10th EABCN Workshop on Uncertainty over the Business Cycle

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The 10th Euro Area Business Cycle Network (EABCN) workshop, "Uncertainty over the Business Cycle" was hosted by the European Central bank in Frankfurt. Participants from academic institutions, central banks and statistical agencies, offered a lively debate about the sources of the business cycle, the usefulness of dating, the nature of aggregate uncertainty and, and the potential of learning dynamics to provide an adequate transmission mechanism for the structural shocks that hit the economy. The workshop consisted of a series of 11 presentations of 30 minutes with discussant, and a two hours panel session. The event was divided in six different sessions, namely, **Learning**, **The Yield Curve, Forecasting and Information**, **Business Cycle Dating**, **Panel Discussion** (with James Bullard, Bob Hall and Lucrezia Reichlin), and **Uncertainty and the Business Cycle**.

REPORT

by **David de Antonio Liedo** (Bank of Spain)

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Please note: Papers, presentation notes and presentation slides (where available) can be found at: http://www.eabcn.org/10th-eabcn-workshop-uncertainty-over-business-cycle

Session I – Learning

Chair: Günter Coenen (European Central Bank)

Estimating a Medium-scale DSGE Model with Expectations Based on Small Forecasting Models

[PRESENTATION 1]

Raf Wouters (National Bank of Belgium) presented the paper "Estimating a Medium-scale DSGE Model with Expectations Based on Small Forecasting Models" (jointly with Sergey Slobodyan). He started the first session on learning by saying that most empirical DSGE models retain the restrictive hypothesis of rational expectations, in the sense that the expectations of agents are model consistent. However, as shown by Milani (2004), Orphanides and Williams (2003) or Preston and Eusepi (2008), learning could significantly influence the macroeconomic dynamics and increase the persistence, always in the framework of *small scale* models.

The paper presented by Wouters studies the improvements of learning over the strict rational expectation hypothesis in the framework of a *medium-scale* DSGE model that has been proved to fit the data reasonably well. Thus, the model-consistent expectations of the Smets and Wouters (2007) model are replaced by a combination of simple forecasting models, the parameters of which are time-varying and are estimated by the agents with the Kalman filter. As a result, the model provides a better fit for the data, independently of the forecasting combination used to replace the model-consistent expectations. Moreover, the models with learning are estimated to have lower persistence of shocks (the autocorrelation of the price and wage markup shocks tends to disappear), which means that the major source of persistence required to fit the data is now attributed to the internal mechanisms of the model, the structural (deep) parameters of which remain quite stable. As a matter of fact, the time-varying beliefs reproduce the Great Inflation and the Great Moderation inflation, but not in output growth. Finally, the learning dynamics are also consistent with the observed flattening of the Phillips curve.

[DISCUSSION] **add link to slides**

Peter Tillmann (University of Bonn) emphasized the underlying tension that appears in the framework of Slobodyan and Wouters: On the one hand, the economic agents solve their optimization problems and make fully rational decisions, while on the other hand, the model is solved under the assumption that agents use naïve model combinations to forecast. For example, even if price setters know the probability of being able to change the price in the future, their inflation forecast is purely based on a very simple forecasting model.
Having said that, Tillmann pointed out that it is not easy to understand whether the improved fit induced by learning is due to the simplicity in the forecasting models used by the agents or

the time variation of their coefficients. **Lucrezia Reichlin** (London Business School) stated that the forecast combination of small forecasting models employed to replace the rational expectations projections might not imply a loss of information. On the contrary, she argued that the parsimony in which the information about all the variables enters the model could be a key ingredient in its success.

Learning about risk and returns: A simple model for Bubbles and Crashes

[PRESENTATION 2]

William Branch (University of California, Irvine) presented his joint work with George W. Evans: "Learning about Risks and Return: a Simple Model of Bubbles and Crashes". The presentation started with some graphical evidence about bubbles, that is, increases in the prices of an asset beyond its fundamental value, with the purpose of motivating his asset-pricing model of crashes and bubbles. While the previous literature used to focus on the learning of mean returns, the agents in Branch and Evans's model estimate both the mean and risk of returns.

When the model is used to simulate data, formal tests for bubbles give plausibility to Branch and Evans's interpretation. The story goes as follows: we depart from a stock price "usually" near its fundamental values. Occasional shocks cause agents to lower their risk estimates, leading them mistakenly to think that recent price innovations are permanent, bidding up the stock prices and fueling the bubble. Eventually, risk estimates increase and the bubble crashes.

