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ENHANCING MONETARY ANALYSIS

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Monetary analysis is an important component of the ECB's monetary policy strategy. Recent research at the ECB has deepened our understanding of the role played by monetary developments in macroeconomic dynamics and the evolution of the price level. On the basis of these insights, a number of tools have been developed to support monetary policy decisions. This article provides a selective review of these research findings and discusses their implications for the conduct of monetary policy.

Inflation is always and everywhere a monetary phenomenon.[1] Yet, following the high point of monetarism in the late 1970s and early 1980s, at many central banks monetary aggregates have played a diminished role in the preparation of monetary policy decisions over the past decade. The ECB has been a notable exception to this rule. From the outset, the ECB has accorded a "prominent role" to the analysis of monetary developments in its monetary policy strategy.[2]

In mid 2007 – before the onset of the financial turmoil, which presaged a renewed interest in monetary and credit developments in the wider academic and central banking community – the ECB Governing Council endorsed a research agenda to enhance monetary analysis. This article reports some of the results of this agenda (in particular, those produced by economists working in DG-Research) and discusses their implications, complementing summaries presented in the ECB's Monthly Bulletin and in a special volume.[3]

Monetary developments as an indicator for inflation

The traditional starting point for any discussion of monetary analysis is the quantity theory relationship between monetary growth and inflation over the longer run. In his Nobel Prize Lecture,[4] Robert Lucas said that monetary neutrality (an embodiment of this relationship) "*needs to be a central feature of any monetary or macroeconomic theory that claims empirical seriousness*." Yet making use of the relationship in monetary policy decision-making has proved challenging.

Although the long-run co-movement of monetary growth and inflation is a well-established empirical regularity, in recent years the predictive power of money (and many other variables) for future inflation has declined. In large part, this is a sign of the success of monetary policy: by maintaining low and stable inflation rates through exploiting the information in indicator variables when making policy decisions, the reduced-form indicator relationships have naturally disappeared. By implication, the weakening of reduced-form correlations between money growth and inflation does not mean that money can or should be ignored by central banks aiming to keep inflation at levels consistent with price stability. On the contrary, to the extent that monetary developments have proved influential in the past, continued reliance on them is required to maintain price stability even as indicator properties weaken.

Yet it remains an open question whether these ideas can be used in a way that supports monetary policy decisions on a month-to-month or quarter-to-quarter basis. In a recent paper, Amisano and Fagan (2010) address this issue. In their model, price developments are characterised by two regimes: high inflation and low inflation. Using Bayesian techniques, the model was applied to the euro area, Germany, the United States, the United Kingdom and Canada using data from the 1950s to the present.

This approach embodies two key elements. First, the estimation sample includes periods of greater inflation volatility (and, by implication, less successful monetary policy making). Since both inflation and monetary growth are more variable over this longer sample than in recent years, these data

1 *As background to the discussion in this article, it is worth quoting the passage from M. Friedman (1970) in full: "Inflation is always and everywhere a monetary phenomenon in the sense that it is and can be produced only by a more rapid increase in the quantity of money than in output. ...A steady rate of monetary growth at a moderate level can provide a framework under which a country can have little inflation and much growth. It will not produce perfect stability; it will not produce heaven on earth; but it can make an important contribution to a stable economic society."*

2 *See ECB (1999) and Fischer et al. (2008).*

3 *A more complete summary of the exercise and its outcome is presented in: Papademos and Stark (2010) and ECB (2010).*

4 *See Lucas (1996).*

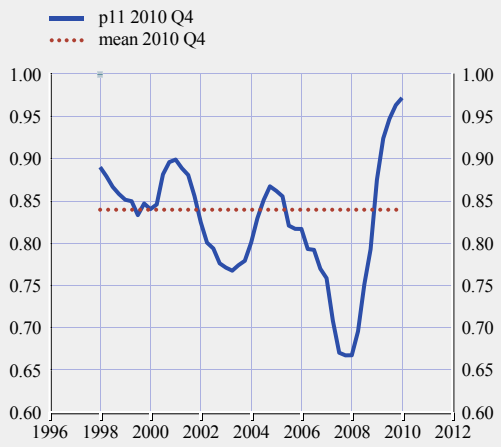
reveal more about the underlying quantity theoretic relationships. Second (and related), the technique employed focuses attention on more persistent changes in inflation developments (essentially shifts in the average rate of inflation) and thereby concentrating on the low frequency relationship between money and prices. This is more robust than the relationship at higher frequencies, where many other factors also influence price developments.

Model estimates suggest that a smoothed measure of broad money growth (corrected for real-time estimates of trend velocity and potential output growth) has important leading indicator properties for switches between inflation regimes. In this framework, money growth therefore provides an important early warning of risks to price stability.

…money growth provides an important early warning of risks to price stability by offering a signal of changes in inflation regime…

To illustrate, Chart 1 shows the model's estimates, derived from the evolution of monetary growth, of the probability that euro area inflation will remain in a regime of price stability. For comparison purposes, the horizontal line shows this probability computed under "neutral" monetary conditions (i.e. with monetary growth at its sample mean). On the basis of the money growth indicator, the chart shows that risks to price stability over the medium term increased steadily from early 2005 to end-2007, but have decreased subsequently given the deceleration in monetary dynamics seen over the past three years.

Chart 1 Conditional probability of staying in a low inflation regime in the Amisano and Fagan (2010) model



Source: Amisano and Fagan (2010).
Note: The horizontal axis refers to the vintage of data available at the time the risk assessment is conducted.

Monetary developments and asset prices

While such indicator models constitute an important weapon in the armoury of monetary analysis, experience has demonstrated that relying on such models entails risks. In particular, in the face of financial innovation and other structural changes, we may see shifts in velocity or (equivalently) the economically relevant definition of money may drift away from the available statistical measures. Such developments can corrupt the indicator properties of money. In order to protect against such false signals, it is essential that the central bank has a deep understanding of the forces driving the monetary data.

