EUROPEAN CENTRAL BANK

EUROSYSTEM

A guide to the Eurosystem/ECB staff macroeconomic projection exercises

Contents

1 Introduction and overview

Over the past 15 years, the forecasting procedures and techniques used for the Eurosystem/ECB staff macroeconomic projections have been subject to many changes and improvements, all aimed at contributing to the monetary policy decision-making process. The projections, conditioned on a set of assumptions, combine the use of models and other tools with the knowledge and judgement of economic experts. This guide presents the organisational and procedural framework in place in 2016 for the Eurosystem/ECB staff macroeconomic projection exercises, together with the associated techniques and tools.

The macroeconomic projections for the euro area and for the individual euro area countries play an important role in monetary policy decision-making as a tool for bringing together, systematically, information on current and future economic developments. As such, the macroeconomic projections constitute a key element of the economic analysis of the ECB's monetary policy strategy.

The outcome of the macroeconomic projection exercises conducted by Eurosystem/ECB staff is presented to the Governing Council as an input to its monetary policy deliberations. The Governing Council then makes its own overall assessment of the economic situation and outlook, as well as of the risks to medium-term price stability, using all the information available to it, including the Eurosystem/ECB staff projections.

An element of the Eurosystem/ECB staff macroeconomic projection exercises is the combination of both individual country and euro area-wide perspectives. Individual country-level assessments are prepared using the detailed knowledge and experience of both Eurosystem and ECB country experts. These country projections take into account the rich, but somewhat diverse, set of national data sources and incorporate the details of individual countries' institutional frameworks. The procedures behind the projection exercises are designed to fully integrate the country assessments into an overall euro area framework. They ensure that, through a well-structured and thorough interactive process, the final projections – both for the euro area as a whole and for the individual euro area countries – represent the Eurosystem/ECB staff consensus.

The Eurosystem/ECB staff macroeconomic projections for the euro area are published four times a year on the ECB's website. The projections published in June and December are prepared by Eurosystem experts from both the euro area national central banks (NCBs) and the ECB. The projections published in March and September are mainly the outcome of the ECB staff projection exercise, which primarily involves ECB staff experts, with NCBs' experts providing the short-term inflation projections.

The published figures include projections for inflation in terms of the Harmonised Index of Consumer Prices (HICP), for the growth rate of real GDP and its main expenditure components, and for a number of other important macroeconomic and

fiscal variables. The forecast horizon includes the current year and the following two to three years. The published projections are accompanied by a description of their main features and the factors driving them. In order to reflect the degree of uncertainty attached to such exercises, the projections for inflation and for real GDP growth are also published as ranges with the corresponding midpoints.

This guide describes the way in which the Eurosystem/ECB staff macroeconomic projections are produced in 2016. The previous version, "A guide to Eurosystem staff macroeconomic projections exercises", was released in June 2001, following the first publications of the Eurosystem staff macroeconomic projections. Many changes have been introduced since then: in September 2004, the Governing Council agreed to publish ECB staff macroeconomic projections; in June 2013, the Governing Council decided to publish the projections in the form of point forecasts, in addition to the previously published ranges; in December 2013, the material published was expanded to include additional macroeconomic variables, charts showing the quarterly profiles of HICP inflation and real GDP growth projections, together with the corresponding ranges, and a richer text explaining the key features of the projections; in March 2014, a two-year forecast horizon was published (previously only the December rounds of projections included a forecast horizon of this length); and in March 2016, the Governing Council decided that the macroeconomic projections prepared in the December rounds would include the current year and the three subsequent years.

Over the past 15 years, the economic environment has changed considerably. The macroeconomic projections framework has had to adapt to successive enlargements of the euro area, with more countries adopting the euro and thus participating fully in the projection exercises. In addition, following the recent sovereign debt and financial crises, new economic and policy issues have come to the fore in the last few years, including the use of non-standard monetary policy measures. The projection process has therefore had to be supplemented with new tools, approaches and analyses in order to assess the impact of these new developments on the macroeconomic projections.

In particular, new econometric models have been developed and other tools enhanced. Substantial work has been carried out in recent years on the development of a new generation of general equilibrium (Dynamic Stochastic General Equilibrium, DSGE) models and their use in the projection exercises. Since 2008 the New Area-Wide Model (NAWM) – a micro-founded open-economy DSGE model of the euro area – has been gradually phased into the forecast process. In addition, the blocks of the New Multi-Country Model (NMCM) – a large-scale estimated model – have been further enhanced. There has also been an ongoing review of techniques used for the short-term forecasting of economic activity and inflation in order to consolidate and further refine the existing tools. Efforts have been made to broaden the range of models used (including models with non-linearities), assess new methods (e.g. the use of forecast combination techniques) and, where possible, exploit new data sources (e.g. high frequency financial data or alternative sources of conjunctural information). Moreover, as an outcome of the lessons from the recent sovereign debt and financial crises, particular efforts have been made to improve the

financial aspects of the projection exercises, notably by projecting bank lending rates to households and to non-financial corporations, by projecting the external financing of the non-financial corporate sector and by including credit supply considerations. More recently, specific approaches have also been implemented in order to capture the impact of the ECB's non-standard monetary policy measures on the macroeconomic outlook.

Among the other numerous methodological and procedural changes introduced since 2001, of particular note are the improvements in the methods of risk assessment (Quantitative Risk Analysis, QRA) and the extension of the Basic Model Elasticities (BMEs) – the latter being a tool designed to enable timely updates of the projections. There have also been improvements to the global projections framework (new models for projecting developments in China, Japan and the United States), new foreign trade equations, a system of consistent trade flows and an improvement in the trade price equations.

Moreover, since 2001, new information and data have become available – in particular, Eurostat has released additional statistical series. These new series have allowed, for instance, more detailed projections of financial accounts for euro area sectors and an improvement in the balance of payment projections. Recently, the projection framework has been adapted to the new statistical standards of ESA 2010.
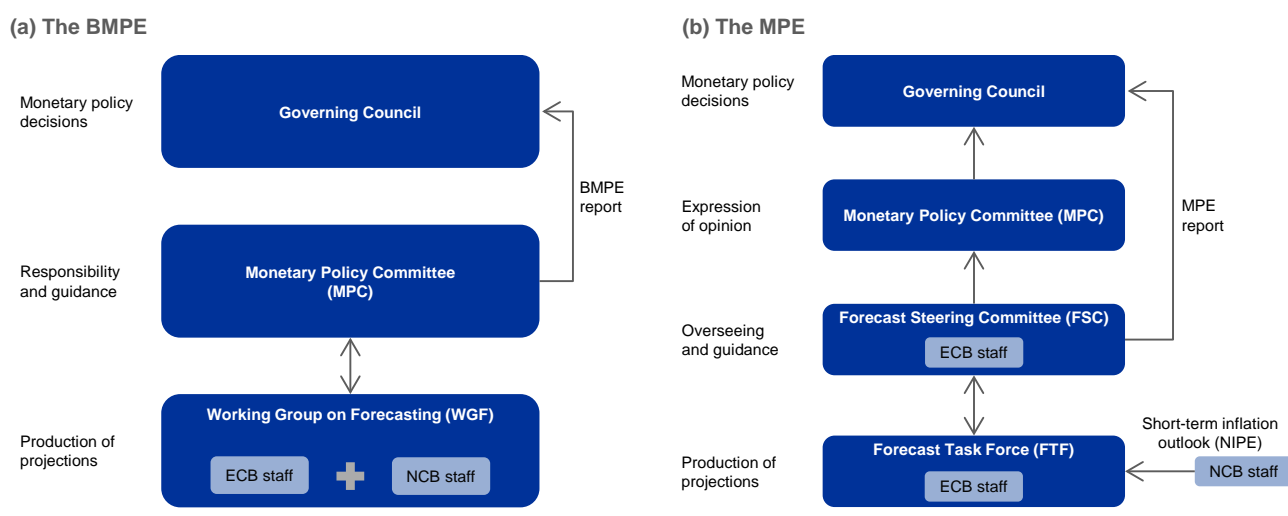
Overall, over the past 15 years, forecasting procedures and techniques have been subject to many changes and improvements given the changing economic and institutional environment of the euro area and the constant effort to remain at the forefront of economic research and techniques in order to improve the quality of the projections and thus contribute to monetary policy decisions.

2 An overview of the Eurosystem/ECB staff macroeconomic projection exercises

2.1 Main features of the organisational framework

There are two types of projection exercises conducted by the Eurosystem/ECB staff: the Eurosystem staff Broad Macroeconomic Projection Exercise (BMPE) and the ECB staff Macroeconomic Projection Exercise (MPE) (see Figure 1). In both exercises, NCBs provide the short-term inflation projections. In both the BMPE and the MPE, structured interaction among the relevant parties, organised in the form of sequential meetings, ensures that the country aggregate reflects the area-wide "story", alongside the individual country "stories" that experts consider valid in view of the underlying assumptions.