[DISCUSSION]

Klaus Adams (European Central Bank) pointed out that there is another way to think about the asset price dynamics implied by the simulation results of the model, suggesting that it is the crash that provides a foundation for a bubble and not the other way round: start in the (empirically implausible) non-explosive rational expectations equilibrium. A crash can arise from an increase in the risk estimates, which makes investors expect high compensation for risk, creating a downward spiral in prices. What generates the bubble is the recovery from low prices to higher prices and potentially the overshooting of the prices. The way back towards the rational expectations equilibrium is not so clear, according to Adams. He concludes that it would be very interesting to construct a model for bubbles and crashes with only endogenous dynamics. **Martin Ellison** (Oxford University) suggested that the extremely low frequency of crushes and bubbles that occurs in the simulations does not seem to be in line with the empirical evidence, pointing out the difficulties of taking such a model to the data. Finally, **Valdislav Damjanovic** (University of Saint Andrews) added that it would be useful to understand the determinants of the expected time from a crash to a bubble and vice versa.

Session II – The Yield Curve

Chair: Günter Coenen (European Central Bank)

Nested Information Sets and the Term Structure of Interest Rates

[PRESENTATION 3]

Kristoffer Nimark (CREI) presented his paper "Nested Information Sets and the Term Structure of Interest Rates", providing a new explanation for predictable excess returns that does not rely on a time-varying price of risk. In this model, the assumption that all traders have access to the same information is relaxed, although no trader knows more, on average, than other traders. As a consequence, it could be rational for individuals to exploit the average prediction errors, making the yield dynamics look *as if* there was a time-varying premium for risk.

In the second part of the presentation, after the technical details about the probabilistic nature of his model, Nimark used US bond yields monthly data (since 1964) to show that a likelihood-based estimation of his model was possible. Interestingly, Nimark offered a simple validation exercise that suggests that the overwhelming (in his view, also misleading) evidence about a time-varying price of risk given by non-arbitrage factor models is purely due to misspecification. As a matter of fact, artificial data simulated from the posterior distribution of his own model (with a constant price of risk), could be used to estimate a three-factor no-arbitrage model and mistakenly conclude that there is a time-varying risk premium.

[DISCUSSION]

Jerôme Henry (European Central Bank) emphasized the role of traders' heterogeneous information and the consequent dispersion of the expectations. However, he claimed that the role of private information may be clearer in stock prices than in bonds. Henry also suggested that it would be interesting to take into account the central bank communication in the agents' information set, which is not a trivial exercise to perform, since those communications do not have the same frequency as the data. Finally, he concluded that it would also be interesting to conduct the empirical exercise with euro area data.

The Predictive Power of the Yield Curve across Countries and Time

[PRESENTATION 4]

Kavan Kucko (Federal Reserve Board) presented the paper "The Predictive Power of the Yield Curve across Countries and Time" (joint work with Menzie David Chinn). The presentation started with some graphs showing that the yield spread (long-term interest rate minus short-term interest rate) tends to turn negative before recessions.

Therefore, the question of whether the yield spread can help to explain economic growth is studied across countries. In the sample, regressing the industrial production growth one year ahead on a constant and on the yield spread (ten years' minus three months' rate) suggests that an increase in that spread results in higher growth. However, the out-of-sample results suggest predictability only for Germany, Sweden and France. Kucko also showed that the link between growth and the yield spread is much weaker over the most recent period, as confirmed by both a rolling window estimation approach and a probit model.

[DISCUSSION]

Jagit S. Chadha (University of Cambridge) commented on the difficulty of finding predictability for economic growth in the yield spread, mainly due to the fact that long-term rates seem to be disconnected from short-rate fundamentals. Moreover, the 1998–2006 period has registered very stable behavior of both the yield spread and output growth, which did not induce a sufficient co-variation to lead to an observable relationship. Thus, Chadha underlined that the paper is a starting point for further work to model the yield curve better. The challenge is, he argued, to look for a macroeconomic structure (e.g. a DSGE model) that drives the term spread. Chadha remarked that the credibility of central banks, anchoring inflation expectations and macroeconomic stability seem to have been problematic as regards having an observable link between growth and the term premium. Perhaps, he concluded, the relationship will start to hold again.