Money demand models have provided the traditional framework for developing such an understanding, since these models provide a framework for assessing whether monetary developments are consistent with past behaviour or instead are signalling structural changes which need to be further investigated. There is a long tradition of modelling money demand for the euro area at the ECB.[5]

As part of the research agenda to enhance monetary analysis, a new generation of money demand models has been estimated to address the well-known shortcomings identified in previous vintages. In particular, building on the real-time assessment of portfolio shifts into monetary assets described by Fischer et al. (2008), the new generation of models extends

…the new generation of models reconfirms the stability of money demand by including wealth and asset prices as additional explanatory variables…

5 *See Fischer et al. (2008) for an overview.*

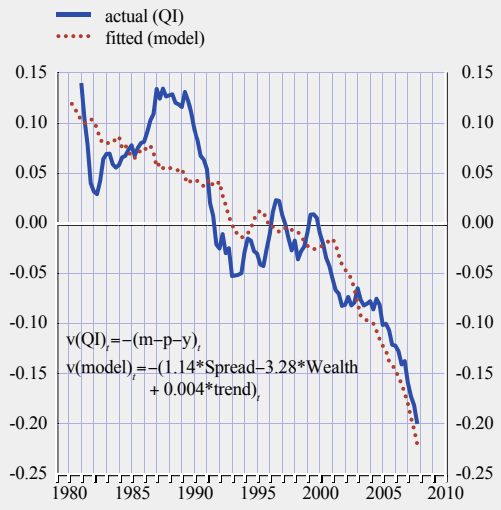
conventional money demand specification to include asset prices. While De Santis et al. (2009) analyse the effects of international portfolio allocation on euro area money demand, Beyer (2009) focuses on the role played by the evolution of housing wealth in the behaviour of trend-velocity over the past decade.

The Beyer (2009) model establishes empirically stable (cointegrated) long-run relationships among money, prices, income, housing wealth and interest rates in the euro area. Thus far, the estimated relationships have proved stable, even in the face of the financial crisis. As can be seen from Chart 2, the model is capable of explaining the pattern of velocity observed over the last decade.

Moreover, the model – which constitutes a macroeconomic system, rather than a "stand-alone" single money demand equation as in some previous works – offers a framework for monetary policy analysis for the euro area. For example, the model can be used to produce conditional projections of inflation and money growth, which represent a benchmark against which to compare observed monetary developments in real time.

The Beyer model also allows measures of "excess money" to be constructed, creating a framework for analysing money stocks, rather than simply looking at flows and growth rates, as in many other modelling frameworks. At a time when balance sheet positions are seen as crucial to understanding the outlook for the economy and price developments, developing indicators of stock positions is crucially important.

Chart 2 M3 Velocity: Beyer (2010) and the "Quantity Identity"



Source: Beyer (2009).

While the new money demand models evaluate the impact of asset price developments on money holdings, another strand of work undertaken as part of the agenda to enhance monetary analysis investigates the reverse causality: that is, from monetary developments to asset prices. For example, Alessi and Detken (2009) consider whether global credit developments can be used to anticipate asset price "booms" that result in significant falls in economic activity once the correction occurs.[6]

Methodologically, these studies take a different approach. They build on a narrative literature in the tradition of Kindleberger (2005) and Minsky (1982), which views the accumulation of financial imbalances over time as creating tensions that ultimately lead to episodic asset price collapses. In order to identify such patterns in the data, non-linear modelling of the relationships – say in the form of limited dependent variable models – is more appropriate than the linear VECM methods used for money demand.

…monetary developments can help to predict episodic costly collapses in asset prices which threaten macroeconomic – and ultimately price – stability…

Alessi and Detken find that the emergence of a "credit gap" at the global level (defined as a deviation of the credit/GDP ratio from a real-time estimate of its trend) systematically precedes costly asset price booms. The subsequent asset price collapses lead to macroeconomic and, ultimately, price instability.[7] Progress achieved under the enhancing monetary analysis agenda has therefore deepened our understanding of how monetary impulses are transmitted to the broader economy and price developments via asset markets.

6 *See also Gerdesmeier et al. (2009) for predicting asset price busts and Agnello Schuknecht (2009) for a focus on the housing market.*
7 *See also a previous ECB Research Bulletin article, Alessi and Detken (2008).*

As reflected in this discussion, the available empirical evidence suggests that the causal relationships between monetary developments and asset prices operate in both directions. Ideally, these relationships would be embodied in a single model, which would account for such simultaneity. This remains an important objective of future work: it has obvious policy relevance, since it may help to distinguish between monetary shocks that have implications for asset prices, rather than the general price level, at least in the first instance. However, the challenges in developing such a unified model are formidable, not least because the methodologies underlying the existing tools are so different in nature.

Richer explanations of monetary developments

In describing the regular conduct of monetary analysis, the ECB has always emphasised that its understanding of monetary developments is deepened through a comprehensive assessment of all aspects of banks' balance sheets (what are sometimes called the components and counterparts of the broad monetary aggregate M3). A number of models have been used in the past to systematise this approach, but an encompassing framework has been lacking.

To close this gap, Giannone et al. (2010) have developed a large Bayesian vector autoregressive (BVAR) model to characterise the joint dynamics of euro area macroeconomic, financial and monetary variables over the past two decades. Their study focuses on how a large set of monetary and credit aggregates respond to monetary policy and cyclical shocks: it can be understood as a complement to analysis of the traditional long-run link between monetary growth and inflation, which provides a framework for better and more systematic understanding of the data on a month-to-month basis.

The model establishes or confirms a number of "stylised facts" about the transmission mechanism of monetary policy and the cyclical behaviour of the monetary variables. For example, it demonstrates the pro-cyclicality of credit variables and identifies the sizable lag from economic activity to loans to non-financial corporations. It also captures the dynamic pattern of responses to monetary policy tightening: on impact M1 moderates, whereas M3 responds positively (via the impact of the tightening on the term structure of interest rates). Loans to firms demonstrate a hump-shaped response, rising on impact (e.g. because the tightening of financial conditions prompts some substitution of existing credit lines with alternative non-bank sources of external finance).

…new models explaining the interrelationships among monetary and credit aggregates support the interpretation of data on a month-to-month basis…

To illustrate how this model can be used to inform monetary policy making, Chart 3 presents some results of an investigation of the behaviour of money and credit during the recent crisis. Whether financial intermediation has been impeded by the crisis – in other words, whether a "credit crunch" has emerged – has proved a central policy question in recent years.