Figure 1

Organisational framework of the BMPE and the MPE

(a) The BMPE

Monetary policy decisions — Governing Council

Responsibility and guidance — Monetary Policy Committee (MPC)

Production of projections — Working Group on Forecasting (WGF) — ECB staff + NCB staff

BMPE report

(b) The MPE

Monetary policy decisions — Governing Council

Expression of opinion — Monetary Policy Committee (MPC)

Overseeing and guidance — Forecast Steering Committee (FSC) — ECB staff

Production of projections — Forecast Task Force (FTF) — ECB staff

Short-term inflation outlook (NIPE) — NCB staff

MPE report

(a) The BMPE

The BMPE is conducted twice a year and involves staff from both the euro area NCBs and the ECB. It delivers the short and medium-term economic outlook for the euro area and for the individual euro area countries, including short-term inflation projections by NCB experts (for more details on the latter, see Section 2.3). This exercise generates projections for a broad set of macroeconomic variables – overall HICP and its components, other key price and cost variables (such as deflators, unit labour costs and profit margins), real GDP and its components, labour market variables (employment, unemployment, compensation per employee and labour force), external trade (exports, imports and trade balances), fiscal variables

(government balances and debt), house prices and financial variables (such as lending rates and loans to households and non-financial corporations (NFCs)). For most countries and for the euro area, the frequency of the forecast series is quarterly. In the case of some smaller euro area countries, whose quarterly national accounts data are highly volatile and subject to notable revisions, the frequency of the projection figures is currently still annual. When aggregating to obtain the figure for the euro area, these annual figures are therefore interpolated.

The BMPE involves NCBs and ECB staff in a process that ensures that the euro area and individual country projections draw on all the expertise available and that there is consistency between the euro area and the individual country projections, reflecting a consensus among Eurosystem/ECB staff. The preparation of detailed figures for the macroeconomic projections for the euro area and for the individual euro area countries is undertaken by the Working Group on Forecasting (WGF) under the responsibility and guidance of the Monetary Policy Committee (MPC), which has "ownership" of the BMPE projection figures and finalises the projection report at a drafting session (see Figure 1a). The MPC comprises senior staff representatives of the NCBs and the ECB, while the WGF comprises NCB and ECB macroeconomic and econometric experts. The work of the WGF is complemented by contributions from two other working groups, which are also subgroups of the MPC. First, the Working Group on Public Finance (WGPF), which is mandated to provide projections for fiscal variables in the context of the BMPE.[1] Second, the Working Group on Econometric Modelling (WGEM), which focuses on econometric tools but whose work is not directly linked to the cycles of the projection exercises.

The projection figures, a discussion of the features of the exercise and special issues derived from the BMPE are compiled in the resultant BMPE report. The special features of the report are discussed in the WGF meetings and are agreed upon by the MPC. The report is drafted by ECB staff and is discussed and finalised by the MPC. This report is submitted to the Governing Council at its meetings in early June and December. An article based on the BMPE report is published on the ECB's website immediately after the press conference following the respective meetings of the Governing Council.

(b)   The MPE

Like the BMPE, the MPE is conducted twice a year and delivers the short and medium-term economic outlook for the individual euro area countries and the euro area, the latter being consistent with the country aggregation. It covers the same variables as the BMPE but is produced mainly by ECB staff, with NCBs only contributing the short-term inflation projections[2]. As with the BMPE, for most countries and for the euro area the frequency of the forecast series is quarterly.

The Forecast Task Force (FTF), a group comprising experts from a wide range of business areas within the ECB, is responsible for the production of the projection

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[1]   The WGPF also contributes to the development of standard indicators and analytical tools for assessing fiscal developments, including those having an impact on the fiscal stance in the euro area.

[2]   In the MPE, ECB staff updates the house price projections provided by NCBs in the previous BMPE.

figures. Guiding the work of the FTF is the Forecast Steering Committee (FSC), which consists of ECB managers (see Figure 1b).

ECB staff is responsible for compiling the resultant MPE report, whose structure is the same as the BMPE report. The MPE report is presented to the MPC, whose Chair conveys the Committee's opinion on the outcome of the exercise in the form of a letter to the President of the ECB. The report and the related letter by the Chair of the MPC are subsequently submitted to the Governing Council at its meetings in early March and September. As with the BMPE, an article based on the MPE report is published on the ECB's website immediately after the press conference following the respective meetings of the Governing Council.

2.2 Additional organisational features of the BMPE and the MPE

(a) The assessment of risks around the baseline projections

In the BMPE and the MPE, the MPC and ECB staff (FSC), respectively, prepare their own assessment of risks around the baseline projections. This assessment is set out in a dedicated section of the BMPE and the MPE report (see Section 3.5 for further details). It should be noted that this assessment of risks is not necessarily that of the Governing Council, which is based on a broader assessment and communicated by the President of the ECB in the Introductory Statement at the press conferences after the Governing Council meetings.

(b) The Narrow Inflation Projection Exercise (NIPE)

In both the BMPE and the MPE, NCBs provide short-term forecasts for overall HICP inflation and its key components (unprocessed food, processed food, non-energy industrial goods, energy and services) for their respective countries, with a monthly frequency, over a horizon of 11 months. ECB staff aggregates these individual country inflation figures in order to obtain the euro area inflation path. NCBs also provide other information, such as the impact of changes in net indirect taxation and in administered prices on overall HICP inflation in their countries, projections for tobacco prices and detailed information on the projections for energy prices. The key purpose of this exercise is to provide a better and more detailed understanding of short-term inflation developments and the factors that determine the monthly path of the inflation dynamics, as seen at the individual country level. This exercise helps separate transient inflationary shocks from persistent changes in the underlying path of inflation and therefore helps to better assess the medium-term inflation outlook. This exercise is called "narrow" because it only entails inflation projections over a shorter forecast horizon.

The monthly inflation figures produced in this exercise are fully consistent with the quarterly inflation figures of the BMPE and the MPE for the overlapping period of the NIPE. The results of the NIPE are included in the NIPE report, which is attached to the BMPE and the MPE reports. The NIPE report provides a description of the

factors that drive the forecasts for overall HICP inflation and its key components over the short term.

2.3 Main procedural steps for preparing the projections

There are three main steps in the production of the Eurosystem/ECB staff macroeconomic projections (see Figure 2). The first step consists of a number of preparatory elements, including setting up the technical, financial and fiscal assumptions underlying the exercise, generating the projections relating to the global outlook, assessing the conjunctural situation and the short-term outlook for the euro area as a whole and for the individual euro area countries, as well as identifying key projection issues. In the second step, the macroeconomic projection figures are derived following a process of reviewing the area-wide and country figures, together with numerous projection consistency checks. The final step is to prepare the report for the Governing Council and to publish the projections.

The projections production process is coordinated by Forecast Administration, a small group of experts in the ECB's Directorate General Economics. Forecast Administration also comprises the FTF and the WGF secretariats, and contributes to resolving any issues that may arise during the projection process.