Session III – Forecasting and Information

Chair: Frank Smets (European Central Bank)

What Questions are Staff and FOMC Forecasts Supposed to Answer?

[PRESENTATION 5]

Martin Ellison (Oxford University) presented a joint paper with Thomas Sargent, entitled: "What Questions are Staff and FOMC Forecasts Supposed to Answer?". Ellison explained that the *Federal Open Market Committee* (FOMC) publishes its own forecasts twice a year. On the other hand, the staff forecasts, contained in the *Greenbook*, are made public only after five years, although the FOMC has that information available before its meetings.

Ellison departed from Romer and Romer's (2008) finding that the forecast errors associated with the FOMC forecasts are larger, and policy seems to react to discrepancies between the two forecasts. The point of Ellison and Sargent is to give a rationale to the difference between these two forecasts on the basis of the model uncertainty faced by the FOMC, which biases the final projections towards worst-case scenarios. Therefore, the interpretation is very different from that of Romer and Romer (2008), who claim that the FOMC projections are not efficient and have little informative value. Ellison argued that Romer and Romer's criticism makes sense in a world with a single-probability density and rational expectations. Alternatively, in Ellison and Sargent's paper, the FOMC is actually responding in a reasonable way to the possibility that the model is misspecified. Thus, FOMC forecasts may be worst-case scenarios that are important for a policy maker concerned that the model is only an approximation of reality.

[DISCUSSION]

James Bullard (FED St. Louis) suggested that the uncertainty faced by the FOMC is extremely high, probably larger than suggested by Ellison and Sargent, but he agreed with the possibility that policy makers' concern for robustness could indeed drive a systematic difference between FOMC and staff forecasts. Nevertheless, Bullard highlighted that the

FOMC members' forecasts are made under the assumption of "appropriate monetary policy". The implicit policy assumption in the staff forecasts (e.g. constant interest rates) could differ from that of the Committee members, providing a basis for different projections. In Bullard's view, this raises the question of whether each one of the FOMC members should try to predict what the Committee is deciding regarding monetary policy. Therefore, the FOMC forecasting exercise would make sense only under the assumption that monetary policy has a very limited impact on the macro economy, which is probably not what Romer and Romer have in mind. Bullard underlined that the "appropriate monetary policy" clause invalidates their exercise, while Ellison and Sargent's exercise makes more sense. **Jagit S. Chadha** (University of Cambridge) asked about the interpretation of a sort of *evil agent* that interacts with the monetary policy in Ellison and Sargent's formulation. **Ellison** responded that this interaction defines the optimization problem of the central bank, leading to the robust policy. Therefore, that *evil agent* helps to incorporate worst-case scenarios.

Nowcasting, Business Cycle Dating and the Interpretation of New Information when Real Time Data are Available

[PRESENTATION 6]

Kevin Lee (University of Leicester) presented the second paper of the session: "Nowcasting, Business Cycle Dating and the Interpretation of New Information when Real Time Data are Available**"** (jointly with Nilss Olekalns and Kalvinder Shids). Lee argued that models based on real-time data can improve to some exent on more conventional models, which omit market-informed insights on future macroeconomic conditions and inappropriately incorporate information that was not available at the time. The gains of his real-time modelling approach are found both in interpreting new information as it arrives and in decision-making, which is very sensitive to accurate business cycle dating. Lee showed empirical results based on US data, underlining the usefulness of his model independently of whether the evaluation is based on specific variables or more complicated functions, like output gaps. In addition, Lee showed density forecasts and event probability forecasts relating to the US recessions. However, he argued that the use of real-time data is less helpful in addressing the processing issues involved in the identification of structural models.

[DISCUSSION]

Vincent Labhard (European Central Bank) discussed the paper. He started by providing some background information about the availability of real-time data. The EABCN that organizes this workshop, the Federal Reserve Bank of Philadelphia and the OECD provide some of the sources where researchers can have free access to the data. **James Bullard**, representing the Federal Reserve Bank of St. Louis, added that his institution also provides a very complete real-time database. **Labhard** continued with a description of the existing approaches to dealing with the problem of interpreting new information, which include state-space formulations of the problem. Concerning nowcasting, Labhard offered a small review of the literature to suggest that the use of real-time data helps, but the key ingredient is the use of forward-looking indicators. Finally, on the issue of business cycle dating, Labhard highlighted that the existing methods are ex post, while the VAR-based formulation of Lee, Olekalns and Shids is ex ante.

