomic time series for two main reasons. First, they update their initial releases to include new information. Second, they revise the entire time series (roughly every five years) using "benchmark" revisions to account for the introduction of new aggregation techniques, measurement concepts or survey methods.

The nature and importance of data revisions have been studied extensively in economic literature.[1] Most studies have found that data revisions are predictable (e.g. Aruoba, 2008). Consequently, the data measurement process could, in principle, be incorporated in the models to improve estimation or forecasting accuracy. In practice, however, this modelling is difficult (see Jacobs and van Norden, 2011).

In this article, we present a simple estimation strategy which is robust to the uncertainty stemming from revisions, and does not require modelling of the data measurement process. To account for this uncertainty, we propose estimating a model for all vintages and then combining the estimates.

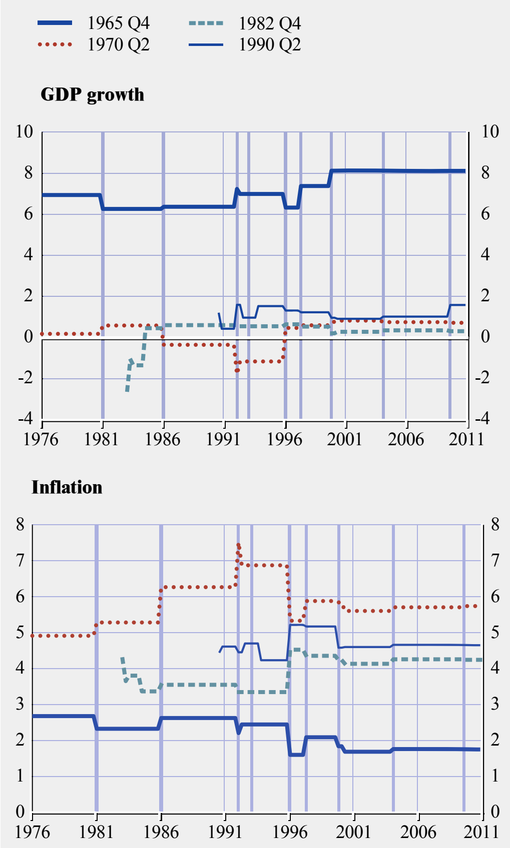
Several measures of the same concepts

Past data "vintages" have recently become available to researchers for several variables and countries in the form of real-time data sets.[2] These are constructed to reflect, for each date, exactly what the macroeconomic data looked like on that date. In the literature, the term "vintage" is used to describe each date for which data exist as they looked at the time (Croushore and Stark, 2000).

The revision of macroeconomic variables may cast doubt on the validity of a theory.

To show how revisions can affect estimation results, we focus on two macroeconomic variables which are often revised. The charts in Figure 1 track real GDP growth and the GDP deflator inflation for four observation dates (1965 Q4, 1970 Q2, 1982Q4 and 1990 Q2) as they were successively revised across all the available vintages since their initial releases. Both

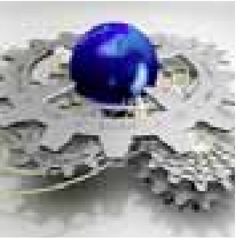
Chart 1 GDP growth and inflation for selected quarters as measured at all vintages



Notes: The charts show the GDP growth and inflation rates for four representative quarters (1965 Q4, 1970 Q2, 1982 Q4 and 1990 Q2) as they were successively revised across all vintages since their initial releases. The vertical lines indicate benchmark revision dates.

1 *See, for example, Mankiw et al. (1984), Mankiw and Shapiro (1986) and Aruoba (2008) for studies on regular revisions, and Croushore and Stark (2001) and Siklos (2008) for studies on the information content of benchmark revisions.*

2 *See, for example, the real-time data set for macroeconomists of the Federal Reserve Bank of Philadelphia (available at http://www.philadelphiafed.org/research-and-data/real-time-center/real-time-data), the more recent real-time database project of the Euro Area Business Cycle Network (available at http://www.eabcn.org/eabcn-real-time-database), and the real-time database of the OECD (available at http://stats.oecd.org/mei/default.asp?rev=1).*



variables come from the real-time data set for macroeconomists developed at the Federal Reserve Bank of Philadelphia and described in great detail in, for instance, Croushore and Stark (2001).

Both variables have undergone several revisions of various magnitudes with many redefinitions, and this has made them fluctuate in a non-monotonic manner. Therefore the results of any model estimation and inference are likely to depend on the choice of vintage and on the revisions which had occurred around the time when the exercise was performed. Croushore and Stark (2003) show that testing hypotheses using time series of different vintages might cast doubt on the robustness of the results or on the validity of a theory.