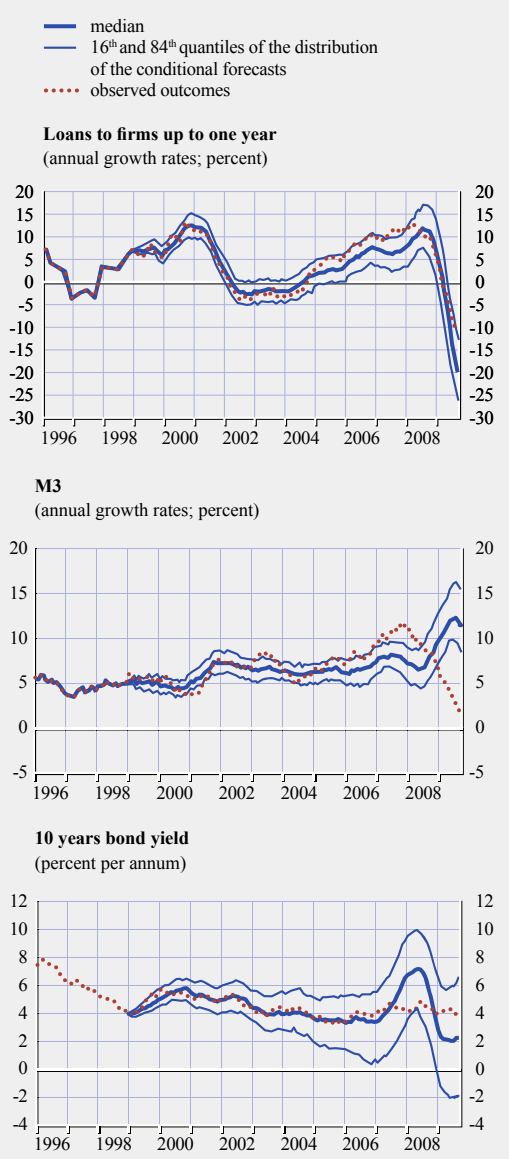
The exercise compares the observed path of monetary variables with that forecast by the model, conditional on the business cycle shocks that have affected the euro area in the recent crisis.[8] Implicit in these forecasts is the view that economic structure, as captured in the estimated model, has remained unchanged. Large discrepancies between these conditional forecasts and the observed outcomes would suggest that the crisis has changed the relationship of the variable in question with the rest of the euro area economy relative to the pre-crisis period.

Chart 3 reports the results of this exercise for short-term loans to non-financial corporations, M3 and the 10-year bond rate.

The results suggest that the behaviour of bank loans to corporations in recent years can be

8 *In order to take into account the economic structure of the euro area prevailing before the financial crisis, the model is estimated with data up to July 2007. Then, given the estimated VAR parameters, conditional expectations are computed for all the variables included in the model in the period January 1999 to present, conditional on the values of all variables until December 1998 and exclusively on the values of the real macroeconomic variables (i.e. industrial production in the euro area and the United States and unemployment in the euro area) from January 1999 to present. The algorithm used to compute conditional forecasts is based on the Kalman filter and it is described in Banbura et al. (2010).*

Chart 3 Expectations of loans, M3 and bond rates conditional on business cycle and pre-crisis economic structure



Source: Giannone et al. (2010).
Note: Loans and M3 are expressed in terms of annual growth rates, while bond rates are in levels. The horizontal axis reports the dates (from January 1996 to September 2009).

explained on the basis of pre-crisis regularities in the data, once developments are conditioned on the shocks to economic activity. In other words, one does not need to rely on exceptional or aberrant bank behaviour to explain developments in credit during the financial crisis. The ensuing weakness of economic activity suffices to account for what was observed.[9]

By contrast, some anomalies are seen in the behaviour of the monetary aggregates. Notably, both the sustained increase of M3 growth prior to the crisis and its subsequent sharp decline are difficult to reconcile with the pre-crisis economic relationships and the business cycle shocks. Interestingly, the only other variables that prove difficult to reconcile with the pre-crisis economic relationships and the business cycle are long-term bond yields. The last panel in Chart 3 shows that observed 10-year bond rates were lower than predicted by the conditional forecast during the period of surprising strength in M3 growth (and vice versa). This association may reflect the impact of portfolio choices, motivated by changes in the term structure, on the demand for M3.

Concluding remarks

Recent events have created a new and pressing need for a better understanding of monetary and credit developments. This is increasingly being recognised in the academic and central banking research communities.

The ECB's emphasis on the importance of monetary analysis prior to the emergence of the financial crisis was exemplified by the decision to pursue a research agenda to enhance that analysis even before the first emergence of market tensions in August 2007. A suite of new analytical tools – some of which are described in this article – has been developed that deepens our understanding of monetary developments and how they can inform and support monetary policy decision-making.

Yet much remains to be done. In particular, there is a need to develop a fuller account of the transmission mechanism from monetary impulses to the price level – including a better understanding of financial intermediation over the business cycle, the behaviour of the banking sector and the interaction between monetary developments and asset prices. As ever, progress in pursuit of one agenda has identified a number of further research questions that need to be addressed in a follow-up: such is the nature of academic research, in the field of monetary analysis as elsewhere.

9 *Notice, however, that the picture is slightly different for loans for house purchases which have been higher than predicted since 2004 and have continued to fall even after the model would have predicted a turning point on the basis of cyclical conditions (first quarter 2009). These results are not reported here in the interest of brevity, but are available in the paper.*

"RETURN-FREE RISK"? MARKET PRICING IN CREDIT RISK MARKETS[1]

By Martin Scheicher

The wide-ranging reassessment of the risk-return relationship in credit risk markets is a key element of the global financial crisis. Since summer 2007, sharp falls in the value of many credit-risky instruments have led to potentially life-threatening mark-to-market losses for many major banks, thereby causing severe systemic distress. The significant impact of this repricing of credit risk on the global financial system also illustrates the growing importance of credit risk markets.

Credit risk markets permit the trading of a wide range of instruments with exposure to credit risk. They comprise single-name instruments (such as corporate bonds), portfolio instruments (such as securitisations) and derivatives (such as credit default swaps). Until the 1990s, credit risk trading was mainly confined to corporate bonds. In comparison with stock markets, for example, the corporate bond market was less liquid and less transparent. Typically, therefore, banks originated credit-risky assets in the form of corporate loans or mortgages, and then held them to maturity in their banking books.

Rapid growth of credit risk trading over the last decade

In the late 1990s credit risk trading changed substantially in two ways. First, credit default swaps (CDSs), which offer traded insurance against default risk, provided markets with an instrument for price discovery. Many banks thus started to use CDSs in order to price their loans and subsequently mark them to market. Second, securitisation expanded and became more complex, as evidenced by collateralised debt obligations (CDOs), for example. Underlying assets range from a pool of several dozen corporate bonds to tranches of other securitisations. The increasing integration of financial institutions and financial markets, which had historically been separate components of the financial system, created a "shadow banking system" alongside the regulated banking system (cf. Pozsar et al. (2010)). At the same time, additional important changes were investors' search for yield, advances in credit risk modelling and the Basel II process.

The evolution of an active market for trading credit risk is a major structural change in the financial system.

Owing to their growing importance, credit risk markets have been at the epicentre of the financial crisis since its outbreak in summer 2007 (cf. Gorton (2010) or Krishnamurthy (2010)). As a large part of credit risk transfer had remained within the banking system, many banks had a high exposure to CDOs. Furthermore, idiosyncratic features in many securitisation transactions make trading in secondary markets impossible. Hence valuation often uses model estimates rather than market prices. However, the fact that CDOs are very opaque exacerbated general uncertainty about the value of banks' positions, which, in turn, again increased perceived counterparty risk. At the same time, the CDS market acted as a live thermometer of the crisis, making declining valuations of credit-risky instruments immediately transparent, which may have created additional feedback loops.