Optimal Monetary Policy in the Euro Area: The Role of Imperfect Information and Real-Time Data

[PRESENTATION 7]

Steffano Neri (Banca d'Italia) presented the last paper of the day: "Optimal Monetary Policy in the Euro Area: The Role of Imperfect Information and Real-Time Data" (joint with Tiziano Ropele). Neri started the presentation underlining that monetary policy decisions are always based on an imperfect knowledge of the state of the economy. In his paper, he provides two types of estimation results of the reduced form new Keynesian model of Ehrmann and Smets (2003), under two distinct assumptions. On the one hand, it is assumed that both agents and central banker have imperfect information about the state of the economy, like in Swenson and Woodford (1993). That means that the Kalman filter is used to extract the signal about the current state of the economy. On the second hand, the model is estimated under the assumption of complete information in order to have a benchmark to understand the implications of the previous model specification. At the same time, both exercises are conducted either with revised data or in real-time.

An important result is that under imperfect information, the trade-off between inflation and output gap deteriorates remarkable. The estimation results also confirm Orphanides (2001)'s finding that in real-time, monetary policy is less responsive to inflation and more responsive to the ouput gap, and the policy trade-off between inflation and output variability deteriorates. However, the fit for the interest rate is better with revised data, both under a tailor rule and an optimal (under discretion) monetary policy reaction function. Neri concluded that information and policy revisions matter for monetary policy analysis.

[DISCUSSION]

Valdislav Damjanovic (University of St. Andrews) argued that information symmetry between agents and central banks is not so realistic, although such an assumption is in his view better than giving the central bank higher information. Thus, Damjanovic proposed to allow a fraction of agents have more information than the central bank to understand the sensitivity of the results to such an assumption. **Lucrezia Reichlin** (London Business School) highlighted that the worse fit provided by the estimation under real-time data could possibly be a sign that the model is misspecified, since monetary policy decisions are taken on the basis of real-time data.

Session IV – Business Cycle Dating

Chair: Andrew Scott (LBS and CEPR)

Identification of Slowdowns and Accelerations for the Euro Area

[PRESENTATION 8]

Laurent Ferrara (Banque de France) presented the first paper of day "**Idenfitication of Slowdowns and Accelerations for the Euro Area**" (joint with Olivier Darné). Ferrara

started explaining the difference between the *business cycle* (classical cycle) and the *acceleration cycle*. The first one, originally studied by Burns and Mitchell in the early 1920s, aims to find turning points delimitating periods of negative growth rates (recessions) and periods of positive growth (expansions). It should not be confused with the so called *growth cycle*, which considers output in deviations from a trend. On the other hand, the *acceleration cycle*, which is the focus of this paper, distinguishes phases of increasing growth rates and decreasing growth rates. Ferrara argued that the end of a recession, in the classical sense, is *preceded by* an initial acceleration stage, or in other words, increases in the growth rate.

Ferrara showed that applying Harding and Pagan (2002)'s version of the Bry and Boschan (1971) non-parametric algorithm on monthly industrial production and quarterly GDP series, it is possible to have a monthly chronology for Germany, France, Italy, Spain, Belgium, the Netherlands, and the euro area as a whole. Ferrara argued that those turning points are a useful benchmark to validate his parametric indicators, which are based on factor models with a time-varying mean that implies either low or high growth rates depending on whether we are on a recession state or in an expansion. Ferrara explained that the turning point detection algorithm suggests that the first differences of the Industrial Sentiment Indicator and its industrial component (the Industrial Confidence Indicator), both for the euro area and for the countries, are linked to the acceleration cycle, and therefore, become natural candidates to be included in their markov switching factor model. Other candidates that perform reasonably well are the surveys provided by IFO, INSEE and INSAE, and the Purchasing Managers Index (PMI). The problem with the last one is that since it is only available since 1997, the history of recessions and expansions is too short for the markov switching model to be estimated with precision.