The combination approach

How can researchers and policy-makers respond to imperfect data, and which estimation strategy would make results robust to the revision process, regardless of its nature? Starting from the evidence that estimating a model using different vintages may give rise to contradicting results, we argue that a robust set of results can be obtained by following a "vintage combination approach". At a given point in time the approach would suggest estimating a model not by using solely the latest available time series, which would make the results dependent on the current vintage, but by using a (simple or weighted) average of estimates obtained from current and past vintages as a risk diversification strategy against the uncertainty stemming from the revisions.

It is possible to compare a strategy which accounts for all vintages and considers the average of estimation results across vintages to a "model combination approach" which averages results across different methodologies. Using only the latest available data to check the results of a model can be as misleading as using only one model to check a theory. Conversely, vintage combination (averaging over all available vintages) can be as valid when dealing with data uncertainty as model combination (averaging over all available models) is when dealing with model uncertainty.

Real-time estimation of a monetary policy model

We apply our vintage combination approach to estimate a standard model of output and inflation used to derive a Taylor-type rule for monetary policy consistent with inflation targeting. The literature on monetary policy suggests that analyses based on real-time data often reach substantially different conclusions from analyses based on the latest available data (see, for example, Orphanides, 2001 and 2003). Moreover, data revisions are also responsible for a mismatch between the estimates of a Taylor rule using historical data, which suggest that the FED reacted moderately to output and inflation gaps, and the estimates implied by optimal policy rules, which often recommend more vigorous policy responses (see Rudebusch, 2001).[3] The purpose of this section is to show that the proposed approach, not only avoids choosing between real-time and latest available data when estimating the model, but also serves to reconcile historical and optimal policy rules.

The analytical framework is standard: the monetary authority sets up a policy rule by minimising an expected loss function subject to the macroeconometric model of Rudebusch and Svensson (1999). The real-time data set used in the estimation is the one developed at the Federal Reserve Bank of Philadelphia. The federal funds rate measures the interest rate, the GDP deflator measures prices and the real GDP measures output. The estimation runs from the vintage 1975 Q4 to the vintage 2010 Q4, with the initial available data for each vintage being 1959 Q3. The parameters are estimated both using our vintage combination approach (simple average of estimates) and using a single-vintage approach.[4]

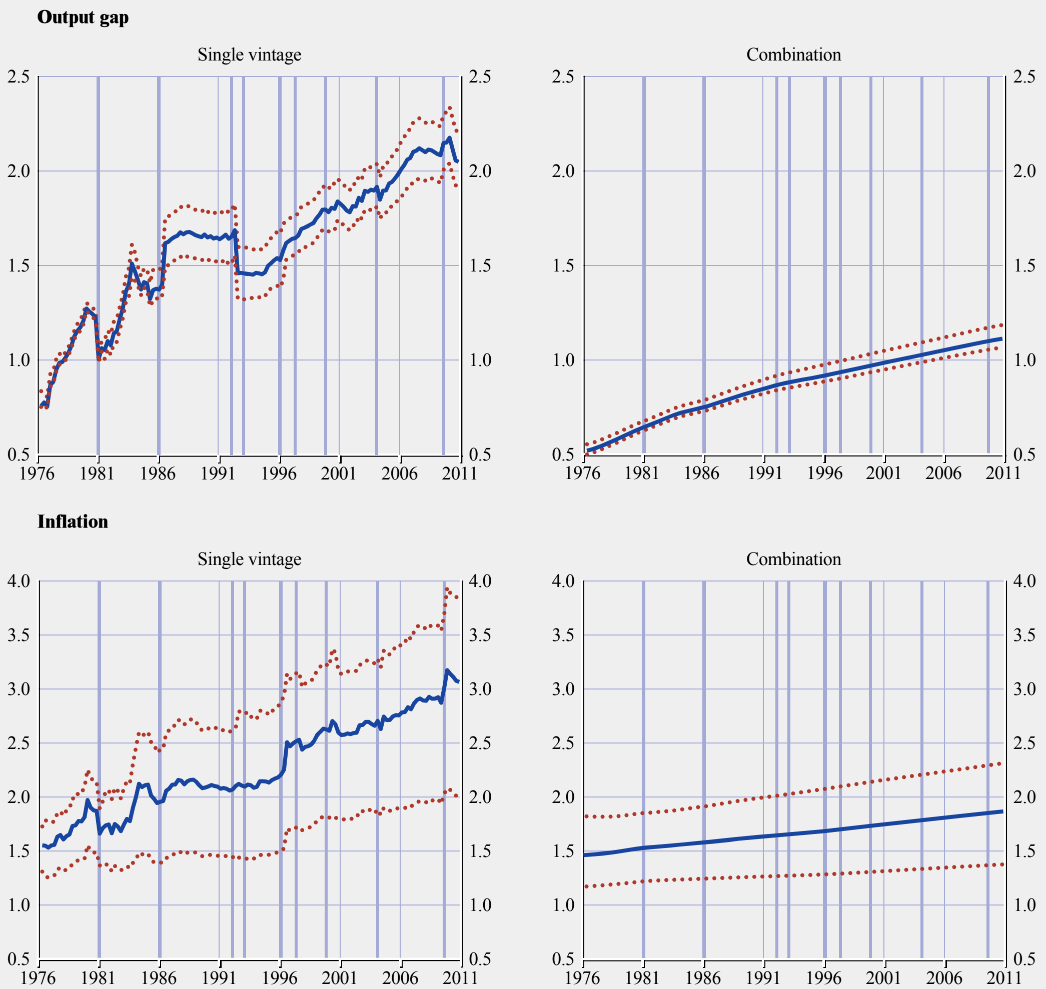
The derived response coefficients of the Taylor rule are plotted in Chart 2. The left-hand panels report the estimates obtained with the single-vintage approach while the right-hand panels report the estimates obtained with the vintage combination approach (with equal weights). For each point in time, the former is obtained by