Understanding the unprecedented repricing of credit risk

Research on credit risk markets typically analyses CDS premia. Blanco et al. (2005) were the first to show that CDSs lead credit spreads on bonds in terms of the price discovery process. A second key finding in this literature is the "credit spread puzzle" (Amato and Remolona (2003)). According to this empirical observation, expected default losses account for only part of the variation of credit spreads or CDS premia, with the residual providing a "risk premium" (Hull et al. (2005)). For a sample of US corporate bonds from 1866 to 2008, Giesecke et al. (2010) document that default losses account for about half the level of observed credit spreads, which leads to an average long-term risk premium of 80 basis points. Risk premia have also been documented in CDSs on US industrial firms (Berndt et al. (2005)), corporate CDOs (Longstaff and Myers (2009)) and US sub-prime securitisations (Fender and Scheicher (2008)). Risk premia are frequently found to be related to market liquidity or indicators of investors' risk appetite.

[1] *This article has benefited from comments by P. Hartmann and F. Smets.*

To illustrate the repricing in credit markets in the crisis, Table 1 shows CDS quotes for European standardised CDOs over the last three years. A CDO represents a set of claims of varying exposures ("tranches") to the cash flows from a portfolio of credit instruments (cf. Coval et al. (2009)). In this actively-traded and transparent CDO segment, the underlying portfolio is a credit index. Owing to this benchmark function, these quotes are often used to value non-traded idiosyncratic CDOs, so that they are the "tip of the iceberg" of the CDO market (cf. Scheicher (2008)). The six tranches range from "equity", with the highest credit risk exposure (covering the first few defaults), to "super-senior", where expected losses are much smaller.

In the crisis, premia on safer CDO tranches increased by a factor of 50.

The table illustrates the sizeable repricing that has taken place since summer 2007. The CDS premium on the underlying portfolio, the iTraxx index, rose from 20 basis points before the crisis to a peak of 124 basis points thereafter. Hence, the cost of insuring a debt portfolio of €1 million containing the benchmark European corporates against default risk rose from €2,000 to €12,400.

Sharp price declines in supposedly safe tranches forced many investors to realise that CDOs did not provide the expected *risk-free returns*, but rather *return-free risk*. The most significant price changes are observed for the higher, i.e. senior and super-senior, tranches. In June 2007 the premium for the highest super-senior tranche was quoted at below 1 basis point, and it subsequently peaked at 48 basis points in autumn 2008 after the Lehman Brothers default. More than 22% of the portfolio needs to be lost for the highest tranche to be at risk; hence, in September 2008, investors thought large-scale defaults far more likely than in June 2007. These highest tranches were often rated AAA, causing investors to perceive them as being very safe. This perception is also indicated by the close-to-zero premium before the crisis.

Researchers have also studied the determinants of this repricing in CDO markets. For CDOs similar to those in Table 1, Longstaff and Myers (2009) find that counterparty risk, funding costs and market liquidity all significantly affect market quotes. Given the existence of such risk premia, parts of the repricing of securitisation instruments are likely to be due to changes in risk appetite (a "subjective" component), rather than to changes in loss forecasts (an "objective" component).

Conclusions

The emergence of a market for credit risk is a major structural change in the global financial system. Essentially, a core segment of financial intermediation has moved from a "hold to maturity" approach to a trading-based environment. Owing to a stronger use of marking-to-market accounting, market developments now also directly affect the value of banks' credit portfolios, increasing the challenges for bank credit risk management.

Sizeable risk premia in CDS quotes imply that changes in credit and non-credit-related components lead to different interpretations of market expectations. Specifically, decreasing appetite for credit-risky instruments is a different signal of market perceptions than rising future defaults in the underlying instruments. Hence, high CDS premia during the crisis may be due to changes in risk premia, but also to concerns about an increasing number of credit rating downgrades, rather than to principal losses on outstanding debt.

Table 1 CDS quotes for European standardised CDOs over the last three years

(basis points)

Instrument	Before the crisis (1/6/2007)	Post-Lehman (15/9/2008)	(22/7/2010)
Underlying pool (= iTraxx main index)	20.0	124	115
Equity tranche (0-3%)	652.0	2,211	1,450
Junior mezzanine tranche (3-6%)	40.0	615	470
Mezzanine tranche (6-9%)	10.0	364	265
Lower senior tranche (9-12%)	4.5	201	142
Upper senior tranche (12-22%)	1.8	90	68
Super-senior tranche (22-100%)	0.7	48	25

Source: JP Morgan Chase.
Notes: All quotes are expressed in basis points, i.e. one hundredth of 1%, and represent the price of protection on the underlying segment of the loss distribution. The maturity of the contracts is five years. The underlying portfolio comprises 125 European investment-grade firms.

MACROECONOMIC FORECASTING: CAN FORECAST COMBINATION HELP?

By Geoff Kenny

The dramatic downturn in euro area GDP growth in 2008 and early 2009 resulted in some of the largest macroeconomic forecasting errors that have been witnessed for many decades. As policy-makers use such forecasts as input into policy deliberations, these errors are potentially costly, as much-needed policy adjustments to the economy may be withheld or delayed. Improving or optimising the quality of economic forecasts is therefore a constant priority for policy-making institutions, including the ECB.

Given the heterogeneity of views that often exist regarding the economic outlook, the combination or "pooling" of forecasts is a potentially useful way of improving overall forecast quality. By averaging across divergent forecasts, forecast combination provides a hedge against the risk of a particular forecaster or forecasting method having an extremely poor performance. This is much akin to the familiar gains from diversification often discussed in financial portfolio theory.

"Forecast combination provides a hedge against the risk that a particular forecaster or forecasting method has an extremely poor performance"

The ECB Survey of Professional Forecasters (SPF) provides a potentially valuable source of information for investigating the possible gains from forecast combination. Several indicators suggest that the 2008-09 period was associated with a sharp increase in disagreement about the economic outlook. According to the SPF, the standard deviation of the individual forecasts for euro area GDP growth one year ahead – a measure of forecaster disagreement – increased from below 0.2 percentage point in late 2007 to above 0.6 percentage point in the second quarter of 2009.[1] Currently, the headline results of the SPF are provided to policy-makers and the public using the simple average of these heterogeneous forecasts.[2] A key question to consider, then, is whether there are better ways of combining the SPF results than the current approach, where all forecasts are weighted equally.

Alternative approaches to combining forecasts

Theoretical arguments suggest that the simple average of forecasts should not in general be the best way to combine forecasts. Forecast combination theory would instead suggest that optimal weights can be estimated reflecting two key elements.[3] First, forecasts which are more accurate should receive a higher weight than forecasts which are less accurate. Second, forecasts which are less correlated with other forecasts should receive a higher weight, all other things being equal. This second feature of an optimal combination reflects the "hedging value" that emerges through combination. Intuitively, the less correlated a forecast is with other forecasts, the greater the likelihood that it will succeed when other forecasting models are performing poorly or even breaking down completely.

