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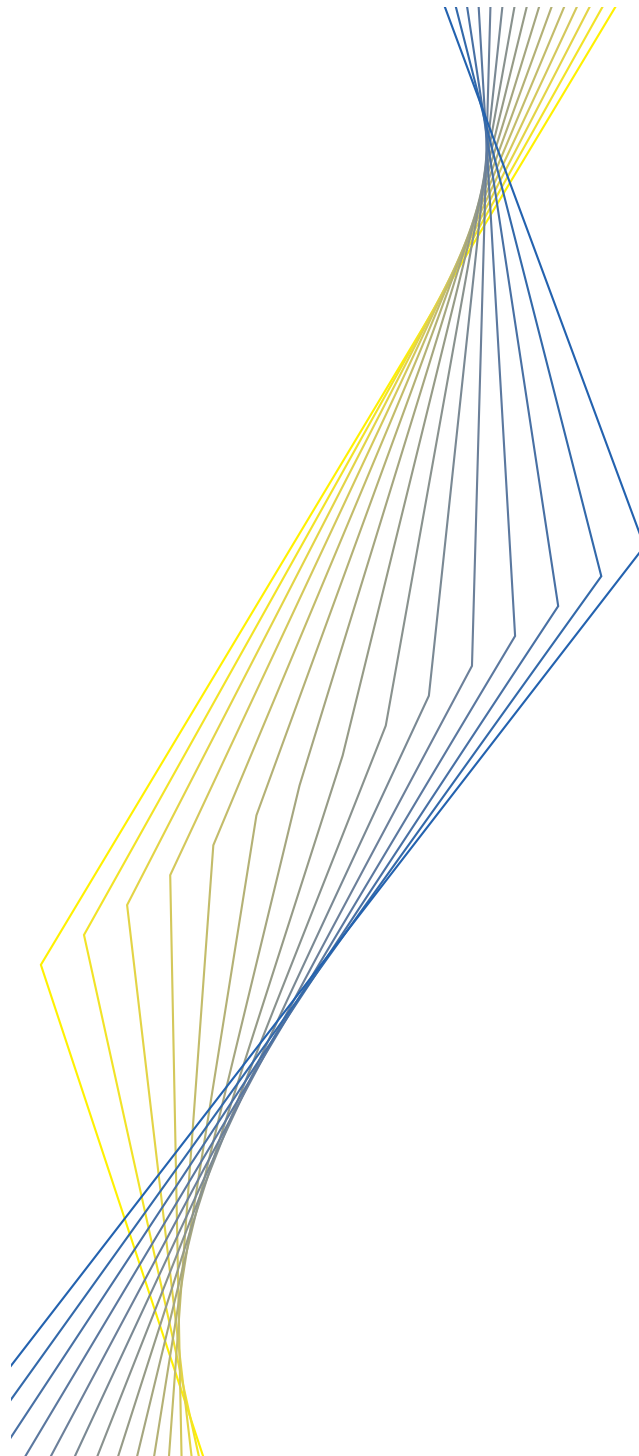# A GUIDE TO EUROSYSTEM STAFF MACROECONOMIC PROJECTION EXERCISES

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Introduction

The Governing Council of the ECB has decided to publish Eurosystem staff macroeconomic projections for the euro area on a biannual basis from December 2000.[1] These projections will be published in the June and December issues of the ECB Monthly Bulletin. The published figures include projections for inflation in terms of the Harmonised Index of Consumer Prices (HICP), the growth of real GDP and its main expenditure components over a two-year horizon. The projections are accompanied by a description of their main features. In order to reflect the degree of uncertainty attached to such exercises, the Governing Council decided to publish the projections in the form of ranges.

The present guide to Eurosystem staff macroeconomic projection exercises (MPEs), prepared jointly by experts from the euro area NCBs and from the ECB, describes the way in which the projections are produced. The projections are a convenient analytical tool for helping bring together in a systematic manner a range of information on current and future economic developments. Conditioned on a set of assumptions, they combine the use of conventional models with economic experts' knowledge. The outcomes of the MPEs are presented to the Governing Council, to be used as input into its monetary policy deliberations.[2] The Governing Council itself has to make an overall assessment both of the economic situation and of the risks to price stability, using all the information available, including, in particular, the information derived from the first pillar of the strategy, but also information other than the Eurosystem's projections under the second pillar.