Figure 2

The main procedural steps for the production of the BMPE and the MPE
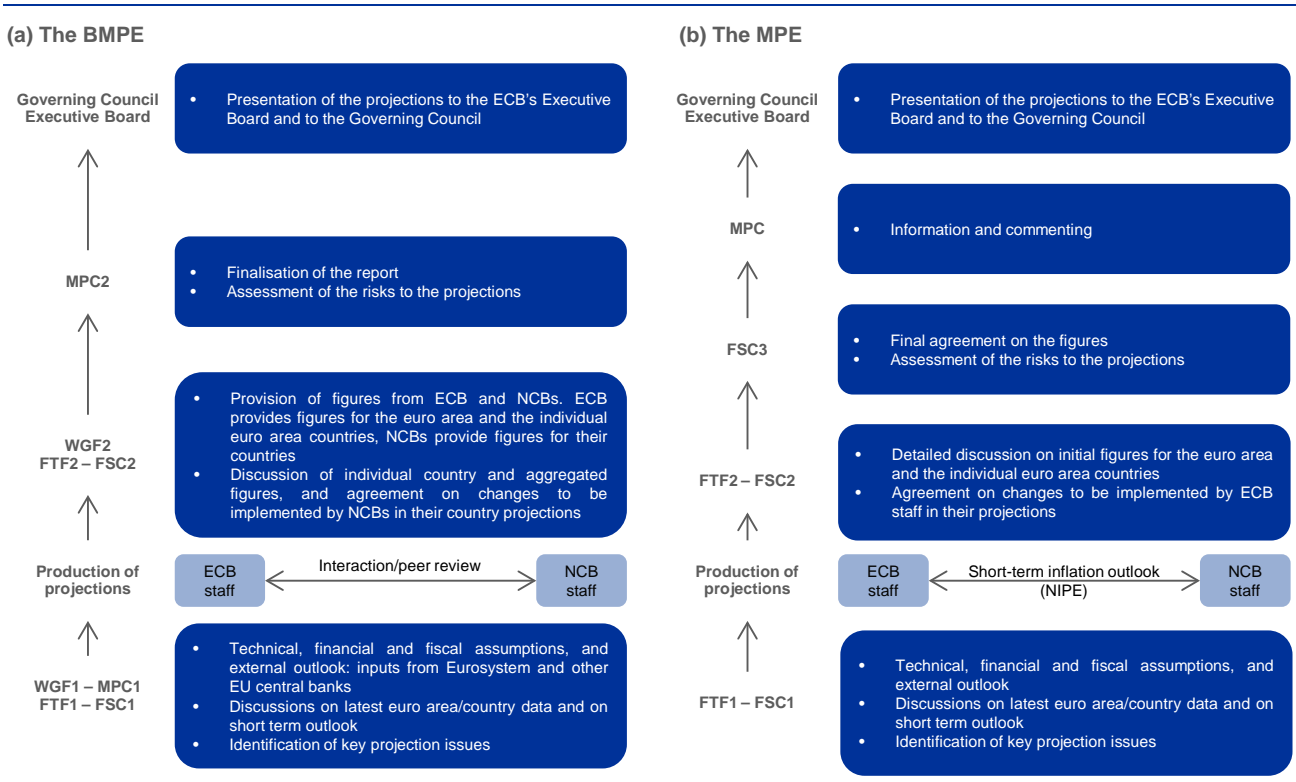
Notes: The numbering used after the name of a group (MPC, WGF, FSC and FTF) refers to the first, second or third meeting of that group.

Step 1: Preparing the starting point of the exercise

At the beginning of every projection exercise, whether the BMPE or the MPE (see Figure 2), a set of initial technical assumptions is derived on the basis of a previously agreed methodology, covering market interest rates (short, long and global rates), oil prices, exchange rates, stock market prices and international non-oil commodity prices. Projections for the international environment – including the main global economies – and for euro area foreign demand are also prepared. In the BMPE, some NCBs provide input regarding the external environment of the euro area. The assumptions are regularly reviewed and updated in the course of the exercise until the final cut-off date, which usually falls around three weeks before the presentation of the BMPE or MPE report to the Governing Council. At the start of the exercise, an assessment of the conjunctural situation and short-term outlook for the euro area and the individual euro area countries is made. Additionally, fiscal experts provide initial preliminary fiscal assumptions. Finally, key issues to be reflected upon during the projection process are identified.

In more detail, **in the case of the BMPE**, Step 1 entails sequential meetings of the FTF, FSC, WGF and MPC. At the first meeting of the FTF (FTF1 in Figure 2a), the technical, financial and fiscal assumptions, as well as the global outlook, are discussed. Subsequently, the FSC, at its first meeting (FSC1), reviews these inputs and makes its own suggestions, which the FTF takes on board. The technical and financial assumptions prepared by the FTF are then submitted to the WGF and discussed at its first meeting (WGF1). In parallel, fiscal projections are discussed in the WGPF. Moreover, the short-term outlook for the euro area and the individual euro area countries, as well as the key projection issues, are prepared. The MPC, at its first meeting (MPC1), reviews these inputs and makes its own suggestions for the WGF to take on board.

As regards **the MPE**, Step 1 entails only the FTF1 and FSC1 meetings referred to above, see Figure 2b.

Step 2: Deriving the macroeconomic projections

(a) In the BMPE

After ECB and NCB staff has reached agreement at a meeting of the WGF on the initial technical assumptions, the short-term outlook and the key projection issues, the parties separately prepare their initial projection figures (see Figure 2a). Each NCB prepares an initial projection for its country (including the short-term inflation projections for the NIPE), while ECB staff prepares an initial set of projections for the euro area and the individual euro area countries, the former being consistent with the aggregate of the ECB staff individual country projections. The ECB staff country projections provide a basis for discussing the country projections prepared by the NCBs, which are aggregated by ECB staff to form the final projection for the euro area. All the resulting figures are documented and elaborated upon in accompanying notes following a standardised format. The NCBs' initial country projections and their

aggregation are discussed within the WGF, along with the initial country and area-wide projections prepared by ECB staff.

In particular, the preparation of the final projection figures involves the following three elements:

1. A **euro area overview** of the figures and the implicit judgements that these figures embody. The euro area overview of the figures is based on the comparison of the initial ECB euro area projection with the aggregate of the NCBs' initial country projections. This comparison includes, inter alia, an analysis of the differences between the initial euro area figures derived by ECB staff and the aggregated NCB staff projections. The revisions vis-à-vis the previous exercise are also discussed with a view to identifying the key factors behind them – for instance, whether they are driven by new historical data, changes in the assumptions or changes in judgement. This exercise provides a framework for the subsequent discussion of individual country projections.

2. A **peer review** (involving NCB and ECB staff) of individual NCB country projections in order to reach consensus on the final projection figures for individual countries, bearing in mind the issues raised at the area-wide level, as explained above. Detailed discussions of individual country projections are carried out within the WGF. Adjustments agreed upon are subsequently implemented by the NCBs for their respective countries. Two iterations are usually required to obtain a set of final NCB country projections, but additional iterations may also be carried out if needed. The final euro area macroeconomic projections are the product of the aggregation of the finalised country projections. The emergence of a clear and plausible euro area story (or narrative) that is shared by all NCB and ECB contributors is the outcome of the exercise.

3. **Technical exercises** to ensure the mutual consistency of the projection figures for the individual euro area countries. A trade consistency exercise is performed to ensure consistency between the projected trade volumes and prices of the individual country projections. This exercise is repeated in the later stages of the projection process. A financial consistency exercise is also carried out to assess the overall consistency of projected financial developments (such as loan developments to households and NFCs) with the non-financial projections (such as private consumption and business investment).

In more detail, the FTF, under the supervision of the FSC, prepares the initial ECB staff projections for discussion with the NCBs within the WGF. These initial country figures and the corresponding euro area aggregate are reviewed and discussed by the FTF at its second meeting (FTF2), and are subsequently reviewed by the FSC at its second meeting (FSC2).

Following the production of the first set of forecasts by NCB and ECB staff, and before the second meeting of the WGF (WGF2), a peer review takes place in the form of a series of teleconferences. At each teleconference a specific country's projection is discussed, a process which involves the respective NCB, the ECB

country expert and another NCB, acting as a reviewer of the country in question. The discussion focuses on the NCB projections, but comparisons are made with the ECB staff country projections and the area-wide issues that have been identified. Clear follow-up steps are agreed upon.

In the second meeting of the WGF (WGF2), the emerging euro area picture is reviewed and the group is informed about the outcome of the peer review teleconferences described above. Any unresolved issues from these teleconferences are discussed. Fiscal experts also provide consistent fiscal projections (taking into account the link between the macroeconomic outlook and fiscal developments). The WGF agrees on any necessary final amendment of the country figures. Subsequently, the NCBs implement the agreed changes for their countries and send the final country figures to the ECB, which performs the final euro area aggregation. The MPC finalises the BMPE report, on the basis of a draft prepared by ECB staff, during its second meeting (MPC2), which takes place once the final figures have been agreed. The members of the MPC are also responsible for the assessment of risks to the projections.

In addition to preparing the projections, ECB and NCB staff also carry out a number of background analyses, considering in detail specific important technical, analytical and structural issues that are relevant to the projection exercise. The most relevant parts of this background work are summarised in the BMPE report as special features.

(b)   In the MPE

In the context of the MPE, a very similar, albeit less elaborate, process is followed. ECB staff prepares a set of projections for both the euro area and the individual euro area countries, the former being consistent with the aggregate of the individual country projections, while NCB experts deliver short-term inflation projections (see Section 2.2b on the NIPE). The figures are reviewed and discussed in meetings of the FTF and FSC (see Figure 2b). The FTF is, under the guidance of the FSC, responsible for the production of the projections. It specifically deals with all related technical aspects and, in particular, with the production of projection numbers, the drafting of the accompanying report and proposals concerning the techniques used for these purposes. The process is reviewed at various stages by the FSC, which is responsible for overseeing the production of the ECB staff projections. For this purpose, the FSC regularly provides feedback and guidance to the FTF, both on the projections and on the nature of the techniques used. The FSC is also the forum in which issues not resolved at the level of the FTF are addressed. Members of the FSC are also responsible for the staff assessment of risks to the projections baseline. As with the BMPE, a number of technical exercises are undertaken to ensure the mutual consistency of the projection figures for the individual countries.