In practice, however, optimised weights need to be estimated and will therefore reflect sampling and estimation error.[4] In situations where there are a large number of forecasts that need to be combined, the negative impact of estimation error on the performance of the combination may be particularly strong. This may place some limits on the gains that can be achieved from the use of theoretically optimal combinations in practice. Indeed, a common finding in applied studies is that combinations based on equal weights often perform as well as – or even better than – theoretically optimised weights (Smith and Wallis, 2009). An alternative to equal weighting proposed by Bates and Granger (1969), and more recently applied by Stock and Watson (2004), is to base the weights only on historical forecast

1 *This is very much in line with other stylised facts on the behaviour of forecaster disagreement over the business cycle. For example, Dovern et al. (2009) demonstrate a strong tendency for disagreement about real variables to intensify during periods of recession.*

2 *The results of the quarterly SPF rounds are published in the ECB Monthly Bulletin in February, May, August and November of each year. Information concerning the SPF can also be downloaded directly from the ECB website at http://www.ecb.europa.eu/stats/prices/indic/forecast/html/index.en.html. Bowles et al. (2010) provide a recent assessment of the forecast performance of the ECB SPF.*

3 *See Timmermann (2006) for a recent review of forecast combination theory. Diebold and Pauly (1990), Clemen and Winkler (1986), as well as Granger and Ramanathan (1984), provide earlier discussions.*

4 *Timmermann (2006) reviews the various ways of estimating optimal combination weights. Genre et al. (2010) explain the practical application of these methods to survey data from the ECB SPF, while Capistrán and Timmermann (2009) apply combination methods to the US SPF.*

performance, but ignoring the cross-correlation structure of the forecasts. A key element in constructing such performance-weighted combinations is the definition and measurement of "historical forecast performance". For example, if the distant past is less relevant to assessing current performance, it may be appropriate to discard or discount more distant forecast errors relative to the recent track record of a given forecaster.

In the approaches to combination discussed above, all available forecasts are pooled together, while the weights attached to them vary depending on historical performance and, in the case of optimised weights, on the correlation structure of the forecasts. An alternative strategy would be to focus only on the forecast that has recently performed the best and, therefore, to attach a zero weight to all other forecasts. This strategy amounts to putting all one's eggs in one basket, so to speak, and neglects potential diversification gains. Such a strategy is potentially very risky in situations where there is a lot of time-variation in forecast performance and if past success is of limited use as a guide to future performance. At the same time, such a strategy may pay off if there is some persistence in an individual's relative forecasting performance over time. This might be the case if some important information on the state of the economy is not widely held by other forecasters who are slower to adapt their outlook to changing circumstances. In such circumstances, placing all the weight on the one forecaster who has incorporated such relevant news may pay off.

Can alternative combinations improve the quality of SPF forecasts?

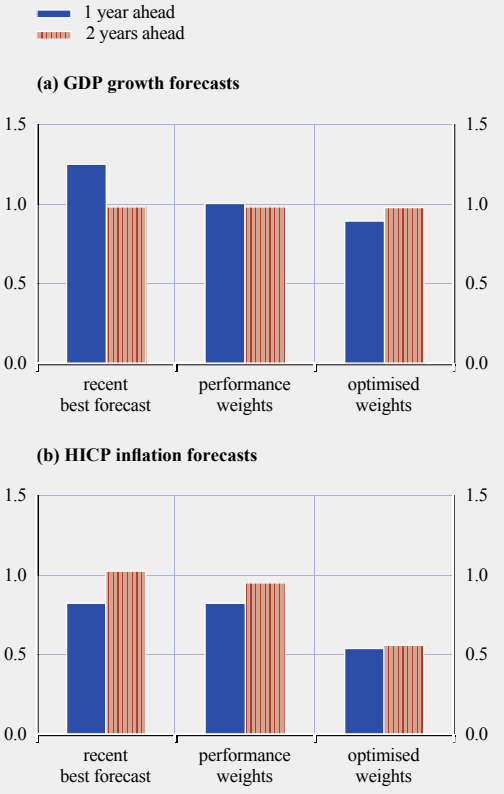
Chart 1 plots an indicator of the overall accuracy of the three different combination methods discussed above, that is i) the recent best forecaster, ii) the performance-based combination and iii) the combination using "optimised" weights.[5] The three approaches are applied to the one-year-ahead and two-year-ahead forecasts for euro area GDP growth and HICP inflation from the ECB SPF.[6] Forecast accuracy is assessed for each alternative combination *relative* to the equal-weighted combination that is regularly reported in the ECB Monthly Bulletin. In the case of GDP (Chart 1a), the alternative combinations deliver only small quantitative improvements compared with the equal-weighted benchmark. The gains are strongest for the optimised weighting schemes, which account for the correlation structure of the forecasts, while the high-risk nature of the strategy of picking the recent best forecaster

5 *Chart 1 is based on the best performing combination from various alternative specifications. In the case of optimised weights, for example, the best performing combination from either least squares or Bayesian estimation is reported. Similarly, the performance-based combination is the best performing model, using either a smooth discounting of past forecast errors or the average performance over a fixed window.*

6 *The forecast performance evaluation in Chart 1 is based on the out-of-sample predictions of the alternative combinations over the period 2004 Q1 to 2008 Q3. In order to provide some evidence of the gains from forecast combination during periods of "normal" business cycle fluctuations, this sample period excludes the observations most affected by the recent financial crisis.*

Chart 1 Accuracy of alternative combinations of SPF forecasts

(relative root mean squared error)



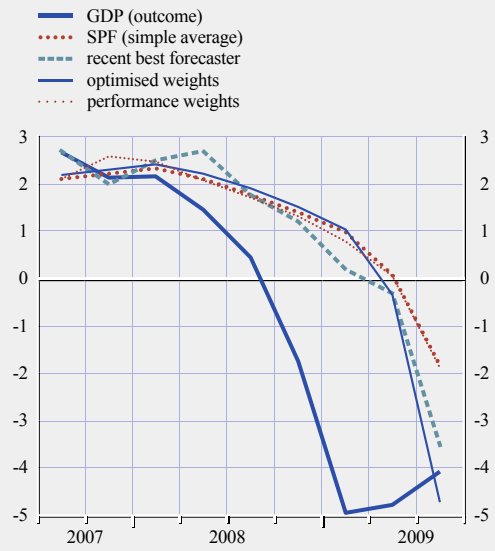
Source: Genre et al. (2010).
Note: The chart shows the relative accuracy of alternative forecast combinations from the ECB SPF as measured by their root mean squared error (RMSE) relative to the RMSE of the equal-weighted average of SPF forecasts. When the relative RMSE is less than 1.0, the alternative combination is more accurate than the headline SPF indicator.

is illustrated by a notable deterioration in forecast accuracy for GDP at the one-year horizon.[7] In the case of inflation (Chart 1b), some more substantial improvements in forecast accuracy are obtained with the alternative combination methods. As discussed in Genre et al. (2010), one reason for this is that the alternative combinations provide less biased forecasts than the equal-weighted benchmark, which consistently tended to underestimate inflation during the period under review. Moreover, the persistence in the relative performance of individual forecasts appears to be higher in the case of inflation – a feature that the alternative combination schemes are designed to exploit. The improvements are most notable using either performance-based or optimised weighting, while – at the one-year-ahead horizon – the strategy of picking the recent best forecaster also results in an improvement compared with the headline SPF indicator.