The report is organised in two chapters. Chapter 1 gives an overview of the main characteristics of the Eurosystem staff MPEs. Chapter 2 describes the tools used to derive the projections, including the techniques used to ensure that the euro area projections are obtained in a way fully consistent with the individual country assessments.

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1 See "Staff economic projections for the euro area", in the December 2000 issue of the ECB Monthly Bulletin.

2 For a discussion of the role of projections within the monetary policy strategy of the ECB, see the ECB's "Annual Report 2000", "The two pillars of the ECB's monetary policy strategy", in the November 2000 issue of the ECB Monthly Bulletin and "The stability-oriented monetary policy strategy of the Eurosystem", in the January 1999 issue of the ECB Monthly Bulletin.

Chapter I

An overview of the Eurosystem staff macroeconomic projection exercises

Within the second pillar of the ECB's monetary policy strategy, the Eurosystem staff macroeconomic projections play an important role as a tool for aggregating and organising existing information on current and future economic developments. Conditioned on a set of assumptions, they provide projections for a range of macroeconomic variables, combining the results of conventional models with economic experts' knowledge. This chapter deals with the main characteristics of the Eurosystem projection exercises, stressing how the projections reflect the interaction between ECB and NCB staff and the main steps followed in their elaboration.

A unique element of the Eurosystem staff macroeconomic projection exercises is their combination of both national and euro area-wide perspectives. The euro area consists of a set of interacting and integrating economies.

However, monetary policy decisions are based upon an assessment of euro area-wide conditions. The projection procedures therefore need to take account of both national and area-wide perspectives.

Individual country-level assessments are prepared which make full use of the detailed knowledge and experience of country experts. These projections can take account of the rich, but somewhat diverse, set of national data sources and incorporate the details of individual countries' institutional frameworks. The procedures of the projection exercises are designed to integrate such country assessments within an overall euro area framework, ensuring that the individual country trade flows are made fully consistent with each other and that the final projections represent the consensus of Eurosystem staff opinion through a technical peer-review process.

A   The framework for interaction between ECB and NCB staff

Macroeconomic projection exercises (MPEs) involve close interaction between ECB and NCB staff to ensure that the euro area projections draw on all expertise available and reflect a consensus among Eurosystem staff.

The MPEs are carried out under the responsibility and guidance of the *Monetary Policy Committee* (MPC). The MPC is composed of senior staff representatives of the ECB and the NCBs. The MPC provides broad guidance for the production of the

projection figures and is responsible for the final draft of the report on the Eurosystem staff macroeconomic projection exercise.

The *Working Group on Forecasting* (WGF), which is one of the three working groups reporting to the MPC,[3] is responsible for producing the detailed figures for the macroeconomic projections and for producing an initial version of the report. The WGF is composed of ECB and NCB macroeconomic and econometric experts.

B   An outline of Eurosystem macroeconomic projection exercises

There are three main steps in the production of the MPEs. First is the setting of *assumptions underlying the exercise;* second, there is the derivation of and agreement on a set of macroeconomic *projection figures*, following a process of overview at area-wide level, projection consistency checks, and peer review of the individual country projection

figures; finally, the third step is the *preparation of the report for the Governing Council* and of the publication of the projections in the Monthly Bulletin.

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3   *The other two are the Working Group on Econometric Modelling and the Working Group on Public Finance.*

1   Setting the underlying assumptions

At the beginning of the exercise, a set of provisional assumptions is agreed, covering *interest rates, exchange rates,* the *international environment* and *fiscal variables*. These assumptions are reviewed and may be changed in the course of the exercise.

The projections are based on the technical assumption that *three-month interest rates* in the euro area remain constant over the horizon of the projection. The constant level of the three-month interest rate corresponds to the prevailing level. This assumption is made in order to illustrate the possible consequences of leaving monetary policy unchanged over the projection horizon. However, for this reason, the staff economic projections will not necessarily be the best unconditional predictor of future outcomes, particularly over longer horizons, since monetary policy will always act to contain any threats to price stability.

For *long-term interest rates*, it is assumed that ten-year interest rates evolve in accordance with the prevailing market expectations. These market projections for long-term interest rates are obtained by pricing notional ten-year euro area coupon bonds. Long-term interest rates may, however, be adjusted in the context of the projection process if this is needed to make them consistent with the rest of the projection.

Exchange rate assumptions are purely technical and based on an average of recent rates (thus they do not in any way constitute a forecast for the future evolution, or an assessment of the appropriate level, of the euro exchange rate). *Oil and non-oil commodity price assumptions* are based on recently observed futures market prices.