In more detail, in the second meeting of the FTF (FTF2), the emerging euro area picture, based on the aggregate of the initial country figures, is reviewed and discussed. The FTF agrees on any necessary amendments of the figures, making concrete suggestions for the individual euro area countries. The second meeting of the FTF covers both the euro area and the euro area countries. Fiscal experts also

provide consistent fiscal projections (taking into account feedback between macroeconomic and fiscal developments). At the second FSC meeting (FSC2), which takes place after the FTF2 meeting, the figures are discussed and further comments, to be subsequently taken up by the FTF, are discussed. At the third meeting of the FSC (FSC3), the committee either confirms the final figures or suggests small revisions and discusses the risks to the projections.

As with the BMPE, in addition to the preparation of the projections, ECB staff produces a number of background analyses, the most relevant parts of which are summarised in the MPE report as special features.[3]

Step 3: The report and communicating the projections

The outcome of the projection exercises is summarised in a number of documents that are available only within the Eurosystem. The main document is either the BMPE report or the MPE report, which are structured in the same way. The reports include parts on the real economy and labour markets, prices and costs, the assessment of risks as seen by staff (described in detail in Section 3.5) and key cross-country themes. The reports also contain a number of special features focusing on topical issues relevant to the projections and, occasionally, ad hoc alternative scenarios. In order to illustrate the uncertainty surrounding the projections, the reports also include sensitivity analysis simulations (described in detail in Section 3.5). In addition, since December 2010, the reports include a Medium-Term Reference Scenario (MTRS) for economic activity and inflation in the euro area, which extends the BMPE and MPE baseline by five years. The reports also contain a review of the technical assumptions underlying the projections, the outlook for the international environment and the fiscal outlook.[4] A separate report that details the results of the NIPE (see Section 2.2b) is attached to the main document. The NIPE report describes, in detail, the short-term dynamics of inflation in the euro area, with explanations for each of the main HICP components. It also assesses cross-country short-term inflation dynamics, as well as the latest NIPE projection errors and their underlying factors.

The BMPE and MPE reports include a very detailed statistical annex, which sets out, inter alia, the euro area projections and the projections for each euro area country, as well as a model-based analysis of the baseline projections, fiscal sensitivity analyses and standard simulation results. There are also detailed monthly inflation projections for the euro area and for the individual euro area countries in the attached NIPE report.

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3   The main procedural features of the forecasting process, as outlined in Section 2.3 (namely using a common set of assumptions, formulating individual country forecasts before aggregating them and checking for consistency), are similar to those in the projection exercises of other international institutions, such as the European Commission, the IMF and the OECD. A combination of top-down and bottom-up approaches, as with the BMPE and MPE, also appears to be a common feature of the forecasting process in the main international organisations that produce global forecasts.

4   The WGPF prepares the Public Finance Report (in June) and the Autumn Fiscal Policy Note (in December), which contain, among other items, a detailed description of the fiscal projections as part of the BMPE.

The BMPE and MPE reports are supplemented by the International Environment Outlook (IEO) report, which provides a detailed assessment of the global outlook. The IEO presents an assessment of the world economy and of the largest economies outside the euro area. It also analyses developments in global trade and the prospects for euro area foreign demand, as well as the outlook for global inflation. Finally, it discusses the risks underlying the global baseline projections. The IEO contains a number of boxes focusing on topical issues and, occasionally, certain ad hoc scenarios.

After the finalisation of the BMPE and MPE reports and the accompanying material, ECB staff presents the projections to the Executive Board. Subsequently, in the case of the BMPE, the Chairperson of the WGF gives a presentation of the Eurosystem projections to the Governing Council, while in the case of the MPE, it is the Chairperson of the FSC who gives a presentation of the ECB staff projections to the Governing Council.

While the documents described above are only available within the Eurosystem, an article about the projections is published on the ECB's website immediately after the press conference given by the ECB's President, following the monetary policy meeting of the Governing Council.[5] This publication, which is a condensed version of the internal BMPE or MPE report, comprises projections for the euro area covering a wide set of macroeconomic variables – overall HICP, some of its components, other key price and cost variables (compensation per employee, unit labour costs), real GDP and its components, labour market variables, external trade and fiscal variables. The results of key sensitivity analyses, as well as comparisons of the projections with those of other institutions, are also included. Besides the point projections published for HICP inflation and real GDP growth, the ranges for these two key variables are also made available in order to provide a measure of uncertainty surrounding these projections. The ranges are calculated by considering the magnitude of previous projection errors, i.e. the difference between actual outcomes and previous projections carried out over a number of years. The width of the ranges is twice the average absolute value of these differences.[6] As such, the ranges do not provide information on the balance of risks around the baseline.

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[5] Since 2015 all NCBs have published their own national projections. In some cases these national projections reflect the NCBs' input to the most recent BMPE, while in other cases the national projections may deviate from the most recent BMPE, especially if they are published with a significant time lag. Links to NCBs' national projections are also available on the ECB's website. In addition, from June 2016 onwards, the individual country projections underlying the BMPE for real GDP, HICP and the unemployment rate will also be published on the ECB's website.

[6] The method used for calculating the ranges is documented in "New procedure for constructing Eurosystem and ECB staff projection ranges", ECB, December 2009, available on the ECB's website.

3 The techniques and projection tools used in Eurosystem/ECB staff macroeconomic projection exercises

3.1 Approaches and tools used for setting the underlying assumptions

In line with the evolving nature of the whole forecasting process, the approaches used for setting the underlying assumptions are regularly reviewed.

The **exchange rate** (both the bilateral EUR/USD exchange rate and the nominal effective exchange rate of the euro against the currencies of the euro area's 19 or 38 most important trading partners) is assumed to be constant over the projection horizon and is set to be equal to the average value of the exchange rate over the ten business days preceding the cut-off date. The ten-day average value is used to smooth out possible volatility. It should be noted that the exchange rate assumptions are purely technical and do not in any way constitute a forecast for future developments in the exchange rate of the euro or an assessment of its appropriate level.

The **oil price** assumption is derived as the average value of the futures price of Brent crude oil as reported over the ten business days up to the cut-off date. As with the exchange rate, the ten-day average value is used to smooth out possible volatility in oil prices.

International food commodity price assumptions are based on the ten-day moving average of the prices of futures contracts over the entire projection horizon. EU farm gate prices (in euro), which are used for forecasting food consumer prices in the euro area, are projected on the basis of an econometric model that takes into account the expected developments in international food commodity prices.

As for the assumptions regarding **non-energy hard commodity prices**, they are assumed to follow futures in the short term, as most such futures contracts expire in the near future. Thereafter, they are assumed to develop in line with global economic activity.

The **short-term interest rate** assumptions are based on market interest rates (three-month EURIBOR). It is assumed that short-term interest rates evolve in line with the prevailing market expectations, derived from futures rates, at the cut-off date.

The assumption for the **euro area ten-year nominal government bond yields** is based on the average of countries' ten-year bond yields, weighted by annual nominal GDP figures. For countries for which relevant data exist, the country-specific ten-year nominal government bond yields are defined as the ten-year benchmark

government bond yields, prolonged with the forward par yields derived, at the cut-off date, from the corresponding country-specific yield curves. For other countries, the country-specific ten-year government bond yields are defined as the ten-year benchmark government bond yields, prolonged with the constant spread observed at the cut-off date over the technical risk-free euro area long-term interest rate assumption. The technical risk-free euro-area long-term interest rate assumption is defined as the spot and forward rates derived from the euro area swap curve.

As regards **stock prices**, the technical assumptions for future developments in euro area stock prices are based on synthetic futures prices for the EURO STOXX index.

To capture the cost of financing of the private sector, Eurosystem/ECB staff also project **bank lending rates**. The lending rate projections are constructed for six euro area aggregate bank lending rates, namely short and long-term rates for NFCs and for households – with the latter split into lending rates for housing and consumption purposes. The country-specific bank lending rates are derived on the basis of error correction models estimated at the country level. The aggregation of bank lending rates at the country level by maturity and sector is computed using weights based on new business volumes. However, since these weights bring about some non-negligible volatility, a moving average over the previous 24 months is applied in order to filter out excessive monthly fluctuations in loan transactions. The aggregation of the country-specific composite lending rates to construct cost of lending indicators at the euro area level is based on country weights, reflecting a 24-month rolling moving average of new business volumes.

In addition to the cost of financing projections, the assessment of **credit supply conditions** and their impact on economic activity is an important element in the projection exercises. Three distinct, yet complementary, analytical approaches are used by ECB staff to assess credit supply conditions for the euro area as a whole.