[DISCUSSION]

Don Harding (Latrobe University) discussed the paper, stating from the very beginning that the focus of the paper is not to add value on the so called *acceleration cycle.* Therefore, in his view, the first part of the paper aiming to identify the turning points may be removed. He first argued that it is contradictory to use a non parametric turning point identification procedure to validate a parametric model of the business cycle. Instead, he suggested simulating data from the Markov switching model and checking whether it matches the moments of the data, as a validation exercise. **Ferrara** replied to this critique at the end of the discussion, arguing that Markov switching models are meant to capture the transition between low growth phases and high growth phases, and they are not meant to capture all moments of the data. In addition to that, he underlined that the use of such models solves the end-of-sample problem faced by users of the non-parametric procedure. The purpose of the first part of the paper on identification of turning points is necessary to have a benchmark that serves the purpose of validating the parametric models. **Harding** also made a comment on the use of the Hodrik Prescott (HP) filter used to smooth the Industrial Production series for the detection of turning points. He argued that a more suitable approach would be to use a band pass filter that isolates the frequency spectrum that is relevant for business cycle analysis.

A system for dating and detecting turning points in the euro area

[PRESENTATION 9]

Gian Luiggi Mazzi (EUROSTAT) present the paper "A system for dating and detecting turning points in the euro area", which is joint work with the previous speaker, Laurent Ferrara, Jaques Anas, and Monica Billio. The first part of the presentation was a comprehensive work to identify the turning points by applying a non-parametric dating algorithm to the GDP and Industrial Production series in the euro area. The decision rule to determine the cyclical peaks and troughs acknowledges that a business cycle phase is necessarily nested in a growth cycle phase (ABCD approach of Anas and Ferrara (2004)). One of the findings of this method is a double dip recession in the eighties (1980 Q1-1980 Q4, and 1981 Q4-1982 Q4). The focus of the second part of the presentation was the early detection of turning points. The idea is to use the full sample to estimate multiple markov switching AR models (one model for each indicator variable) that gives the probability of being in a recession at each point in time. The resulting probabilities of the models (variables) that most closely match the turning points identified in the first step are aggregated in order to construct a more robust estimate of the probability of being in a recession. Mazzi argued that such an index tracks reasonably well the history of recession episodes.

[DISCUSSION]

Michele Lenza (European Central Bank) raised a major issue related with the first part of the paper, suggesting that the authors might fail to consider some relevant measures of economic activity for the detection of turning points. To illustrate the point, he explained that the CEPR report released on 2003 dates a single recession in the eighties rather than two, emphasizing that while GDP stagnated, employment and investment were clearly deteriorating. Lenza also had two remarks related to the second part of the paper.

On the one hand, he argued that the empirical exercise conducted in the paper does not allow us to evaluate how good is their index to track the turning points *in real time,* since none of the real-time dimensions of the problem are disregarded; the model selection is based on the full sample, the data used is revised, and the differences in the timeliness of the indicators is disregarded too. Lenza showed a graph of euro area GDP from 2001 and 2003 and highlighted that the different vintages released by EUROSTAT have radically different implications for the identification of turning points.

On the other hand, Lenza argued that the real-time identification of turning points also requires the use of large information that enables to extract the information from noisy data, as in Giannone, Reichlin and Small (2008), where a large amount of (daily, weekly and monthly) information is used to forecast US growth. Finally, Lenza argued that since the economic developments in the US lead the euro area business cycle, US data should not be disregarded as a source of information to help identifying euro area turning points in real-time. **Mazzi** responded including US data could possibly help. However, he suggested leaving this issue up to the users of their methodology. Mazzi also added that their results are robust to data revisions. **Jerome Henry** (European Central Bank) said that it would be interesting to extend the analysis for other countries outside the euro area.

Session V –Panel discussion
Chair: Frank Smets

Panel: James Bullard (FED St. Louis)
Bob Hall (Stanford University)
Lucrezia Reichlin (London Business School)

Frank Smets (European Central Bank) introduced the panel discussion, addressing some general questions to the panelists. First, why are we interested in dating the business cycle? Second, what are the relevant macro variables that should be tracked in our analysis? Finally, what are the sources of the business cycle?

On the Usefulness of Business Cycle Dating

James Bullard (FED St. Louis) was the first to intervene, criticizing the business cycle measures based on a binary variable representing two discrete states: recession versus expansion. He argued that the state of the economy evolves continuously; therefore, reducing it to two states alone implies a considerable reduction of information. Automatic dating algorithms that provide business cycle dates, like the ones used in some of the presentations, are in his view conceptually inconsistent with growth theory, since they consider *positive* GDP growth as a defining feature of expansions for any country, independently of their average growth rate. Thus, he proposed to use economic theory to guide the researchers in finding more natural summary measures of the business cycle. His critique went further when he mentioned that the business cycle dating proposed by dating committees (e.g. the NBER or CEPR dating committees) should not be interpreted dogmatically and, perhaps, not published at all. His argument was that announcing the beginning of a recession could deteriorate expectations about future economic growth.