The assumptions for the *international environment* are agreed by the WGF on the basis of a broad consensus. An initial assessment by ECB staff is discussed together with contributions from the NCBs, which also reflect specialist knowledge concerning external economies and regions. The NCBs of those European Union countries not participating in the euro area also contribute to this discussion as part of the co-operation within the European System of Central Banks, although they do not take part in the subsequent macroeconomic projection exercise.

For *fiscal variables*, assumptions for the current year incorporate the most recent information available concerning budgetary developments in the individual member countries of the euro area, while the assumptions for the later years are based on a "most likely policy" scenario.

Whenever, during the course of the exercise, the initial assumptions become clearly inconsistent with recently observed outcomes, they are updated. A procedure for quickly assessing the impact of the updated assumptions on the projection figures is available, based on a set of projection update elasticities.

2   Deriving the projections

Following the agreement on the initial assumptions, NCB and ECB staff separately prepare *initial projection figures*. These are documented in accompanying reports following a standardised format. These reports focus on the key features of the country projections, describing their underlying economic rationale and the specific assumptions made about the institutional setting at the national level (for instance, labour market developments and wage prospects). Each NCB prepares an initial projection for its own country, whereas ECB staff prepare a set of projections for the individual countries as well as for the euro area as a whole, the latter being consistent with the aggregation of the ECB staff individual country projections. The NCB country projections are aggregated by ECB staff.

In addition to the preparation of the projections themselves, ECB and NCB staff also jointly produce a number of background analyses, considering in detail specific important technical or structural issues.

The initial NCB country projections and their aggregation are discussed within the WGF, along with the initial country and area-wide projections of ECB staff. The discussion of and agreement on the final projection figures are the result of the following three elements: first, a *euro area overview* is taken of the figures and the implicit judgements they embody; second, a number of technical exercises are undertaken to ensure the *mutual consistency of the projection figures* for individual countries; and, third, a process of *peer review* is applied to come to a consensus on the final projection figures for individual countries. The projections for the euro area are then obtained by aggregating the country figures.

The *euro area overview* of the figures is based upon the comparison of the initial ECB euro area projection with the aggregation of the initial NCB country projections, taking account of the background analyses that have been prepared. This comparison includes, inter alia, an analysis using the area-wide econometric model[4] of the differences between the initial ECB staff and the aggregated NCB staff projections. This exercise identifies a set of area-wide issues, which helps to provide a framework for the subsequent discussion of individual country projections.

Second, a number of *consistency exercises* are carried out on the figures. A *trade consistency exercise* is performed to ensure the consistency between the projected trade volumes and prices of the individual country projections. The assessment may also raise issues concerning individual national trade volume or price projections. The trade consistency exercise is repeated in the later stages of the projection process. A *financial consistency exercise* is also carried out to assess the implications of the MPE

assumptions and projections in the context of the consolidated balance sheet of the Monetary Financial Institutions in the euro area in the years ahead. This exercise will gain sophistication as financial statistics become more fully available.

Finally, a detailed discussion of individual country projections is carried out within the WGF. It is based on a *peer review* of the initial NCB country projection and the initial country projection prepared by ECB staff, and takes into account the outcome of the consistency exercises. This discussion usually leads to further analyses aimed at clearing any remaining differences in the projection figures. In this context, detailed monthly projections of national HICPs are also considered along with the main macroeconomic projection figures. This ensures that the model and expert-based macroeconomic discussions duly take into account short-term sectoral and fiscal factors relevant for the price outlook.

On the basis of technical considerations, taking into account the outcome of the consistency exercises and possibly upon consultation with the MPC, a list of adjustments needed to reconcile the views on country projections and, implicitly, on the aggregated euro area projection is agreed. Usually one or two iterations are required to obtain a set of final country projections. *The final euro area macroeconomic projections are the aggregation of the agreed revised country projections.*

As mentioned earlier, assumptions may be reviewed in the course of the exercise. When they are modified at an advanced stage of the projection process, a set of *projection update elasticities*, computed in a way that takes into account trade volume and price consistency requirements, can be used for the update of the projection figures.

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4   Fagan, G., Henry, J. and Mestre, R. (2001), "An Area-Wide Model (AWM) for the euro area", ECB Working Paper, No. 42, European Central Bank, Frankfurt am Main.