The first approach employs macroeconomic models using "hard data", such as loans and other macroeconomic variables. This approach is based on two specifications: a DSGE framework with financial frictions (see Darracq-Pariès et al., 2010), which reflects structural relationships among variables as dictated by economic theory, and a structural VAR[7] with sign restrictions, which is mostly driven by observed data patterns.

The second approach relies primarily on data from the balance sheets of euro area banks, with the aim of gauging their deleveraging needs. In doing so, the underlying assumption is that banks choose to downsize their assets (including loan books) to achieve a target capital ratio, while maintaining their dividend ratios in line with historical averages. Using information from the balance sheets of a set of euro area banks, the estimate for the capital shortfall (i.e. the gap between the target and the actual capital ratio) is extrapolated to the whole euro area banking sector. The macroeconomic impact of closing the capital shortfall is derived either *directly* via the DSGE model of the euro area economy referred to above or *indirectly*, first, by

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[7]   In VAR (vector auto-regressive) models, every endogenous variable is modelled as a function of its own lagged values and the lagged values of all the other endogenous variables in the system.

computing the effects of the capital shortfall on the loan supply using panel estimates (see Maurin and Toivanen, 2012) and, second, by simulating the loan supply effects on real GDP growth with the DSGE model.

The third approach makes direct use of information from the euro area bank lending survey conducted by the ECB, since the survey also provides information about expected future developments in credit markets. In order to exploit the cross-sectional information generated by the individual euro area country survey results, a country-panel VAR is employed. The identification of credit supply shocks follows the approach of Darracq-Pariès and De Santis (2013).

In the BMPE, NCBs also provide their own assessments of credit supply conditions and the corresponding impact on economic activity for their countries. To estimate the effects of credit supply conditions, most NCBs use a Bayesian VAR model together with other models and expert judgement.

In the course of 2015 and 2016, the Governing Council decided to implement a series of **non-standard monetary policy measures**. In particular, in January 2015 the expanded asset purchase programme (APP) was launched, which was further enhanced in December 2015 and in March 2016. The non-standard monetary policy measures not only affect the macroeconomy on account of their impact on the technical financial assumptions (such as long and short-term interest rates and the exchange rate) but also through additional financial transmission channels (such as a portfolio rebalancing channel, certain expectational channels and real-financial feedback loops), which are not normally captured by the standard modelling framework used in the projection exercises. Therefore, the projection baseline derived via the standard modelling framework is augmented to reflect the results of "satellite" models that better capture such additional financial channels.

To capture the effects of the **international environment** on the euro area, ECB staff also makes projections for the global economy, focusing on forecasts for global output, trade and inflation. Global projections are primarily a bottom-up exercise, in which individual country and regional forecasts are aggregated to arrive at global projections.[8] For instance, global real GDP growth and inflation projections are derived by aggregating individual country and regional GDP growth and inflation projections on the basis of GDP weights (at purchasing power parities) published by the IMF. Global trade projections are derived by aggregating projections of imports using import value weights at market exchange rates. To compute the external demand for euro area exports, projections of imports by the euro area trade partners are also weighted according to their importance as destinations for the euro area exports (i.e. by the share of each country in extra-euro area exports).

Projections are made for the world's largest economies outside the euro area, including all large advanced and emerging economies. For the remaining countries, forecasts are made for regional aggregates. For all these countries and regions, projections are made for certain variables, such as GDP, real imports and exports,

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[8]   Changes in the euro area outlook during the projection process also have an impact on the global environment by affecting foreign demand of the countries outside the euro area.

import and export prices, and inflation. However, for the larger countries, which are particularly important for assessing the global outlook, the forecasts involve an assessment of a wider range of economic variables.

In the case of the BMPE, global projections are agreed by the WGF. An initial assessment by ECB staff is discussed together with contributions from the NCBs, which also reflect specialist knowledge at some NCBs concerning certain non-euro area economies and regions. The NCBs of those EU countries not participating in the euro area also contribute to these WGF discussions, although they do not take part in the subsequent macroeconomic projection exercise. In the MPE, the projections for the international environment are prepared by ECB staff and are reviewed and discussed in the sequential meetings of the FTF and the FSC.

The projections for **fiscal variables** in the BMPE are carried out under the responsibility of the WGPF; for the MPE the responsibility for the fiscal projections lies with ECB staff. The fiscal projections are fully consistent with the macroeconomic projections and take into account the most recent information, e.g. the latest data releases, budget laws, supplementary budgets, and stability and convergence programmes. The fiscal projections incorporate only those measures that have been approved by the national parliaments or that have already been defined in sufficient detail and are likely to pass the legislative process. For expenditure items that are mostly determined by discretionary decisions (for instance, subsidies, purchases of goods and services, and public investment), a "most-likely" norm is preferred to a simple extrapolation of the past. The fiscal projections in the BMPE and the MPE are independent of governments' official forecasts.

3.2   Tools and models used for deriving and assessing the projections

Models and econometric tools in general play a key role in the Eurosystem/ECB staff projection exercises. They provide a clear accounting framework (identities) and a medium-term path for the economy based on estimated historical relationships (behavioural equations). Models can also help tell "stories", in terms of driving forces and dynamics for the outlook, and they are also very useful for conducting alternative scenarios. However, all models are necessarily a simplification of reality and their results need to be complemented by the impact of factors that are not and/or cannot be included in the model structure. This implies the need for expert judgement. So, while the Eurosystem/ECB staff projection exercises are model-based, the final projections may incorporate a fair amount of expert judgement. An effort is made in the projection exercises to clarify and quantify the judgemental calls made by staff and to provide explanations for the reasons that may have led to departures from the pure model-based outcome.

While ECB and NCB staff use a variety of approaches to project economic developments, these approaches are reviewed on an ongoing basis and joint efforts are made to further develop and improve the macroeconomic projection tools.

3.2.1 Tools and models used by the ECB

3.2.1.1 Main macromodels used by the ECB

The **New Area-Wide Model** (NAWM) (see Christoffel et al., 2008) is a micro-founded open-economy DSGE model of the euro area, which in 2008 replaced the previous Area-Wide Model (AWM) (see Fagan et al., 2001). The NAWM is neo-classical in nature and is centred around the intertemporal decisions of households and firms that aim to maximise their expected life-time utility and the expected stream of profits respectively. As a result, forward-looking expectations play a key role in influencing the adjustment dynamics of both quantities and prices, while changes in supply-side factors have a pronounced impact already in the short run. At the same time, in order to ensure that some Keynesian features prevail in the short run, the NAWM includes a number of nominal and real frictions that have been identified as empirically important, such as sticky prices and wages, habit persistence in private consumption and adjustment costs in private investment. Moreover, the NAWM incorporates frictions relevant in an open economy setting, including local currency pricing (giving rise to imperfect exchange rate pass-through in the short run) and the costs of adjusting trade flows.

The NAWM is designed to be used for policy analysis and for projection purposes. In view of this dual objective, a parallel development strategy has been pursued: a calibrated version, relatively rich in detail and open for topic-driven extensions, has been developed to analyse a broad range of policy issues by means of simulations, while a more parsimoniously specified version has been estimated using Bayesian techniques for projection purposes. In particular, the estimated version of the NAWM has been guided by two important considerations, namely to provide a comprehensive set of projections for core variables and to allow conditioning on monetary, fiscal and external developments. The NAWM entails 18 key macroeconomic variables, including real GDP, private consumption, total investment, government consumption, imports and exports, a number of deflators, employment and wages, and the short-term nominal interest rate. The nominal effective exchange rate, euro area foreign demand, euro area competitors' export prices and oil prices capture the influence of external developments. Consistently with the number of variables, 18 structural shocks are considered in the estimation process. These shocks have an economic interpretation that helps to classify the sources of the observed fluctuations in the data and to assess the baseline projections in the Eurosystem/ECB staff macroeconomic projections.

The NAWM is used in a number of ways in the projection exercises. As the euro area picture emerges from an aggregation of individual country forecasts (produced either by NCBs or by ECB country experts), the NAWM is used to interpret these euro area figures and to help build a related area-wide "story". Moreover, the NAWM is also widely used for policy simulations, alternative scenarios, sensitivity analyses and for extending the projection baseline to prepare a euro area MTRS.

The **New Multi-Country Model** (NMCM) (see Dieppe et al., 2011a and 2011b) is a large-scale estimated model covering the five largest euro area countries (Germany, France, Italy, Spain and the Netherlands)[9]. It also entails a block covering the smaller euro area countries. It has firm microeconomic foundations and can be characterised as a micro-founded New Keynesian model. The expectations formation is treated explicitly so that the model can be simulated under rational model-consistent expectations or under learning expectations. Under the learning expectations regime, agents form their expectations according to a learning rule, which in the NMCM is model-consistent and has stable properties.