The analysis of forecast performance summarised in Chart 1 suggests that, *on average*, alternative combination methods using optimised weights or weights based on past historical performance can result in improved forecast accuracy. Another interesting question to consider is whether alternative combination methods could have helped improve forecast performance during the recent recession, which reflected a period of extreme macroeconomic instability. Chart 2 sheds some light on this question, by showing the forecasts implied by alternative combination methods together with the annual growth rate of euro area GDP over a period strongly affected by the crisis. Not surprisingly, the chart highlights the failure of all the combined forecasts to accurately predict the timing of the deterioration in growth dynamics in late 2007 and the severity of the subsequent collapse in economic activity. Over the crisis period, the equal-weighted and performance-based combinations generate broadly similar forecasts. The strategies of picking the recent best forecaster and optimised weights do slightly better for the outcomes in the second and third quarters of 2009. As discussed above, the relatively good performance of the recent best forecaster during the crisis may relate to sluggishness in the speed of many forecasters in adapting their outlook to changing circumstances.

Chart 2 Actual euro area GDP growth and alternative one-year-ahead SPF forecast combinations

(annual change as a percentage)



Source: Genre et al. (2010).

Correspondingly, the relatively good performance of the optimised weighting scheme is linked to the fact that such combinations are not *a priori* constrained to lie within the range of the available forecasts, but can adapt to the actual evolution of GDP. In a context where the shock to GDP proved somewhat persistent, this yields some improvement, especially for the second and third quarters of 2009.

Concluding remarks

From the above illustrations with the ECB SPF, it is clear that forecast combination is no panacea for the travails of the macroeconomic forecaster. However, current research does suggest that combinations of forecasts may perform better on average over longer periods of time than any individual forecasting model or forecaster. Moreover, such methods offer a rigorous framework in which to consolidate the information contained in a variety of model paradigms and forecasts. Looking forward, a key question for research to address is whether combination can improve prediction during

7 *An important caveat to the gains highlighted in Chart 1 is that chance alone may explain the findings of a significant result. Genre et al. (2010) demonstrate that the gains identified for inflation are sufficiently strong to be considered robust, particularly for the one-year-ahead forecasts. This is, however, not the case for GDP.*

periods of macroeconomic instability as were recently observed in many economies.

A particularly promising field of ongoing research is examining the combination of density forecasts, which provide a full probabilistic representation of the uncertainty surrounding a given forecast. Focusing on density forecasts directly acknowledges the large uncertainty surrounding the economic outlook. Moreover, by combining density forecasts, it may be possible to better approximate the true underlying uncertainty in the economy than would be the case with the density forecasts implicit in any one modelling paradigm. For example, even if a set of competing density forecasts are individually "normal", their combination may exhibit non-normal properties that may be important in reality.[8] Unlike point forecast combination, theoretical predictions for the choice of an optimal weighting scheme are only just starting to emerge from this line of research.[9] Not surprisingly therefore, much more has still to be learnt about how to derive successful combinations of density forecasts in practice, including the combination of the individual densities collected as part of the ECB SPF.

"Looking forward, a key question for research to address is whether combination can improve prediction during periods of macroeconomic instability as were recently observed in many economies"

8 *Such as an upward or a downward skew in the distribution, sizeable and time varying probabilities assigned to more extreme events and even bi-modal features.*

9 *Hall and Mitchell (2007) and Amisano and Geweke (2009) provide recent contributions in this field.*

Box 1

THE GREAT FINANCIAL CRISIS: LESSONS FOR FINANCIAL STABILITY AND MONETARY POLICY. A COLLOQUIUM IN HONOUR OF LUCAS PAPADEMOS

On 20-21 May 2010 the European Central Bank hosted a colloquium on "The great financial crisis: lessons for financial stability and monetary policy." At the end of the eight years of his service as Vice-President of the European Central Bank, the colloquium was organised to honour Lucas Papademos' career, both as a distinguished academic and as an eminent central banker.

Lucas D. Papademos and Jean-Claude Trichet

The first session of the colloquium focused on "The great financial crisis: lessons for financial stability policies." Jaime Caruana (General Manager, BIS) noted that all central banks are becoming more involved in macro-prudential policy and welcomed this development. He argued that the separation between financial and price stability objectives is neither realistic nor desirable, because of the mutual implications of macro-prudential choices on the economy, and of monetary policy on the state of the financial system. At the same time, Caruana pointed out that this raises many new challenges, including the need for a more precise definition of financial stability and for explicit mechanisms of coordination between financial stability policy and fiscal policy.

In "Macroprudential regulation: optimizing the currency area", Markus Brunnermeier (Princeton University) argued that the second pillar of the monetary policy strategy of the ECB should gain weight and evolve into a financial stability pillar. As such, the pillar should focus on detecting asset price bubbles fuelled by credit booms through the use of indicators such as credit aggregates or measures of funding liquidity. Brunnermeier also argued in favour of a policy of "leaning against the wind" of asset price bubbles, and against a policy of "benign neglect." Finally, he suggested that macro-prudential regulations tailored to regions and countries have the potential to make the euro area closer to an optimal currency area.

The second session of the colloquium concentrated on "The great financial crisis: lessons for monetary policy." Jordi Galí (CREI and University Pompeu Fabra) reviewed the role of the monetary pillar in shaping ECB policy decisions. As on past occasions, Galí was critical of the monetary pillar, but now acknowledged that monetary analysis could play a useful role for financial stability. He therefore advocated a "rethinking" of the monetary pillar as a "financial stability pillar", because of the importance of financial stability for monetary policy. At the same time, Galí also acknowledged that many aspects of financial stability analysis are already implicit in the way in which the ECB's monetary analysis has been conducted in recent years.