3 Preparing the report

The report for the Governing Council on the Eurosystem staff macroeconomic projection exercise is prepared by the MPC assisted by the WGF. This report contains a statement of the assumptions made regarding interest rates, exchange rates, the international environment and fiscal policy. It then reviews the projection results for the euro area as a whole, looking at real GDP growth and employment projections, price and cost prospects; the prospects for individual economies are also briefly reviewed. Finally, the report is supplemented by a detailed assessment of short-term price developments.

The report is then submitted to the Governing Council, via the ECB's Executive Board.

A shorter description of the projections based on the original report to the Council is then published *in the June and the December issues of the ECB Monthly Bulletin.* It is also made available on the ECB's website. The published figures include projection ranges for HICP inflation, the growth of real GDP and its main expenditure components over a two-year horizon. The projections are accompanied by a description of their main features.

Chapter 2

The techniques and projection tools used in Eurosystem staff macroeconomic projection exercises

The scope of Eurosystem staff macroeconomic projection exercises includes the HICP, real GDP, a detailed breakdown of expenditure counterparts, as well as a number of other macroeconomic variables, including the GDP deflator. The projections are presented for a horizon of up to two years ahead.

Conditioned on a set of assumptions, the projections combine the use of econometric models with economic expert knowledge.

A variety of *structural macroeconometric models,* as well as reduced-form equation systems and time series models, are employed to generate and provide analytical support for the projections. The models used include the area-wide model of the ECB and country models developed by the ECB and the NCBs, including the multi-country model of the European System of Central Banks (ESCB). Such structural models provide a detailed structure for the projections, ensuring that they are internally consistent and that the relationships between variables are in line with economic theory and econometric evidence.

Nevertheless, structural econometric models do not always fully track the most recent developments, reflect sector-specific behaviour or capture exceptional factors or structural changes. Therefore, the euro area and country assessments of ECB and NCB staff also make use of leading indicators and judgemental methods. Knowledge of the institutional context and other specific information are thus also integrated into the projections. In addition, a number of consistency tools are used to ensure the mutual consistency of the projection figures for individual countries. As a result, the projections incorporate both structural econometric model-based and judgemental methods. In particular, consensus building among experts – modellers and non-modellers – is facilitated by quantifying and analysing the extent to which the macroeconomic projections may depart from a prediction implied by past behaviour, as derived from a structural macroeconometric model.

A   Techniques used for producing Eurosystem macroeconomic projections

The approaches followed to produce the Eurosystem macroeconomic projections are a combination of conjunctural analysis, econometric model projections and judgmental assessments on the basis of expert knowledge. An overview of these techniques is provided in this section. Detailed references are given in the bibliography.

Good conjunctural analysis of growth and inflation is one of the foundations of macroeconomic projection exercises. For the short-term analysis of real GDP and its main expenditure counterparts, a number of standard coincident and leading indicators are used. Many NCBs have developed and use econometric techniques to quantify these relationships. Coincident indicators and national accounts bridge models are widely

used (see Bravo and Sanchez (2001), Dias (1993), Irac and Sedillot (2001) and Parigi and Schlitzer (1995)). Leading indicator models have been developed by some NCBs (e.g. Rooij and Stokman (2000) and Altissimo et al. (1999)). Some NCBs have developed indicators for cyclical turning-points (e.g. Vanhaelen et al. (2000)).

A particular feature of Eurosystem macroeconomic projection exercises is the concentration on the detailed analysis of short-term price developments. For this purpose, ECB and NCB staff use a number of tools ranging from relatively simple indicators to sophisticated econometric models. Such analysis is generally carried out at a disaggregated level, together with an aggregated projection to check consistency.

Vector auto-regressive models, including in some cases Bayesian priors, are used by a number of NCBs for projecting the overall price index or for particularly important components (see Ballabriga et al. (2000), Meyler et al. (1998), Cristadoro and Sabatinni (1999) and Wit (1998)).[5] These are often combined with ARIMA time series, transfer function models for particular price components, and provide an initial baseline projection for judgemental input (e.g. Alvarez (1999)). Structural Phillips curve equations, relating inflation to a measure of excess demand, are also used by some NCBs (e.g. Jondeau et al. (1999) and Zonzilos (2000)). Moreover, indicator models are widely used by NCBs. Some NCBs have developed composite leading indicator models, where a selected set of leading indicators is weighted together to form a projection for a particular variable, with the weights being determined statistically (for a published example see Gibson and Lazaretou (2001)).