The key features of the NMCM are as follows:

- The theoretical core of the model consists of three optimising private sector decision-making agents, i.e. utility-maximising households, profit-maximising firms and trade unions, which minimise the quadratic loss function under the staggered wage adjustment assumption. Monopolistically competing firms set prices, inventories and the demand for factors of production under the assumptions of indivisible labour. In the short run, output is demand-determined. Monopoly unions set wages and overlapping generation households make consumption/saving decisions.

- The production function is the normalised CES (Constant Elasticity of Substitution), allowing for a non-unitary elasticity of substitution, non-constant augmenting technical progress and heterogeneous sectors with differentiated price and income elasticities of demand.

- The behavioural equations and the production function are estimated on the basis of quarterly national historical data from 1980 onwards.

- In the linked version of the model, cross-country linkages occur through four channels: trade volumes; trade prices; common monetary policy and a common exchange rate.

- Its country-blocks can be used either on a single country basis (mainly for forecasting purposes) or as a linked euro area multi-country model (especially for policy analysis).

- The model can be run either under rational expectations (mainly for policy analysis) or under learning expectations (both in forecast and in policy analysis).

The model is used by ECB staff to prepare projections for the large euro area countries, both in the BMPE and, more especially, the MPE. The model is also used for policy simulations, alternative scenarios, sensitivity analyses and to extend the projection baseline when preparing country-specific MTRS.

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[9]   The previous version of the Multi Country Model is documented in the following papers: Vetlov, Warmedinger (2006), Boissay, Villetelle (2005), Estrada, Willman (2002), Angelini, D'Agostino, McAdam (2006) and Angelini, Boissay, Ciccarelli (2006).

3.2.1.2 Other tools and models used by the ECB

- **Projection platforms and models for smaller euro area countries.** For each of the smaller euro area countries (those not covered by the NMCM), there is a specific projection platform. These platforms encompass identities, calibrated equations and certain calibrated ratios. Over the last few years, there has been an ongoing project aimed at developing, estimating and calibrating a simple econometric structural model for each of the smaller euro area countries, with the contribution of the respective NCBs. The goal is to improve the current platforms by delivering an efficient tool for the production of short to medium-term forecasts and to provide a consistent analysis of the behaviour of the key macroeconomic variables under alternative scenarios.

- **Tools for short-term forecasts of real GDP developments and its main expenditure counterparts** for the euro area, the euro area countries and some non-euro area countries.

  - Information from high frequency (e.g. monthly or daily) and timely economic indicators is used to derive early estimates of developments in real GDP (and its components) over the following two quarters. The early estimates are currently primarily based on models of the bridge equation type, as mixed frequency factor models (previously in use) turned out to be somewhat less robust to structural changes. In particular, bridge equations link the target low-frequency variable (e.g. quarterly real GDP growth) to some higher-frequency predictors (e.g. monthly industrial production or monthly survey information) aggregated to the lower frequency. These predictors are in turn forecast using multivariate models, such as (Bayesian) vector autoregressions or dynamic factor models (at a higher frequency, such as monthly) (see Angelini et al., 2008a and 2008b; Hahn et al., 2008).

  - The early estimates of euro area GDP rely mainly on developments in industrial production, European Commission opinion surveys and the Purchasing Managers' Index surveys. The country early estimates also rely on specific national sources.

  - By delivering quantitative estimates of real GDP growth ahead of the release of the flash estimate by Eurostat, these early estimates are used as a valuable input to the monitoring of euro area and euro area countries' macroeconomic developments and to the projection exercises. They are also used to assess the macroeconomic "news" since the completion of the previous projection round.

  - The difference between the early GDP estimates and the projections is that the former are purely mechanical while the latter include additional information and judgement.

  - Another tool for short-term forecasting is the Area-wide Leading Indicator (ALI) (see De Bondt and Hahn, 2014), which aims to detect turning points

in the euro area growth cycle. The ALI is computed as an un-weighted average of the cyclical components of nine series that are seen as having leading indicator properties (ten-year government bond yields, stock prices, the US unemployment rate, real M1 growth, German Ifo expectations, building permits, consumer confidence, the economic sentiment indicator and the PMI manufacturing order-stocks ratio).

- **Tools for projecting residential property prices** for the euro area. The ECB currently uses a parsimoniously specified vector error correction model (VECM). In this framework, real house prices are related to housing demand and supply fundamentals, including real housing investment, real income per capita and the real interest rate. The model can also be used to generate measures of overvaluation or undervaluation of house prices relative to their equilibrium values (see Box 3 of the ECB's Financial Stability Report, November 2015). Ongoing modelling efforts related to house price forecasting are focusing on the use of Bayesian VAR models, considering in particular their forecast performance at different time horizons relative to alternative models.

- **Fiscal projection platforms.** For each euro area country there is a fiscal projection platform that encompasses a set of identities, calibrated relationships and estimated elasticities. The communication between macroeconomic and fiscal projections follows an iterative process.

- **Models for oil prices.** In order to gauge the macroeconomic impact of alternative oil price paths (other than those suggested by oil price futures), the following approaches are used to derive alternative paths: (i) oil price model (Pagano and Pisani, 2009), which uses "risk-adjusted" futures that aim to correct the forecast error of futures by adjusting them on the basis of a time-varying risk premium linked to US economic activity; (ii) a Bayesian VAR (BVAR) oil price model, which is based on oil fundamentals (oil production, oil inventories and global economic activity); (iii) a DSGE model featuring the long-term dynamics in the oil market; (iv) a four-model combination, which is the weighted average of the three oil price models mentioned above and oil price futures, which is the method currently used for deriving oil price assumptions (see Section 3.1) (see *Economic Bulletin*, Issue 4, ECB, 2015; Manescu et al., 2014).

- **Ad hoc satellite equations and models.** A number of satellite equations and models are occasionally used in order to complement and cross check the results of the main models. For example, the assessment of the impact of the recent expanded APP, based on the ECB's standard models, has been complemented by results from satellite models featuring a wider set of financial transmission channels that are not fully captured by the standard projection modelling framework.

- **Projection platforms for the non-euro area EU countries.** These are tools similar to those mentioned above for the smaller euro area countries. These platforms are used to prepare projections for the non-euro area EU countries in order to construct the external environment of the euro area.

- **Macroeconomic models for the US, Japan and China.** The Model of the US Economy with Learning (MUSEL) is a large-scale, agent-optimising estimated model, which follows the same approach as the NMCM with expectations based on learning (see Baumann et al., 2014). One key difference from the NMCM is that there is an explicit modelling of the private sector and housing. For Japan, a traditional backward-looking model is used. For China, a semi-structural model with cross-country linkages is used, which is a mixture of a DSGE model and a statistical model. It is based on the IMF Global Projection Model and covers China, the rest of emerging Asia and the US economy.

- **Other models used for global projections.** Various other models and econometric tools are used in forming the international projections. Models used are the National Institute Global Econometric Model (NiGEM, maintained by the UK National Institute for Social and Economic Research) and a global VAR model, which is used to analyse scenarios and assess cross-country spillovers. Although the international projections are primarily based on individual country forecasts, these bottom-up forecasts are also cross-checked with top-down global models. For example, top-down models focusing on short-term trade prospects and global inflation help to inform judgements about the wider global picture.

- **The flow-of-funds projections framework.** Feedback channels from financial to real variables (for example, wealth effects and credit channels) are typically not well-captured in most standard macro-models such as those used in the context of the macroeconomic projection exercises. Against this background, a flow-of-funds projections framework has been developed and, since mid-2003, has been used as a cross-checking tool in the projection exercises. This framework entails a consistent set of projections – derived on the basis of econometric models, accounting identities and judgement – for the full set of financial transactions and for the financial balance sheet positions of the domestic sectors of the euro area economy and the rest of the world. The flow-of-funds projections are derived, post-recursively, on the basis of the underlying assumptions (on interest rates, equity prices, exchange rates and house prices) and on the projections of non-financial variables (GDP, business investment, private consumption, gross operating surplus and price developments). The outcome of this exercise is, inter alia, projections for balance sheets, bank loans, other sources of financing and the debt ratios of households and NFCs. Such a framework makes it possible to assess the overall consistency between the projected financial developments and the non-financial projections, with the aim of identifying possible risks to key macroeconomic variables (e.g. the household saving ratio, private consumption and business investment) stemming from the financial side. However, in the absence of a joint modelling framework, there is no complete link between the projections for flow of funds and other macroeconomic variables. Thus, flow-of-funds projections primarily contribute to the discussions on the plausibility of the forecast paths of private consumption, savings and business investment.