In "Monetary policy lessons from the crisis", Athanasios Orphanides (Governor, Central Bank of Cyprus) questioned whether the crisis highlighted a need for change in central banking along three main dimensions: (1) central bank independence and the desirability of a "higher" inflation objective; (2) the appropriateness of greater "activism" in monetary policy strategies; (3) the attractiveness of greater central bank involvement in regulation and supervision. Concerning the first two questions, Orphanides concluded that change along all dimensions – reducing central banks' independence, increasing their inflation objectives, or requiring a higher degree of activism in policy – is undesirable. Orphanides was, however, in favour of the possibility of bringing micro-supervision under the same roof as other central bank functions.

The contributions to this conference can be downloaded from the ECB's website at: http://www.ecb.europa.eu/events/conferences/html/colloq_papademos.en.html. The conference proceedings will be published in a festschrift later this year.

Box 2

THE THEORY AND PRACTICE OF MACRO-PRUDENTIAL REGULATION

One of the main lessons from the financial crisis over the past three years has been the need for the establishment of a macro-prudential supervisor that oversees the health and stability of the *overall* financial system. The principles, tools and transmission channels of such a new macro-prudential policy framework are, however, not yet fully understood. The second financial stability conference of the International Journal of Central Banking (IJCB), organised by Douglas Gale, Rafael Repullo, Til Schuermann and Frank Smets, and hosted by Banco de España in Madrid on 17-18 June 2010, dealt with the topic of "The theory and practice of macro-prudential regulation". Selected papers will be published in the December issue of the IJCB and can be downloaded from http://www.ijcb.org.

The first session of the conference dealt with empirical work on the importance of bank capital and financial conditions of banks for their lending and the monetary transmission mechanism more generally. Jose Berrospide and Rochelle Edge (Federal Reserve Board) used a number of different methods for gauging the size of the effect of bank capital on the extension of bank credit. They found modest estimated effects and applied these estimates to investigate the role of TARP capital injections and the effects of higher capital requirements in the context of Basle III. In the second paper, Ramona Jimborean and Jean-Stéphane Mésonnier (Banque de France) used a novel approach to show that common factors extracted from individual banks' liquidity and leverage ratios do predict macroeconomic developments in France. They also found that these bank factors are, however, largely irrelevant for the transmission of monetary policy once the development of credit aggregates is taken into account. In his commentary, Mark Gertler (New York University) provided a framework for thinking about the link between banking crises and real activity, and presented some suggestive evidence of the importance of bank credit risk in the current recession.

The second session dealt with theoretical research on the impact of capital and liquidity regulation. Jin Cao and Gerhard Illing (University of Munich) presented a model of systemic liquidity risk to show that imposing minimum liquidity standards for banks ex ante is a crucial requirement for sensible lender-of-last-resort policies. Using a general equilibrium model where the financing of capital goods production is subject to an agency problem, Francisco Covas and Shigeru Fujita (Federal Reserve Bank of Philadelphia) showed that capital requirements

significantly contribute to magnifying output fluctuations. In his commentary, Douglas Gale (New York University) reviewed the impact of capital requirements on risk taking and argued that the classical risk-shifting argument that underlies the claim that capital reduces risk is a partial equilibrium argument that ignores the factors that determine the supply and cost of capital. He showed that, in a model in which managers have target rates of return which force them to "reach for yield", the effects of greater capital on risk taking are turned upside down.

The third session dealt with empirical approaches to determine systemically important financial institutions. Chen Zhou (De Nederlandsche Bank) considered three measures of the systemic importance of a financial institution within an interconnected financial system and argued that size is not necessarily a good proxy of systemic importance. Giovanni Calice (University of Aberdeen) presented an empirical model of volatility spillovers between the bank CDS market and the valuation of a bank's assets. In his commentary, Jean-Charles Rochet (University of Zurich) presented a different perspective on regulations aimed at containing systemic risk. He proposed adopting a platform-based (instead of institution-based) regulatory perspective on systemic risk and encouraging a generalised move to central counterparty clearing.

The concluding panel discussion was introduced by Alan Blinder (Princeton University). With a topic of "It's broke, let's fix it", he presented a number of principles of sound regulation and a list of major recommendations, as well as reviewing the regulatory response in the United States in this area. Jean-Pierre Danthine (Swiss National Bank) reviewed the Swiss experience of new capital and liquidity regulation and indicated that, although the balance sheets of the large Swiss banks have shrunk significantly, there has so far been no effect on lending. Charles Goodhart (London School of Economics) emphasised the importance of designing bank taxes well in order to prevent externalities and pointed to legal problems stemming from insufficient harmonisation of national laws. Finally, Jean-Pierre Landau (Banque de France) made a distinction between a buffer and an incentive approach to macro-prudential regulation, noting that different instruments (such as capital requirements) may not necessarily serve both.

REFERENCES ON

ENHANCING MONETARY ANALYSIS

Agnello, L. and Schuknecht, L. (2009), "Booms and busts in housing markets: determinants and implications", *Working Paper Series*, No 1071, ECB.

Alessi, L. and Detken, C. (2009), "Global liquidity as an early warning indicator for asset price boom/bust cycles", *Research Bulletin*, No 8, ECB, pp. 7-9.

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

Amisano, G. and Fagan, G. (2010), "Money growth and inflation: a regime-switching approach", *Working Paper Series*, No 1207, ECB.

Banbura, M., Giannone, D. and Lenza, M. (2010), "A large VAR for the euro area", mimeo, ECB.

Beyer, A. (2009), "A stable model for euro area money demand: revisiting the role of wealth", *Working Paper Series*, No 1111, ECB.

De Santis, R., Favero, C.A. and Roffia, B. (2008), "Euro area money demand and international portfolio allocation: a contribution to assessing risks to price stability", *Working Paper Series*, No 926, ECB.

European Central Bank (1999), "The stability-oriented monetary policy strategy of the Eurosystem", *Monthly Bulletin*, January, pp. 39-50.

European Central Bank (2010), "Enhancing monetary analysis", *Monthly Bulletin*, November.

Fischer, B., Lenza, M., Pill, H. and Reichlin, L. (2008), "Money and monetary policy: the ECB experience 1999-2006", in A. Beyer and Reichlin, L. (eds.), *The role of money – money and monetary policy in the 21st century*, ECB, Frankfurt am Main, pp. 102-175.

Friedman, M. (1970), *The Counter-Revolution in Monetary Theory*, Institute of Economic Affairs, London.

Gerdesmeier, D., Roffia, B. and Reimers, H-E. (2009), "Asset price misalignments and the role of money and credit", *Working Paper Series*, No 1068, ECB.

Giannone D., Lenza, M. and Reichlin, L. (2010), "Money, credit, monetary policy and the business cycle in the euro area", mimeo, ECB.

Kindleberger, C. (2005), *Manias, panics, and crashes: A history of financial crises*, Wiley Investment Classics.

Lucas, R.E. (1996), "Monetary neutrality", *Journal of Political Economy*, No 104(3), pp. 661-82.