3 *See also Croushore (2011) for a comprehensive review of existing evidence.*
4 *The details of the model and results can be found in Altavilla and Ciccarelli (2011).*

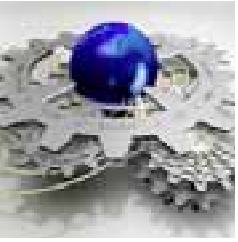
estimating the model using only the time series of the corresponding vintage, while the latter is an average of estimates obtained using current and past vintages. Note that, as the combination estimation is performed using an increasing number of vintages of increasing size, the figures are mean-group estimates (Pesaran and Smith, 1995) of an unbalanced panel of data where each vintage is a unit of the panel and the time series increases for more recent vintages.

The charts show that the estimates obtained with the combination strategy are not dependent on revisions and imply a smoother and less aggressive optimal monetary rule than those obtained with the single-vintage approach. Both features are consistent with the evidence that the reaction coefficients are typically lower when we account for data uncertainty (Rudebusch, 2001). They are also consistent with the conservative behaviour of a central bank that, with a medium-term orientation strategy, does not react immediately to out-of-target developments in inflation and output. In this sense, the estimates implied by optimal policy rules can indeed be consistent with a moderate reaction of the FED, as suggested by the historical evidence.

Chart 2 Optimal Taylor rule coefficients



Notes: The charts report the distribution (1st percentile, median, and 99th percentile) of the long-run reaction coefficient of the output gap and the inflation rate over 100 different central bank preferences. The distribution is obtained by varying the weights on output gap stabilisation in increments of 0.1 between 0 and 10 (while leaving the weights on inflation and interest rate stabilisation at 1 and 0.5 respectively). The reference model can be found in Rudebusch and Svensson (1999). The left-hand panels report the estimates obtained with the single-vintage approach and the right-hand panels report the estimates obtained with the vintage combination approach (with equal weights). For each point in time, the former is obtained by estimating the model using only the time series of the corresponding vintage, while the latter is an average of estimates obtained over the current and past vintages. The vertical lines indicate benchmark revision dates.



Concluding remarks

The proposed approach is a valid strategy to cope with the uncertainty stemming from data revisions. By assigning only a small weight to new information, it minimises the risk of estimating a model based on data subject to potentially large revisions. This stability is an important condition for drawing inference.

Combining estimates over all vintages is a good risk diversification strategy for coping with data uncertainty.

Moreover, by weighting all vintages equally, the approach assigns the same probability to the estimates obtained from data measured in different ways and, at the same time, is more cautious in the face of uncertainty stemming from structural breaks. The downside is that structural changes might be recognised with some delay and only when it becomes clear that they come from the economy and not from the revision process. However, the imperfect knowledge of the nature of these changes makes their modelling difficult and justifies the use of a combination approach.

REFERENCES

Altavilla, C. and Ciccarelli, M. (2011), "Monetary policy analysis and data uncertainty – vintage combination from a real-time dataset", mimeo, ECB.

Altavilla, C. and Ciccarelli, M. (2007), "Information combination and forecast (st)ability – evidence from vintages of time-series data", *Working Paper Series*, No 1580, ECB.

Aruoba, S.B. (2008), "Data Revisions Are Not Well Behaved", *Journal of Money, Credit and Banking*, Vol. 40, pp. 319-340.

Croushore, D. (2011), "Frontiers of Real-Time Data Analysis", *Journal of Economic Literature*, Vol. 49, pp. 72-100.