3.2.2 Tools and models used by the NCBs

3.2.2.1 Main macromodels used by the NCBs

In the BMPE, most NCBs combine medium to large-scale structural econometric models with various other tools. In almost all cases, structural macroeconometric models are used to prepare the baseline projection in a coherent framework. These structural models differ in terms of size, scope, degree of underlying microfoundations, treatment of the financial sector and the modelling of expectations. Most of these structural models are of a standard type and based on a neo-classical synthesis, combining short-run, demand-driven business cycle dynamics with steady-state properties as derived from standard growth theory (see Fagan and Morgan, 2005; Jeanfils, 2000; Baghli et al., 2004; De Nederlandsche Bank, 2011; and Busetti et al., 2005). Some NCBs use a version that is based on the structure used in the AWM (see Fagan et al., 2001). A number of NCBs have also developed multi-country models. In addition, some NCBs have developed models based on agent-optimising behaviour and forward-looking expectations, such as DSGE models, which are used for forecasting and/or scenario analyses (see Andrés et al., 2010; Gadatsch et al., 2015; Kilponen et al., 2004; and Willman et al., 2000).

3.2.2.2 Other tools and models used by the NCBs

- **Satellite models and equations.** In most cases NCBs also use, in addition to their main models, a number of satellite models or single equations that focus on specific aspects of the economy and provide input for the main model. These satellite models are often built in order to estimate potential output (see Chouard et al., 2013; and Guarda, 2002), the NAIRU (see Kajuth, 2010), house prices (see Kennedy and McQuinn, 2011 and 2012), financial variables and external trade.

- **Tools for short-term forecasts of real GDP developments and its main expenditure counterparts.** As is the case at the ECB, a number of coincident and leading indicator models are also used by the NCBs. In particular, some NCBs have developed composite leading indicator models, where a selected set of leading indicators is weighted together in order to form a projection for a particular variable, with the weights being determined statistically (see Rua, 2004 and 2005; and Gibson and Lazaretou, 2001). Bridge models (see Baffigi et.al., 2004; Barhoumi, et al., 2008; Deutsche Bundesbank, 2013; Esteves and Rua, 2012; and Piette and Langenus, 2014) and mixed-frequency models (see Marcellino et al., 2013) are widely used. Some NCBs have developed indicator models for cyclical turning points (see Vanhaelen et al., 2000; and Baffigi and Bassanetti, 2004). Bayesian VAR[10] and VECM models play an important role in

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[10] In Bayesian VAR models, prior beliefs (based e.g. on economic theory) are used – in addition to sample information – to estimate values of the parameters and to indicate the degree of confidence with which these beliefs are held.

projecting short-term developments in activity (see Engsted and Haldrup, 1999). In addition, NCBs also use dynamic factor models for the short-term projection of GDP (see Camacho and Perez-Quiros, 2009; Jansen et al., 2012; and Marcellino and Schumacher, 2010).

3.2.3 Tools used for short-term inflation forecasting by the ECB and NCBs

As previously explained, a particular feature of the macroeconomic projection exercises is the detailed analysis of short-term price developments in the NIPE. To this end, ECB and NCB staff use a number of **tools for short-term inflation forecasting**, ranging from relatively simple indicators to sophisticated econometric models. Such analysis is generally carried out at a disaggregated level (focusing on the various components of the HICP), together with some aggregate projection to check consistency. Single equation techniques (bridge equations, with a small number of monthly or daily indicators) and VAR models (including, in some cases, Bayesian priors) are used by a number of NCBs and the ECB for projecting the overall price index or for particularly important components (see Giannone et at., 2010; Ballabriga et al., 2000; Meyler et al., 1998; Cristadoro and Sabbatini, 1999; Wit, 1998; and den Reijer and Vlaar, 2006). These tools are often combined with ARIMA[11] time series and transfer function models for particular price components and together they provide an initial baseline projection that is normally complemented with other information (such as government measures) and/or with judgemental inputs.

3.3 Aggregating the projections and checking for consistency

Once the individual euro area country figures are agreed upon, either in the BMPE or the MPE, the euro area projection is obtained by **aggregating the individual country projections**. The euro area aggregation of the country projections relies on methods similar to those used by Eurostat, which involve taking the sum of the national variables in levels.

The **aggregation of GDP** and its expenditure components is performed at chain-linked volumes. Chain-linking of quarterly data uses the annual overlap technique adopted by Eurostat. The GDP deflator and its demand components are derived as the ratio of the variables in nominal terms (obtained by a simple sum in terms of euro) divided by the corresponding variables at chain-linked volumes.

The **HICP aggregation** is calculated using Eurostat's methodology, i.e. an annual chain index with changing country weights. The weight of a country is the share of its private final domestic consumption expenditure to the euro area private final

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[11] ARIMA (Auto-Regressive Integrated Moving Average) models or univariate time-series models are models for which a variable is only expressed in terms of its own past values along with current and past errors.

domestic consumption expenditure. For the projection period, the latest available set of weights is used.

All data series, except for the HICP and its components, relate to the current fixed country composition of the euro area for the whole time series. Any change to the composition of the euro area is taken into account only for the HICP and its components.

In order to ensure that the individual country projections serve as a reliable guide for area-wide conclusions, it is necessary for them to be fully consistent with each other. In this context, the purpose of the **trade consistency exercise** (TCE) is to ensure that individual country projections of trade volume and price variables are consistent with each other and with the assumptions made about the international environment i.e. world trade, foreign prices and nominal exchange rates.

Trade consistency is ensured in two directions: first, the cross-trade consistency part of the TCE examines the consistency of the trade projections at any given point in time; second, the ex ante/ex post trade consistency part compares the projections for a given variable across different projection rounds.

Cross-trade consistency checks that each country's export projection is consistent with the import projections of its trading partners in both volume and price terms. Additionally, the consistency of trade flows and prices between the euro area and the rest of the world is checked. This is assessed using trade shares and various trade equations. Trade shares are updated every three years. Convergence with regard to cross-trade consistency is achieved when (i) the projected real exports for a certain country are expected to grow in line with the foreign demand of this country and/or deviations can be explained by changes in competitiveness and/or other factors, and (ii) the projected import and export prices imply "reasonable" profiles for import and export competitiveness.

Ex ante/ex post trade consistency ensures that for each country, external demand and competitors' export prices are updated as the projection exercise progresses, in line with changes in the import and export prices of other euro area countries. Convergence with regard to ex ante/ex post trade consistency is achieved when the differences between successive values of external demand and competitors' prices are small enough to be of no practical importance.

When a country joins the euro area, the techniques for aggregation and consistency checks are adapted. In the light of the fast expansion of the euro area over the past decade, this process has been carried out frequently.

3.4 Updating the projection and ex post assessment of the impact of changes in the underlying assumptions on the outlook

During the projection exercises, it may be necessary to assess the effects of last minute changes in the assumptions underlying the projections or to assess the impact of alternative assumptions in an efficient and consistent manner. For this purpose, a tool called **Basic Model Elasticities** (BMEs) was developed to provide a mechanical "rule of thumb" assessment of the impact on the economy from certain changes in assumptions. BMEs are also used to assess, ex post, the impact of changes in the assumptions from one projection round to the next, as a means of explaining which part of a revision to a projection is due to a change in the assumptions.

In essence, BMEs can be thought of as a smaller version of a multi-country model but linearised around a specific baseline. BMEs are presented by a set of tables that, for each country, provide the impulse responses of endogenous variables to shocks in certain exogenous variables. BMEs, for instance, assess what the impact on real GDP growth and inflation would be if oil prices were 10% higher than in the baseline. The underlying impulse responses to changes in the exogenous variables are provided by NCBs for their countries. ECB staff collects the BMEs from the NCBs, compiles the resulting euro area BMEs and presents the results to the WGF, which is responsible for maintaining this tool. BMEs are updated once a year.

The BME process can be described as follows. First, an alternative path for an exogenous variable is specified in terms of deviations from its baseline. The BME tool first calculates, for each quarter, the related direct impact of the shocks in the exogenous variables on the endogenous variables for each country and for the aggregate euro area. In a second step, the tool uses an incorporated linearised trade link block to calculate the effects of changes in import demand and the export deflator on other countries, namely spillover effects. The final result is given by adding up the direct impact and the spillover effects.

The main advantage of the BME tool is that it makes it possible to calculate mechanically the effects of changes in assumptions underlying the baseline for a large set of variables and countries in a quick and simple way. Another advantage is that the tool brings the NCBs' country expertise, based on different models, together in a single tool.

The main drawback of the BME tool is that it is linear and therefore more suitable for calculating the effects of small deviations from the baseline assumptions. In addition, the BME tool treats the changes in assumptions as independent of one another. While this allows the disentangling of the contributions of changes in different assumptions to the final outcome, it is still a simplified approach since, from an economic point of view, the changes in the assumptions may not be independent of one another.