Bob Hall (Stanford University), who is the chairman of the NBER dating committee, responded to the controversy raised by Bullard, arguing that the NBER announcements are made public with a sufficient delay so that market participants' expectations are not affected. He emphasized that it is very important to define the dates of expansions and recessions that are consistent throughout the history. He recognized, though, that the type of analysis conducted by the dating committee differs substantially from the methods used in academic research.

Bullard suggested that the dating activity of both NBER and CEPR may induce negative externalities in academic research. His main argument was that, when these institutions fix the peaks and troughs, researchers tend to take the dating as given, rather than giving their models the possibility to choose a different timing. Conversely, **Martin Ellison** (Oxford University) and **Don Harding** (Latrobe University) supported the usefulness of dating, arguing that macro models do not explain many of the business cycle features such as the asymmetry in the duration of expansion and contraction phases (expansions last longer than recessions). **Reichlin** also replied to Bullard's point, arguing that the cycle is a robust feature of the data and needs to be investigated with a large degree of judgement from experts with diverse backgrounds and experience, as the CEPR business cycle committee does.

Jerome Henry (European Central Bank), who was in favour of dating the cycle, mentioned that information about past cycles could give us a benchmark estimate about the duration of

the current recession episode. He underlined that the relevant question to be answered in the middle of the current recession is when the recovery is going to start.

Finally, **Bullard** suggested that, rather than basing their description of the cycle in terms of two discrete states (recession versus expansion), a more interesting job for the dating committees would be to have a continuous indicator.

What are the main variables analysed by the NBER and CEPR dating committees?

Bob Hall (Stanford University) described the most important characteristics of the NBER dating methodology. On the one hand, he assured the panel of the NBER's commitment to the use of economy-wide measures of economic activity, like employment or GDP. When one disaggregates, he argued, there is a strong tendency to overweight the industrial sector. Second, recessions are defined in terms of declines in the level of those aggregate measures of economic activity. Thus, the simplicity of this definition of recession is very easy to transmit to the public, as opposed to the concepts of deceleration associated with declines in the growth rate, which do not play a role in the analysis.

Hall provided further information about the dating activity of NBER. First, he explained the reason why the committee dated a maximum in the level of economic activity in the last quarter of 2007, in spite of the fact that the GDP continued to grow over the next quarter. The key was that an alternative measure of economic activity that captures the supply side marked a clear peak in that quarter. That piece of quarterly information, combined with the maximum in a monthly measure of employment taking place in December 2007, provided the basis for setting the peak of the current recession precisely on that date.

Second, he proposed an informal way to assess the magnitude of the current recession. He showed a graph depicting that the decline in employment is larger in percentage terms than the decline in the severe recession that started in July 1981. However, the decline is smaller than in the recession that started in August 1929 (the Great Depression).

Lucrezia Reichlin (London Business School), member of the CEPR business cycle dating committee, started her talk by announcing that the euro area reached a peak in economic activity in the first quarter of 2008. She explained that the methodology followed by the CEPR dating committee uses the same definition of a recession as NBER, and its methods also involve an important degree of judgement from a group of nine top macroeconomists.

She explained that the euro area activity measured by the GDP peaked in the first quarter of 2008, while it took some time to be confirmed with employment figures. Employment peaked in the second quarter and did not show clear signs of contraction until the fourth quarter was published by Eurostat. Only then did the committee judge that it was time to declare a recession. Reichlin emphasized that, unlike in the US, monthly data for employment or personal income data are not available, and the identification of the month of the peak is subject to considerably more uncertainty. The committee found that the date of the peak was robust across the largest countries of the euro area.