Croushore, D. and Stark, T. (2000), "A Funny Thing Happened on the Way to the Data Bank: A Real-Time Data Set for Macroeconomists", *Business Review*, Federal Reserve Bank of Philadelphia, September/October.

Croushore, D. and Stark, T. (2001), "A Real-Time Data Set for Macroeconomists", *Journal of Econometrics*, Vol. 105, pp. 111-130.

Croushore, D. and Stark, T. (2003), "A Real-Time Data Set for Macroeconomists: Does the Data Vintage Matter?", *The Review of Economics and Statistics*, Vol. 85, pp. 605-617.

Jacobs J.P.A.M. and van Norden, S. (2011), "Modeling data revisions: Measurement error and dynamics of 'true' values", *Journal of Econometrics*, Vol. 161, pp. 101-109.

Mankiw, N.G., and Shapiro, M.D. (1986), "News or Noise: An Analysis of GNP Revisions", *Survey of Current Business*, Vol. 66, No 5, May, pp. 20-25.

Mankiw, N.G., Runkle, D.E. and Shapiro, M.D. (1984), "Are Preliminary Announcements of the Money Stock Rational Forecasts?", *Journal of Monetary Economics*, Vol. 14, pp. 15-27.

Orphanides, A. (2001), "Monetary Policy Rules Based on Real-Time Data", *American Economic Review*, Vol. 91, pp. 964-985.

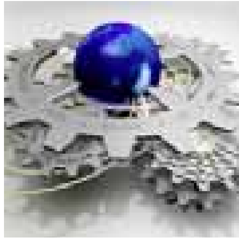
Orphanides, A. (2003), "Historical Monetary Policy Analysis and the Taylor Rule", *Journal of Monetary Economics*, Vol. 50, pp. 983-1022.

Pesaran, M.H. and Smith, R. (1995), "Estimating long-run relationships from dynamic heterogeneous panels", *Journal of Econometrics*, Vol. 68, pp. 79-113.

Rudebusch, G.D. (2001), "Is the Fed Too Timid? Monetary Policy in an Uncertain World", *The Review of Economics and Statistics*, Vol. 83, pp. 203-17.

Rudebusch, G.D. and Svensson, L.E.O. (1999), "Policy Rules for Inflation Targeting", in Taylor, J.B. (ed.), *Monetary Policy Rules*, University of Chicago Press, pp. 205-46.

Siklos, P.L. (2008), "What Can We Learn from Comprehensive Data Revisions for Forecasting Inflation? Some US Evidence", in Rapach, D.E. and Wohar, M.E. (eds.), *Forecasting in the Presence of Structural Breaks and Model Uncertainty*, Emerald Group Publishing Limited, Chapter 7, pp. 271-299.



CREDIT RISK AND THE ZERO LOWER BOUND ON INTEREST RATES

By Fiorella De Fiore and Oreste Tristani

This article evaluates the severity of the zero lower bound on interest rates as a constraint on monetary policy through the lens of a general equilibrium model in which frictions affect the functioning of financial markets. Compared to a situation with perfect financial markets, the article demonstrates that, when the economy is hit by adverse demand shocks and policy follows a simple interest rate rule, the zero lower bound is a more severe constraint on monetary policy. Following a deflationary shock, optimal policy induces a protracted period of inflation, with the result that prices increase to a higher level than prior to the shock.

The question of how severe the zero lower bound (hereinafter ZLB) is as a constraint on monetary policy has generally been addressed within frameworks which rely on the simplifying assumption of frictionless financial markets.[1] In that context, the risk-free rate – current and expected – is the only interest rate at which lending and borrowing would take place. The main policy conclusions emerging from these analyses are that monetary policy can reduce the likelihood of hitting the ZLB and can lessen the severity of the ensuing recession through the promise of maintaining low interest rates in the future.

When financial markets are imperfect, the economy may hit the zero lower bound more frequently.

In reality, however, many different interest rates affect the decisions of households and entrepreneurs, including bank deposit and lending rates. While the spreads between these interest rates move moderately under normal circumstances, they tend to increase dramatically in periods of financial distress. Historically, these are also periods when the policy rates have reached the ZLB. This makes it important to analyse whether the aforementioned policy prescriptions remain valid in models characterised by financial market imperfections.

This article describes the results obtained in a simple dynamic general equilibrium model with these features. The model is a simple extension of the benchmark New-Keynesian framework with nominal price rigidities[2] in which it is assumed that firms must raise nominal debt to finance production and in which asymmetric information and monitoring costs generate a spread between the policy rate and lending rates.