At present, BMEs are prepared for all EU countries. The exogenous shocks for which BMEs are available relate to short and long-term interest rates, oil prices, the nominal effective exchange rate, the bilateral EUR/USD exchange rate, foreign demand, competitors' export prices, food prices, house prices and stock prices. In addition, there are sets of elasticities for shocks on certain endogenous variables, such as household wealth, user cost of capital, wages, private consumption and business investment. Six new BMEs covering the impact of changes in certain general government revenue and expenditure categories (fiscal BMEs) have been recently introduced to improve the assessment of fiscal shocks and scenarios.

3.5 Reflecting the uncertainty and risks associated with economic projections

The complexity of economic and financial developments, as well as the changing nature of interactions among economic agents, imply that projections are subject to **forecast errors**. There are a number of contributing factors. An obvious source of error is that the state of the world is subject to unforeseeable events. Moreover, forecast errors arise because data are revised and information about the current situation is incomplete. A further source of error stems from the assumed path of the conditioning assumptions (see Section 3.1). In particular, the impact of errors in the exchange rate, oil price and foreign demand assumptions on forecast errors in GDP growth and HICP inflation can be sizeable. Forecast errors may also arise from not being fully able to properly assess the impact of structural reforms.

An assessment of the forecast performance of the Eurosystem/ECB staff macroeconomic projections is regularly conducted for a better understanding of the sources of forecast errors and thus to improve the accuracy of the projections. In this context, the impact of errors in the assumptions on the overall forecast performance is regularly reviewed. Moreover, the performance in terms of the size of the forecast errors of the Eurosystem/ECB staff projections is compared with the forecasts of other international institutions (i.e. IMF, European Commission and OECD) and private institutions (i.e. Survey of Professional Forecasters and Consensus Economics).

In order to assess the part of the uncertainty that stems from unforeseeable events, the Eurosystem/ECB staff projections include a **Quantitative Risk Analysis (QRA)**. The purpose of the QRA is to summarise staff views on the uncertainty from unforeseeable events around the baseline projection. The QRA is conducted in a systematic and quantitative manner by combining the assessments made by Eurosystem/ECB staff of the risks around the baseline, using historical forecast errors, a linearised model of the euro area and a certain class of probability functions.[12] This is implemented in the QRA by identifying and quantifying the impact of certain key risks. These key risks are captured by a set of clearly defined area-

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[12] The technical framework of the QRA is based on "puRa2", a tool developed by the Banco de Portugal (Pinheiro M. and Esteves P.S., 2012).

wide "risk events". A risk event is to be interpreted as a set of possible scenarios (eventualities) that are not taken into account in the baseline and that can be associated with a certain theme. Risk events can be divided into global and domestic risk events. Global risk events could be related, for example, to the consequences of a reduction in oil supply or of heightened global geopolitical tensions. Domestic risk events could be linked, for instance, to the effects of additional fiscal consolidation, a more favourable impact of structural reforms or pessimistic perceptions of future potential growth.

In practice, at the beginning of each projection round Eurosystem/ECB staff identifies a number of key risk events. In a second step, the staff assessment of the risks around the baseline is collected using the replies to a risk questionnaire. In this risk questionnaire, for each risk event Eurosystem/ECB staff is asked to give an assessment of the skewness of the distribution around a set of input variables (such as real GDP growth and inflation) under the assumption that the risk event materialises and to assess the probability of materialisation of the risk event. In addition, owing to the fact that not all risks can be covered by the selected risk events, QRA respondents are also asked to fill in a separate questionnaire covering all the remaining risks. When calculating the aggregated overall risk assessment, the impact of each risk event on the input variables is weighed with its probability of occurrence.

Another tool to assess the uncertainty around the baseline projection is provided by **sensitivity analyses**. Sensitivity analyses try to assess the implications on real GDP growth and HICP inflation of alternative paths of certain key assumptions underlying the baseline projections. Typically, these sensitivity analyses include alternative paths for oil prices, exchange rates, interest rates and, occasionally, foreign demand, and are carried out using the BMEs, NMCM and NAWM. Alternative exchange rate assumptions are typically derived from risk neutral probability densities, whereas alternative interest rate assumptions are sometimes derived by keeping the EONIA rate constant over the projection horizon.

The sensitivity analyses also regularly include a specific **fiscal sensitivity analysis**, which assesses the impact on the baseline of possible additional fiscal measures. The fiscal projections only include measures that have been approved by the national parliaments or that have already been defined in sufficient detail and are likely to pass the legislative process. Therefore, additional fiscal measures might be required to meet governments' fiscal targets or such additional measures might appear likely from the perspective of the fiscal experts. This holds particularly in the outer projection years, as government fiscal plans for longer horizons are often not specified in detail or are changed significantly during the legislative process. A so-called "standard" fiscal sensitivity analysis assumes that individual euro area countries adopt additional measures amounting to the size of their fiscal consolidation gap, i.e. the difference between the projected government balance and the government targets, if the projected balances are less optimistic than the targets (for instance, the projected deficit is larger than targeted). Since December 2012, this standard fiscal sensitivity analysis has been "enhanced" in order to embody the expert judgement of NCB and ECB staff on the most likely amount and composition

of fiscal measures that are, in the opinion of staff, likely to be adopted on top of the measures already included in the baseline. This approach goes beyond the purely mechanical nature of the standard fiscal sensitivity analysis. It may also point to possible differences between government targets and the staff's assessment of the likely outcomes. Both types of fiscal sensitivity analyses are carried out regularly, with their impact on the economy assessed using the NMCM, NAWM, BMEs and, in the BMPE, also the NCBs' models.

4 Concluding remarks

The Eurosystem/ECB staff has been producing projections since the creation of the Eurosystem and the ECB. The projection exercises, both the MPE and, more especially, the BMPE, are very complex. This complexity stems from the institutional set–up, which, in the case of the BMPE, involves all euro area NCBs and the ECB, as well as numerous business areas within each institution. In the case of the MPE, numerous business areas within the ECB are involved, complemented by certain inputs from NCBs. An important and unique feature of the Eurosystem/ECB staff projection exercises, which adds to the complexity, is the need to prepare a projection that is seen as valid for each individual euro area country and for the euro area as a whole, conditional on a set of technical assumptions. Despite this inherent complexity, the evolving projection set-up has been successful in terms of reaching consensus and resulting in euro area and euro area country projections that all parties involved are able to agree upon. The projection exercises are now very well established processes that have been running smoothly for quite some time. In particular, the BMPE provides a successful model of interaction among all the central banks involved, which ensures that all the required expertise in the Eurosystem is fully utilised. Moreover, these arrangements have also been successful in terms of the development and sharing of tools among all the parties involved, enriching the quality of the projections.

This updated version of the guide to the Eurosystem/ECB staff macroeconomic projection exercises includes a number of key changes implemented in the projection exercises in response to the changing economic and institutional environment in order to provide the best possible input to the monetary policy decisions of the Governing Council. In this respect, the tools and techniques used in the projection exercises will continue to evolve, making use of newly available information and data, as well as the latest economic research, leading to the development of new and better projection techniques.

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Abbreviations

Institutions

ECB	European Central Bank
ESCB	European System of Central Banks
IMF	International Monetary Fund
NCB	national central bank
OECD	Organisation for Economic Cooperation and Development

Countries and regions

EU	European Union
UK	United Kingdom
US	United States of America

Economic variables

GDP	gross domestic product
HICP	Harmonised Index of Consumer Prices
PMI	Purchasing Managers' Index

Econometric models and forecasting tools

ALI	Area-wide Leading Indicator
AWM	Area-Wide Model
BMEs	Basic Model Elasticities
BVAR	Bayesian vector auto-regressive
DSGE	Dynamic Stochastic General Equilibrium
MUSEL	Model of the US Economy with Learning
NAWM	New Area-Wide Model
NIGEM	National Institute Global Econometric Model

NMCM	New Multi-Country Model
VECM	vector error correction model
TCE	trade consistency exercise
VAR	vector auto-regressive
QRA	Quantitative Risk Analysis

Other

APP	asset purchase programme
BMPE	Broad Macroeconomic Projection Exercise
EFSA	Enhanced Fiscal Sensitivity Analysis
EGFA	Expert Group on Financial Assumptions
ESA	European System of Accounts
FSC	Forecast Steering Committee
FTF	Forecast Task Force
IEO	International Environment Outlook
MPC	Monetary Policy Committee
MPE	Macroeconomic Projection Exercise
MTRS	Medium-Term Reference Scenario
NFCs	non-financial corporations
NIPE	Narrow Inflation Projection Exercise
STIP	Short-Term Inflation Projection
WGEM	Working Group on Econometric Modelling
WGF	Working Group on Forecasting
WGPF	Working Group on Public Finance