Minsky, H.P. (1982), *Can "It" happen again? Essays on instability and finance*, Routledge.

Papademos, L. and Stark, J. (eds.) (2010), *Enhancing monetary analysis*, ECB, Frankfurt am Main.

"RETURN-FREE RISK"? MARKET PRICING IN CREDIT RISK MARKETS

Amato, J. and Remolona, E. (2003), "The credit spread puzzle", *Quarterly Review*, Bank for International Settlements, December, pp. 51-63.

Berndt, A., Douglas, R., Duffie, D., Ferguson, M. and Schranz, D. (2005), "Measuring default risk premia from default swap rates and EDFs", *Working Paper Series*, No 173, Bank for International Settlements.

Blanco, R., Brennan, S. and Marsh, I.W. (2005), "An empirical analysis of the dynamic relationship between investment-grade bonds and credit default swaps", *Journal of Finance*, Vol. 60, pp. 2255-2281.

Coval, J., Jurek, J. and Stafford, E. (2009), "Economic catastrophe bonds". *American Economic Review*, Vol. 99(3), pp. 628-666.

Fender, I. and Scheicher, M. (2008), "The ABX: how do the markets price subprime risk?", *Quarterly Review*, Bank for International Settlements, September, pp. 67-81.

Giesecke, K., Longstaff, F., Schaefer, S. and Strebulaev, I. (2010), "Corporate bond default risk: A 150-year perspective", *NBER Working Paper Series*, No 15848, National Bureau of Economic Research.

Gorton, G. (2010), "Questions and answers about the financial crisis", *NBER Working Paper Series*, No 15787, National Bureau of Economic Research.

Hull, J., Predescu, M. and White, A. (2005), "Bond prices, default probabilities and risk premiums", *Journal of Credit Risk*, Vol. 1, pp. 53-60.

Krishnamurthy, A. (2010), "How debt markets have malfunctioned in the crisis", *Journal of Economic Perspectives*, Vol. 24, No 1, pp. 3-28.

Longstaff, F., and Myers, B. (2009), "How Does the Market Value Toxic Assets?", *NBER Working Paper Series*, No 14871, National Bureau of Economic Research.

Pozsar, Z., Adrian, T., Ashcraft, A. and Boesky, H. (2010), "Shadow banking". *Staff Report*, No 458, Federal Reserve Bank of New York.

Scheicher, M. (2008), "How has CDO market pricing changed during the turmoil? Evidence from CDS index tranches", *Working Paper Series*, No 910, European Central Bank.

MACROECONOMIC FORECASTING: CAN FORECAST COMBINATION HELP?

Amisano, G. and Geweke, J. (2009), "Optimal prediction pools", *Working Paper Series*, No 1017, European Central Bank, March.

Bowles, C., Friz, R., Genre, V., Kenny, G., Meyler, A. and Rautanen, T. (2010), "An evaluation of the growth and unemployment rate forecasts in the ECB SPF", *Journal of Business Cycle Measurement and Analysis*, forthcoming.

Capistrán, C. and Timmermann, A. (2009), "Forecast combination with entry and exit of experts", *Journal of Business and Economic Statistics*, No 27, pp. 428-440.

Clemen, R.T. and Winkler, R.L. (1986), "Combining economic forecasts", *Journal of Business and Economic Statistics*, No 4, pp. 39-46.

Diebold, F.X. and Pauly, P. (1990), "The use of prior information in forecast combination", *International Journal of Forecasting*, No 6, pp. 503-508.

Dovern, J., Fritsche, U. and Slacalek, J. (2009), "Disagreement among forecasters in G7 countries", *Working Paper Series*, No 1082, European Central Bank, August.

Genre, V., Kenny, G., Meyler, A. and Timmermann, A. (2010), "Combining the forecasts in the ECB SPF: Can anything beat the simple average?", mimeo, European Central Bank.

Granger, C.W.J. and Ramanathan, R. (1984), "Improved methods of combining forecasts", *Journal of Forecasting*, No 3, pp. 197-204.

Hall, S.G. and Mitchell, J. (2007), "Combining density forecasts", *International Journal of Forecasting*, No 23, pp. 1-13.

Smith, J. and Wallis, K.F. (2009), "A simple explanation of the forecast combination puzzle", *Oxford Bulletin of Economics and Statistics*, No 71, pp. 331-355.

Stock, J.H. and Watson, M.W. (2004), "Combining forecasts of output growth in a seven-country data set", *Journal of Forecasting*, No 23, pp. 405-430.

Timmermann, A. (2006), "Forecast combinations", in Elliott, G., Granger, C.W.J. and Timmermann, A. (eds.), *Handbook of Economic Forecasting*, Vol. 1, North Holland, Amsterdam.

SELECTED RECENT JOURNAL PUBLICATIONS BY ECB STAFF

Andersson, M. (2010), "Using intraday data to gauge financial market responses to Fed and ECB monetary policy decisions", *International Journal of Central Banking*, Vol. 6, No 2, pp. 117-146.

Christoffel, K. and Linzert, T. (2010), "The role of real wage rigidity and labor market frictions for inflation persistence", *Journal of Money, Credit and Banking*, Vol. 42, No 7, pp. 1435-1446.

Ciccarelli, M. and Mojon, B. (2010), "Global inflation", *Review of Economics and Statistics*, Vol. 92, No 3, pp. 524-535.

De Santis, R.A. (2010), "The geography of international portfolio flows, international CAPM, and the role of monetary policy frameworks", *International Journal of Central Banking*, Vol. 6, No 2, pp. 147-197.

De Walque, G., Jimeno, J., Krause, M., Le Bihan, H., Millard, S. and Smets, F. (2010), "Some macroeconomic and monetary policy implications of new micro evidence on wage dynamics", *Journal of the European Economic Association*, Vol. 8, No 2-3, pp. 506-513.

Fratzscher, M., Juvenal, L. and Sarno, L. (2010), "Asset prices, exchange rates and the current account", *European Economic Review*, Vol. 54, No 5, pp. 643-658.

Jarociński, M. (2010), "Responses to monetary policy shocks in the east and the west of Europe: a comparison", *Journal of Applied Econometrics*, Vol. 25, No 5, pp. 833-868.

Kalemli-Ozcan, S., Papaioannou, E. and Peydró-Alcalde, J.-L. (2010), "What lies beneath the euro's effect on financial integration? Currency risk, legal harmonization, or trade", *Journal of International Economics,* Vol. 81, No 1, pp. 75–88.

Nakov, A. and Pescatori, A. (2010), "Monetary policy trade-offs with a dominant oil producer", *Journal of Money, Credit and Banking,* Vol. 42, No 1, pp. 1-32.

Nakov, A. and Pescatori, A. (2010), "Oil and the great moderation", *The Economic Journal,* Vol. 120, No 543, pp. 131-156.

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