Once a policy rule has been specified, the equilibrium behaviour of this economy can be characterised by an expression for credit spreads, an aggregate demand equation and a type of Phillips curve.[3] Given the need of firms to finance their factors of production, marginal costs are sensitive to changes in financing costs. Inflationary pressures therefore arise not only as a consequence of excess aggregate demand, but also when lending rates to firms go up. In turn, lending rates can increase for two reasons: an increase in the risk-free interest rate, e.g. due to a monetary policy tightening, or an increase in credit spreads, e.g. due to a deterioration in firms' balance sheets.

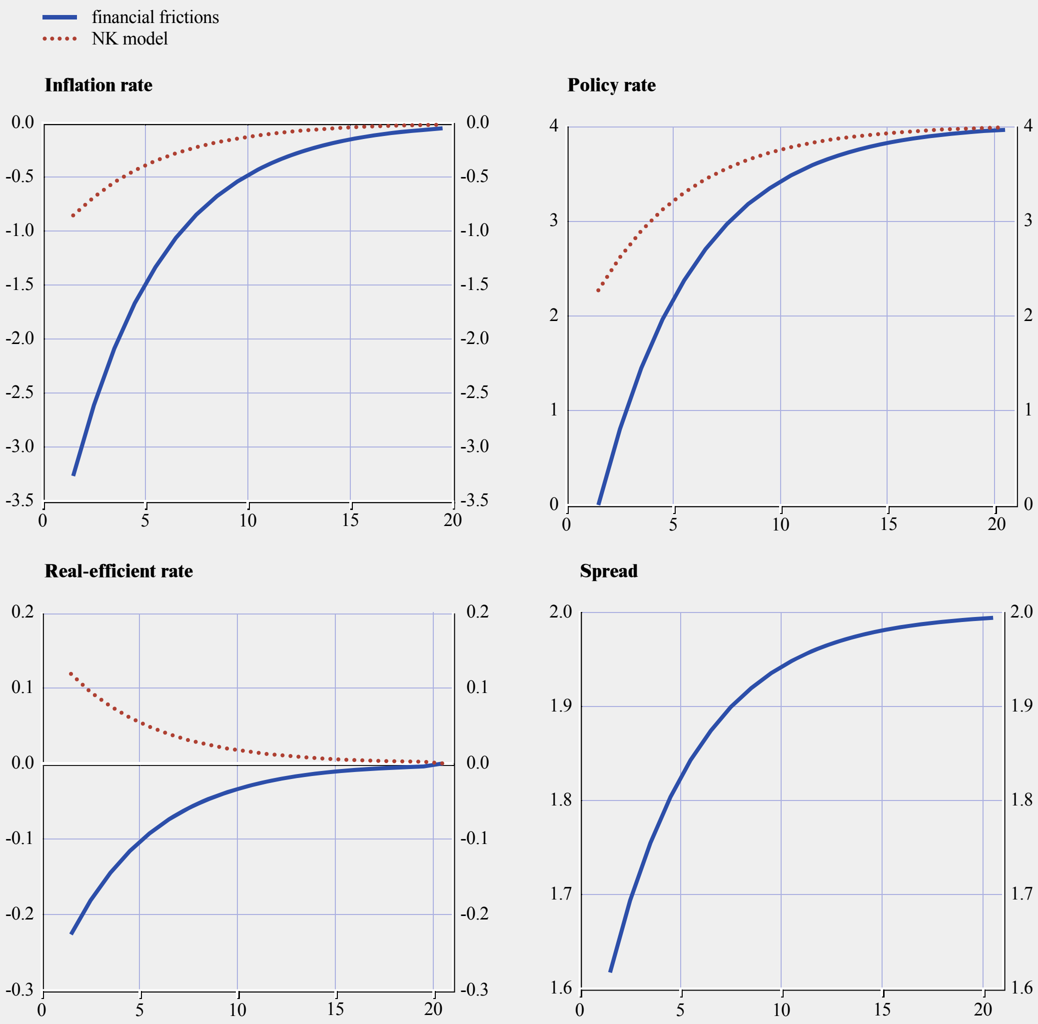
Severity of the zero lower bound

In this environment, when the economy is hit by an adverse demand shock, the ZLB exerts a tighter constraint on monetary policy than in the standard New-Keynesian model (see Chart 1). In the absence of financial frictions, when policy follows a Taylor rule, a shock of this type reduces the policy rate more than expected inflation. The real interest rate falls, although not sufficiently to reach its "efficient" level (i.e. the level it would reach in the absence of all market frictions, including price rigidities), thereby depressing aggregate demand. In the presence of asymmetric information and default risk, a shock of the same size would also reduce demand for external finance and leverage, thereby lowering credit spreads and lending rates.[4] The lower

1 See, for example, Eggertsson and Woodford (2003), Adam and Billi (2006) and Nakov (2008).
2 See, for example, Woodford (2003).
3 See our previous article on "Financial conditions and monetary policy" for a more detailed discussion of the effect of financial conditions on aggregate demand and new-Keynesian Phillips curve.
4 With a demand shock, our model generates a pro-cyclical credit spread. However, the model can generate a counter-cyclical spread when the economy suffers demand and financial shocks at the same time, which is in line with the empirical evidence.