In the context of the MPEs, the ECB staff and a majority of NCBs combine medium to large-scale structural econometric models with various sources of additional information. With few exceptions, *structural macroeconometric models* are used to represent the central aspects of the projection in a coherent framework, incorporating *additional information* coming from different sources. In addition to the macroeconometric models used by NCBs, two models are also used to assess the overall consistency of the projections: the area-wide model and the multi-country model of the ESCB. In addition to the macroeconomic models, staff also use off-model tools – such as reduced form equation systems and time series models – for complementary assessments.

The variety of econometric tools used in Eurosystem macroeconomic projection exercises encompasses the *area-wide model* (AWM) (see Fagan et al. (2001)). The AWM is used in Eurosystem projection exercises, inter alia, to provide an assessment of average judgements embodied in the aggregation of

country projections and for running scenarios. The AWM treats the euro area as a single economy and has the particular advantage of helping to underpin an area-wide focus in general economic analysis and policy discussion within the Eurosystem. While the long-run properties of the model are consistent with a basic neo-classical steady state, in which the long-run output is determined by technological progress and the available factors of production, the short-run dynamics are not explicitly derived from an optimisation framework, but are instead specified in a more traditional "ad hoc" form and estimated on the basis of historical data. The relatively small scale of the model also makes it a tractable tool for the purpose of scenarios.

A second econometric tool is the *multi-country model* (MCM), which is used by ECB staff and some NCBs. The MCM is an ESCB project, i.e. it is the result of collaboration between ECB and NCB staff. The country blocs of the MCM share many features of the AWM, regarding their theoretical foundations, their relatively small size and the approach taken to distinguish clearly between long-run specifications and dynamic adjustment in the short-run. Whereas the AWM is for the euro area as a whole, the country blocs of the MCM provide a tool for forecasting the macroeconomic developments in the countries of this area.

A range of *structural national macroeconometric models* are used by NCB staff. These models differ in size, scope, degree of underlying microfoundations, and in their treatment of the financial sector and forward-looking expectations. Most of the models are of a standard type based on the neo-classical

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5   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. 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 in a VAR model and to indicate the degree of confidence with which these beliefs are held. **ARIMA** (Auto-Regressive Integrated Moving Average) models or univariate time-series models are models where a variable is only expressed in terms of its own past values along with current and past errors.

synthesis, combining short-run demand-driven business cycle dynamics with steady-state properties as derived from standard growth theory (e.g. Banque de France et al. (1996-97), De Nederlandsche Bank (1985)/Fase et al. (1992), Banca d'Italia (1986)). Some NCBs use as their main tool a version of the respective country bloc of the MCM, often complemented by other econometric tools (McGuire and Ryan (2000)). In addition, NCBs have themselves developed multi-country models which can be used in the peer-review process (e.g. Deutsche Bundesbank (2000) and de Bondt et al. (1997)/De Nederlandsche Bank (2000)). NCBs also use, in parallel, a number of different macroeconometric models that focus on different aspects of the economy. For instance, a number of NCBs have developed models based on optimising behaviour and forward-looking expectations which are often used for scenario analysis (e.g. Jeanfils (2000), Kortelainen (2001)) and Willman et al. (1998; 2000)).

Whilst ECB and NCB staff use a variety of approaches to project economic developments, they review their techniques on an ongoing basis. In particular, the exchange of experience and ideas taking place in the WGF and the Working Group on Econometric Modelling, as well as joint efforts to further develop macroeconomic projection tools, will lead to further development in the medium term.

B   Eurosystem projection tools

1   Aggregating the projections

In the context of the discussions between the ECB and the NCB staff an overall euro area projection is obtained. This projection is consistent with the aggregation of country figures, as described below.

The euro area aggregation of the country projections uses methods analogous with those of Eurostat, which involves taking the sum of national concepts in levels expressed as a common unit of measure. The raw data used for the aggregation are the projections in levels in national currencies, the euro conversion rates at the 1995 ECU exchange rate, as well as some specific weights.

The *aggregation of GDP and its expenditure components* at constant prices is performed in a common currency, in this case the 1995 ECU. The GDP deflator and its demand components are derived as the ratio of variables in nominal terms (also obtained by simple sum) divided by the corresponding variables at constant prices. The nominal variables are derived by converting the original nominal variables (in national currency) into a single currency using the 1995 ECU exchange rate. In practice, this amounts to a fixed exchange rate-weighted aggregation, but with variable-dependent and time-varying weights.[6]

The *HICP aggregation* is computed using the exact Eurostat methodology, i.e. as an annual chain index with changing country weights. The weight of a country is its share of the private final domestic consumption expenditure expressed in euro. For the projection period, the latest available set of weights is used.