On the Sources of the Business Cycle

Regarding the origin of the current recession in the US, **Bob Hall** (Stanford University) underlined that it may not be considered as a shock in the financial market. His main

argument was that durables consumption was already falling before the beginning of the financial turmoil. He suggested that it would be possible to think of an oil shock as the driving force that can be reflected in a slight drop of consumption durables, and then its effect over the rest of the economy is amplified by the current situation of the financial markets..**James Bullard** (FED St. Louis) agreed with Bob Hall that the role attributed to the financial turmoil in the current recession episode is being exacerbated, although its importance in the propagation is not questionable in his view. In addition, he worried about possible wealth effects derived from the strong decline in house and stock prices. He asked the representatives of the NBER and CEPR dating committees their views on the wealth effects of these persistent declines in asset prices. **Hall**'s answer was that dating committees only stare at the data to understand whether there is a recession or not, without addressing the type of question more related to forecasting. In addition, Hall argued that, since it is very difficult to understand the sources behind stock price fluctuations, we have no idea how much consumption is supposed to go down as a result of wealth effects. Therefore, he concluded, wealth effects do not provide an appropriate metric to look at recessions.

Domenico Giannone (European Central Bank) addressed to the panel discussants the following question: what is the nature of the different shocks behind the business cycle? **Bob Hall** replied that, 90% of the time, we do not know what to call the shock that drives the recession. Among the names given to the various shocks, we have monetary policy shocks, which are nowadays less important due to the more systematic conduct of monetary policy, and technology shocks. These shocks, as defined by Kyland and Prescott in 1982, do not seem to be behind the recessions in Hall's view. More tangible sources of business cycle fluctuations could be the shocks to the price of oil, which happen to be very high in the onset of recession, although, he recognized, it is not easy to explain why oil price declines are not followed by busts in economic activity.

Further discussion: Forecastability, the Great Moderation

Lucrezia Reichlin (London Business School) put emphasis during her intervention on her experience at forecasting. She explained that there is robust evidence on forecastability only in the very short run: (now)casts (the current quarter) and one quarter ahead forecasts. Regarding the very short run assessment of the economic conditions, **Bob Hall** (Standord University) commented on the large availability of data. He mentioned that the current information technology enables the collection of high-frequency data in real time, like electronic transactions, which are an immediate source of timely information. Therefore, he suggested to find ways to exploit such information as a starting point for the construction of better economic indicators or surveys. **Reichlin** also claimed that uncertainty does not seem to be so directly associated with the business cycle any more, but with specific events, like September 11 or the Lehman bankruptcy. Her argument was mainly based on a graph showing that the magnitude and dispersion of GDP forecast revisions has typically increased around recessions, while this is not the case over the last years, when very particular episodes have triggered important updates in the macroeconomic forecasts.

There was some discrepancy on the implications of the *great moderation.* In many of the papers presented in the workshop, the *great moderation* is described as a period of low volatility in macroeconomic time series that started in the mid eighties. **Bob Hall** recognized

that the variance of quarterly series like GDP has indeed decreased after the mid-eighties, but he argued that the relevant frequency for welfare is rather yearly. In his view, it is not so easy to see a great moderation in terms of the yearly frequency, what led him to conclude that it never existed, and the abrupt slowdown in economic activity we are currently experiencing is eclipsing that "*myth*". **Reichlin** argued that there is a puzzle associated to that *great moderation* period . Surprisingly, forecasting is nowadays a more difficult job than it used to be. More precisely, even if forecast errors are smaller on average after the reduction of volatility implied by the so-called *great moderation*, it is harder to outperform naïve forecasting models. In her view, the question of why this occurs remains unclear, but it could be related to changes in the covariance structure of the data.

Session VI – Uncertainty and the Business Cycle

Chair: Huw Pill (European Central Bank)

Learning and the Great Moderation

[PRESENTATION]

Aarti Singh (University of Sydney) presented the last paper of the workshop: "**Learning and the Great Moderation**", joint work with James Bullard. Singh started the presentation showing a picture of the evolution of US real GDP growth rate since 1955, to illustrate that the volatility of macroeconomic time series suffered a severe decline since the mid eighties (*great moderation)*. Singh claimed that a standard equilibrium business cycle model with technology following an unobserved two regimes switching process can provide a version of the so-called *good luck* explanation where learning plays an important role.
In the same spirit as in Kim and Nelson (1999), the unconditional variance of the stochastic process defining technology in Singh and Bullard's model is supposed to decline when recession and expansion regimes movecloser together, and (not because the variance of the shocks has decreased). Therefore, expansion and recession phases happen to become more similar (*good luck*), and agents face higher uncertainty about the actual state of the economy. But the key ingredient of Bullard and Singh's model is that agents learn about this change and react by moderating their behavior. The consequence is that the effect of the less volatile stochastic technology is reinforced by the learning effect and the variance of macroeconomic variables decreases more than proportionally. This idea was very clearly illustrated by a graph the ration between the standard deviation of output relative to the standard deviation of the shock as a function of the standard deviation of the technology process. While such function is a constant for both a version of their model with complete information and a benchmark RBC model, the model with incomplete information represents that ratio as an increasing function of the standard deviation of the technology process, which grows when the two states are more distant and there is less confusion.