Chart 1 Impulse responses to a negative preference shock

(percentages)

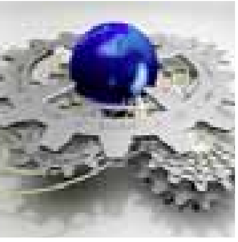


cost of external finance induces firms to charge lower prices, leading expected inflation to fall further and exacerbating the downward pressure on the policy interest rate. As a consequence, the ZLB is hit more easily than in the model with frictionless financial markets.[5]

In contrast to preference shocks, a negative financial shock that reduces firms' net worth generates an increase in credit spreads and a fall in output. The increase in credit spreads produces inflationary pressure. In equilibrium, inflation increases in spite of the fall in output to below its "efficient" level. As a result, the policy rate increases, when set according to a Taylor rule, so the economy does not hit the ZLB.

Therefore, when policy follows a Taylor rule, neither an adverse preference (or "confidence") shock nor a negative financial shock can generate a simultaneous increase in credit spreads and fall in output and policy rates, as observed in the recent financial crisis. However, a scenario of this type can be generated easily through a combination of these two shocks. As a result, the ZLB can be hit for many periods.

5 The real interest rate falls below its "efficient" level, generating a milder contraction in aggregate demand.



Implications for monetary policy

An intuition for what a central bank ought to do in our economy can be obtained by solving the problem of a benevolent social planner, who aims to maximise citizens' utility, in the case when the ZLB is never acting as a constraint. The solution to that problem can be expressed as a "target rule", i.e. a policy rule prescribing how changes in the variables which appear in the central bank loss function should be managed in response to shocks.

> *The zero lower bound can be reached even in the absence of deflationary pressure.*

In the case of frictionless financial markets, the target rule prescribes a continued contraction of output as long as inflation remains positive. In the case of financial frictions, the optimal amount by which to contract output (relative to its "efficient" level) depends not only on current inflation, but also on the lagged levels of both inflation and output. The reason for this is that the increase in the nominal interest rate, which is needed to induce a contraction in output and eventually stabilise inflation, also produces an increase in marginal costs with consequent inflationary effects. Monetary policy must find the appropriate balance between these opposing forces over time.

In terms of the price level, in the case of frictionless financial markets the target rule requires the inducement of an inflationary period following a deflationary shock, so as to ensure a return to the original price level. In an economy with financial frictions, a return to the original price level is not sufficient. Following a deflationary shock, some additional upward pressure on the price level must be engineered, even after output has stabilised at its "efficient" level. As a result, prices will increase to a higher level than where the economy started.

In terms of reactions to shocks, two notable features emerge from an optimal policy analysis.

First, following an adverse financial shock, optimal policy requires a cut in the nominal interest rate, in spite of the inflationary pressure created by the increase in spreads. The policy response is aimed at limiting the negative effect of this inefficient shock on household consumption. Therefore, if the financial shock is large enough, the ZLB may be reached even in the absence of deflationary pressure.[6]

Second, following the same combination of shocks that leads the economy to hit the ZLB under a Taylor rule, the interest rate falls less at the time of impact, but more persistently, than under the Taylor rule. Together with the increase in credit spreads, this increases marginal costs, thus preventing any fall in inflation, while it cushions the fall in output. All in all, both inflation and output are stabilised much better under the optimal policy, and the likelihood of reaching the ZLB is much lower.

6 *This finding is consistent with the evidence from the financial crisis of 2007-09, when interest rates reached levels close to the ZLB, but underlying inflation remained above zero.*

REFERENCES

Adam, K. and Billi, R.M. (2006), "Optimal Monetary Policy under Commitment with a Zero Bound on Nominal Interest Rates", *Journal of Money, Credit and Banking*, Vol. 38, No 7 pp. 1877-1905.

De Fiore, F. and Tristani, O. (2010), "Financial conditions and monetary policy", *Research Bulletin*, No 9, ECB.

Eggertsson, G.B. and Woodford, M. (2003), "The Zero Bound on Interest Rates and Optimal Monetary Policy", *Brookings Papers on Economic Activity*, 2003, No 1, pp. 139-233.

Nakov, A. (2008), "Optimal and Simple Monetary Policy Rules with Zero Floor on the Nominal Interest Rate", *International Journal of Central Banking*, Vol. 4, No 2.