2   Ensuring trade consistency

In the context of the MPEs, projections are prepared for the individual countries and then aggregated at the euro area level. However, in order for these individual country projections to serve as a reliable guide for area-wide conclusions, it is necessary for them to be fully consistent with each other. The *trade consistency exercise* ensures that individual country projections of trade volume and price variables are consistent with each other as well as being consistent with

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6   Winder, C. (1997), "On the Construction of European Area-Wide Aggregates: A Review of the Issues and Empirical Evidence", DNB Staff Report No. 499.

the assumptions made about the international environment.

Trade consistency can be divided into what can be termed "cross-trade consistency" and "ex ante/ex post trade consistency".

"Cross-trade consistency" ensures that each country's export projection is consistent with the import projections for its trading partners in both volume and price terms. This is assessed using trade shares and various trade equations. Convergence with regard to "cross-trade consistency" is achieved when (i) projected real exports are expected to grow in line with world demand and/or deviations can be explained by changes in competitiveness and/or other factors and (ii) projected export and import prices imply "reasonable" profiles for export and import competitiveness.

"*Ex ante/ex post trade consistency*" ensures that the original assumptions made for each country for external demand variables are updated to remain consistent with the projections obtained for the imports of other euro area countries, with the same kind of consistency being ensured with regard to external competitors' prices. Hence, in successive iterations of the projection, the euro area trade prices will be updated and new measures of competitors' prices will be calculated. Convergence with regard to "ex ante/ex post trade consistency" is achieved when the differences between successive values of world demand and competitors' prices are small enough to be of no practical importance.

Depending on the results of the trade consistency analysis, additional projection rounds or iterations could be required.

3 Reflecting the uncertainty associated with economic projections

As with any similar exercise, the Eurosystem macroeconomic projections are surrounded by considerable uncertainty. To take into account this uncertainty, the Governing Council has decided to publish the projections in the form of *projection ranges*.

The technique used to produce projection ranges is simple. For each variable, a range is applied with a size equal to twice the average absolute value of the differences between actual outcomes and previous macroeconomic projections carried out over a number of years by euro area central banks. In general, the ranges differ depending on the variables and the time horizons involved. They reflect both the different degrees of difficulty in projecting individual variables at different horizons and the effects of discrepancies between the assumptions made for conditioning variables and their subsequent actual values. It should be noted that the tendency of most ranges to widen over the projection horizon reflects the increased uncertainty surrounding projections for the later years. In addition, the ranges tend to be greater for variables with greater intrinsic volatility, such as the growth of gross fixed capital formation.

In addition, to further quantify the impact of various sources of uncertainty, the Eurosystem staff may also present *scenario exercises* to the Governing Council. Such scenario exercises are performed at euro area aggregate level both using the area-wide model and by examining the aggregate of the country effects. The latter exercise is performed by the NCBs, who first compute the direct impacts of the scenario for their respective countries, before ECB staff derive the aggregate euro area impact, taking into account the second-round spillover effects through intra-euro area trade volumes and prices. The results are then discussed by the WGF, as a result of which modifications to the impacts may be made. Both the area-wide model and aggregated country results are presented to the Governing Council.

Conclusions and future developments

This guide to Eurosystem staff macroeconomic projection exercises follows the publication for the first time in December 2000 of the outcome of the staff macroeconomic projections. The projections represent Eurosystem staff views regarding future prospects. As an input twice a year into the monetary policy decisions of the Governing Council, the projections serve as a useful tool for summarising the existing information on current and future economic developments, in addition to the analysis, under the first pillar and other regular analysis, of information under the second pillar. The projections derive from a process that involves close interaction between staff from the NCBs and the ECB, ensuring that the projections are fully consistent both across countries and for the euro area and that they draw on all expertise available.

This guide has described the current procedures and techniques used to derive Eurosystem staff macroeconomic projection exercises. However, there are a number of areas where further developments will take place. In particular, tools and procedures will be updated in the light of newly available information and data, particularly as additional statistical series are released by Eurostat, allowing for more detailed projections of financial accounts for households and enterprises. The improvement of balance of payments projections, including the disaggregation of intra-euro area and extra-euro area trade flows, is another example. Ongoing economic research leads constantly to the development of new and better projection techniques, whilst new economic issues also keep arising which call for developing new approaches and projection tools. An important task of the Eurosystem is to continue to be at the forefront of economic research, and thereby to develop and improve techniques to assist monetary policy.

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