In a benchmark calibration, 30% of the reduction in volatility is due to an increased difficulty faced by the economic agents to filter the true state of the economy, leaving the remaining 70% to be explained by a decrease in the variance of the process driving technology.

[DISCUSSION]

Michael MacMahon (Warwick University) argued that the results of the paper might be too much dependent on the the presence of two states. MacMahon wondered whether an additional state "in the middle" would not mitigate part of the moderation effect that the authors associate with learning. **James Bullard** replied that Kim and Nelson tried incorporating a third state and the results did not improve. **MacMahon** also raised an empirical issue. The paper of Singh and Bullard does not explore the possibility that the great moderation might imply a change in the covariance structure of the macroeconomy. **Lucrezia Reichlin** (London Business School) added that it is very interesting to relax the "good luck" story. However, **Reichlin** suggested that in her view, the 70% of the moderation explained by the *good luck* is too high, even if the transmission mechanism implied by the learning plays a crucial *moderating* role. On top of that, she explained that there is strong evidence that the size of the forecast errors has decreased in the post-moderation era, which goes against the increased uncertainty faced by the agent's in Singh and Bullard's model. **Singh** replied that their argument is based on Campbell (2007)'s evaluation of professional forecast errors, but the well-documented lags in the business cycle dating would go in the same line; there is higher uncertainty or increased confusion between boom and recession states.

Real Uncertain Business Cycles

[PRESENTATION 10]

Max Floetotto (Stanford University) presented the paper "**Really Uncertain Business Cycles**" (joint work with Nicholas Bloom and Nir Jaimovich). The model proposed by the authors explains the a large part of the business cycle fluctuations as the optimal response of agents to what they call *second moment* shocks, that is, changes in the level of aggregate macroeconomic uncertainty.

Floetotto started emphasing that the standard VAR framework of Christiano, Eichenbaum and Evans (2005), which includes ten key macroeconomic variables, can be augmented with an aggregate uncertainty index that captures cross-industry growth rate and sales dispersion, stock market volatility, dispersion in forecasts, and other proxies for uncertainty, which happen to be highly counter-cyclical. His results suggest that *uncertainty shocks* are able to result on significant drops of output, consumption and investment.

Next, Floetotto described a model, where uncertainty shocks are defined in terms of a time-varying variance of innovations to productivity. Therefore, a recession in their model may occur without a negative shock to technology (first moment shock). A second deviation of their model with respect to the benchmark Real Business Cycle (RBC) model is the existence of non-convex adjustment costs in both capital and labour, which makes expensive for firms to hire and then fire or invest and disinvest.

These two departures from the classical RBC model create a time-varying option value of waiting, which increases when uncertainty becomes larger. In addition, an increase in uncertainty reduces productivity growth. The mechanism is a lower expansion of productive firms and lower degree of contraction of unproductive firms, resulting on a smaller extent of reallocation in the economy.

Floetotto concluded that the next step of their project is to evaluate the performance of the model using establishment level data from the Census.

[DISCUSSION]

Frank Smets (European Central Bank) acted as a discussant. His first suggestion was to compute the percentage of variance explained by the *uncertainty shock* identified in the structural VAR analysis that motivates their model. Next, he said that understanding the driving force behind a recession is a relevant policy issue, since it is crucial to formulate a projection about its depth and duration.

The main critique of Smets was that uncertainty could be endogenous to a large extent. Therefore, he argued that the relevant issue is to understand the sources of this time-varying uncertainty, and how it affects the transmission mechanism. In particular, would it be able to explain the procyclicality of the financial system?

A similar analysis conducted with German data showed that uncertainty falls after productivity shocks and increases after demand shocks. An important difference with respect to the US is that the countercyclicality of uncertainty is not as stricking for Germany as for the US. **Lucrezia Reiclin** (London Business School) pointed out that the slower rebound of output in Germany than in the US after an uncertainty shock shown by Smets is in line with the CEPR findings for the euro area. **Jagjit S. Chadha** (University of Cambridge) added that misperceptions about risk could also be an important source of the business cycle.