Box 1

FIRST CONFERENCE OF THE MACRO-PRUDENTIAL RESEARCH (MARS) NETWORK OF THE EUROPEAN SYSTEM OF CENTRAL BANKS

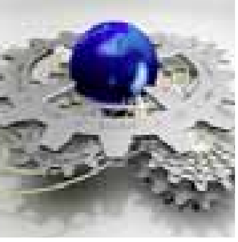
On 5-6 October 2011 the European Central Bank hosted the first public conference of the Macro-prudential Research (MaRs) network.[1] The programme was organised around the three MaRs work streams: “Macro-financial models linking financial stability and the performance of the economy” (sessions 1 to 3), “Assessing contagion risks” (session 4) and “Early warning systems and systemic risk indicators” (sessions 5 and 6). It mainly included papers produced by MaRs researchers, but also papers relevant for MaRs questions produced by a number of researchers from outside the network. The discussions were led by renowned experts in the field.

The first session of the conference focused on “Financial instability and the macroeconomy”. Aoki and Nikolov presented a model of rational bubbles under credit frictions in which bubbles held by banks are followed by costly financial crises, whereas bubbles held by ordinary savers have relatively muted effects. Financial instability is characterised by a switch from equilibriums in which bubbles are valuable to equilibriums in which the same bubbles are worthless. In the absence of government intervention, the bubble’s collapse may also lead to the insolvency of the banking system. The empirical work of Jordà, Schularick and Taylor studied the experience of 14 developed countries over a period of 140 years, identifying episodes of financial instability. The analysis suggests that, in the run-up to global financial crises, credit growth tends to be elevated and natural interest rates depressed. Credit growth is also the best single predictor of financial instability.

“Leverage cycles and macro-financial linkages” was the theme of the second session. Rannenberg’s theoretical model combines a costly state verification problem that banks have vis-à-vis borrowing entrepreneurs with a moral hazard problem between banks and depositors. In this setup, the response of the external finance premium, and thus output and investment, to a variety of shocks is amplified when compared to a conventional financial accelerator-type model. Accordingly, the Rannenberg model fits US data on the external finance premium, investment and output better than previous models. The paper of Damar, Meh and Terajima uses Canadian data to show that the procyclicality of bank leverage is amplified by wholesale funding and funding-market illiquidity.

The third session of the conference addressed “Macro-prudential policy”. Macro-prudential instruments to curb housing price booms, such as counter-cyclical loan-to-value (LTV) ratios, were assessed in the paper by Lambertini, Mendicino and Punzi. They showed that LTV rules responding to credit growth do not increase inflation volatility and are effective in maintaining financial stability. Beau, Clerc and Mojon simulated a dynamic stochastic general equilibrium (DSGE) model with financial frictions, calibrated to the euro area and the United States, to assess interactions between monetary policy and macro-prudential policy. The combination of an independent macro-prudential policy leaning against “excessive” credit growth and a monetary policy focusing on inflation is the best response to asset price or credit supply shocks in order to maintain price stability. In addition, a monetary policy taking into account any macroeconomic effects resulting from macro-prudential policies will optimise general welfare. Goodhart et al. proposed a new general equilibrium model with bank default. It included a

1 A brief description of the purpose, objectives and organisation of the MaRs network can be found on the ECB website at http://www.ecb.europa.eu/home/html/researcher_mars.en.html



shadow banking system which holds securitised assets issued by the traditional banking system that are subject to default. It also allows for fire sales. The analysis explored how different types of financial regulation would perform. It turns out that a variety of policy instruments would need to be used to address different problems causing systemic risk.

Session four of the conference was devoted to "Contagion risk". The paper by Memmel, Sachs and Stein analysed contagion risk from exposures in the German interbank market. They found that the differential recovery rates for unsecured transactions and repos have a significant influence on contagion risk. The paper by Derviz and Raková looked at multinational banking groups, and in particular at how parent banks influence the lending rates charged by their affiliates. The results suggest that parent bank influence is not a dominant factor in interest-rate setting in general, but occasionally may be of importance for specific classes of borrowers.

The last two session of the conference focused on "Financial stability indicators" and "Early warning models". The paper by Louzis and Vouldis showed the importance of including a mix of bank balance sheet data and market data in a financial stress index. Peltonen and Sarlin proposed a novel approach to visualise systemic risk based on self-organising maps. The work by Babecký et al. used a panel of 40 EU and OECD countries for the period 1970-2010 to construct an early warning system, and showed that, on average, global (rather than national) variables provide the most useful early warning indicators. Fornari and Lemke analysed the power of financial variables to predict economic recessions in the United States, Germany and Japan. Finally, Abildgren showed a significant and long-lasting negative impact of the banking sector's write-down ratio on real GDP in Denmark.

The conference also featured three keynote speeches. The first, by ECB Vice-President Vítor Constâncio, focused on the ECB's top-down stress-testing framework and also analysed the set of macro-prudential policy instruments embedded in the draft Capital Requirements Directive ("CRD IV").

The other two keynote speeches, by Prof. Markus Brunnermeier (Princeton University and member of the Advisory Scientific Committee of the European Systemic Risk Board) and Prof. Jean-Charles Rochet (University of Zurich), provided overviews at the frontier of macro-prudential research. Prof. Brunnermeier explained a methodology for measuring systemic risk by aggregating risk sensitivities reported by individual financial intermediaries and introduced a new integrated theory of monetary and financial stability. Prof. Rochet talked about the foundations of counter-cyclical capital regulation.

The contributions to this conference can be downloaded from the ECB's website at: http://www.ecb.europa.eu/events/conferences/html/mar_net.en.html

Box 2

THE POST-CRISIS DESIGN OF THE OPERATIONAL FRAMEWORK FOR THE IMPLEMENTATION OF MONETARY POLICY – AN ECB WORKSHOP

The financial crisis led many central banks to adjust their operational frameworks for the implementation of monetary policy. For various reasons, it also led to a reconsideration of the optimal design of such frameworks. First, the crisis may have highlighted particular strengths and weaknesses of the pre-crisis design of operational frameworks. Second, during the crisis central banks gained more experience of the functioning of markets under stress. Third, both the crisis and new regulatory measures are likely to have a lasting impact on the functioning of different market segments, which may alter the way in which monetary policy is implemented.

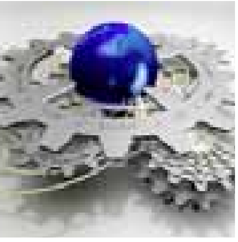
To gain more insight into these issues, and to stimulate related academic work, the European Central Bank organised a workshop on "The post-crisis design of the operational framework for the implementation of monetary policy" on 10 and 11 October 2011 in Frankfurt am Main.

One question that attracted some interest during the workshop concerned the appropriate choice of operational target for the central bank. In many currency areas, monetary policy implementation is aimed at aligning the interest rate for short-term funds in the unsecured interbank market to a desired level. These markets usually have the advantage of being very liquid and of being accessible to and relevant for a large number of market participants. Therefore, the interest rate in these markets is a good indicator of the funding conditions of financial intermediaries. Moreover, it can be steered with a high degree of precision. The experience gained during the financial crisis, however, called into question some of these properties of unsecured short-term money markets, which are crucial to their suitability as target rates. Specifically, the discussion at the workshop centred around two alternative approaches. First, as turnover in markets for unsecured funds sometimes dried up, central banks might consider repo market rates as an alternative target. Second, because the relationship between unsecured short-term rates and the conditions for firms' access to financing became much less predictable than prior to the crisis, a target rate of a longer maturity could be considered.

A second area of current interest is the design of central bank auctions. One issue is the choice between different tender procedures, namely fixed rate tenders with rationing, variable rate tenders, and fixed-rate tenders with full allotment. The latter has the advantage of a very elastic liquidity supply, adjusting easily and endogenously to changing money market conditions, which is particularly relevant in times of crisis. However, an over-supply of liquidity can emerge, potentially leading to less stable interest rates.

Another topical question related to the auction design concerns the appropriate pricing of the collateral posted by banks when they access central bank funds. This topic received attention during the crisis as many central banks widened the set of assets that were eligible for their operations. Without an appropriate pricing mechanism, banks may have an incentive to overuse collateral that is of lower value or less liquid than other types. During the workshop, there was particular interest in the experience of the Bank of England with its newly introduced indexed long-term repo auctions.

Finally, one topic of interest that was addressed in the workshop was the macroeconomic implications of the non-standard measures taken by central banks during the financial crisis. While increased credit and liquidity risks in financial markets can lead to a decline in credit provision to the real economy, the increase in central bank reserves that resulted from the



non-standard measures in many countries might lead to an expansion of banks' balance sheets. Assessing the impact on the real economy of these types of effect remains largely an empirical question. Available studies on this topic point to an important role for non-standard measures of central banks in helping to maintain the flow of credit to the economy and in effectively addressing large peaks in liquidity risk in financial markets.

Further topics included, inter alia, the relationship between interbank and repo markets and the operational framework, the role of minimum reserve requirements, bank's bidding behaviour during reserve maintenance periods, and the role of rating agencies.

The contributions to this conference can be downloaded from the ECB's website at: http://www.ecb.europa.eu/events/conferences/html/pocrides_opfram.en.html

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