ANALYSIS

# How it’s done – The models and analysis behind the Bank of Finland’s forecasts for the Finnish economy

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The Bank of Finland produces forecasts for the Finnish economy using advanced modelling tools. Central to this process is its Aino model, which is a dynamic stochastic general equilibrium (DSGE) model that integrates various aspects of the Finnish economy. The forecasts support policy decisions within the Eurosystem and are updated regularly. This article describes the forecasting process, model features and their key role in economic analysis at the Bank of Finland.

**Economic forecasting is conducted because economic decisions are largely based on expectations about the future.** Businesses and households plan their economic decisions based on the outlook for the economy. Forecasts are essential information for policymakers, such as governments and monetary policy authorities, who require a detailed and coherent picture, along with a clear narrative, of the current economic situation and outlook.

The impact of monetary policy on inflation and other elements of the macroeconomy typically involves a time lag. For this reason, monetary policy decision-makers need an informed view of how the economy is expected to develop over the time horizon relevant to monetary policy decisions. Therefore**, the preparation of euro area monetary policy and the analysis of its effects necessitate an independent, analytical assessment of economic developments in the immediate years ahead.**

**The Bank of Finland produces its macroeconomic forecasts for the Finnish economy as part of the Eurosystem forecast.**[1] The Bank's forecasts are produced primarily to support preparation of the single monetary policy and related decision-making. Its forecasts form part of the Eurosystem's joint biannual broad macroeconomic projection exercise (BMPE) for the whole euro area.[2, 3] These Eurosystem projections are produced in June and December. Institutionally, the Eurosystem comprises the national central banks of the euro area and the European Central Bank (ECB), and forecasting at the Bank of Finland is conducted as part of a joint and coordinated effort among this large group of institutions. It therefore involves more stages and is a more extensive process than the forecasting conducted by many other domestic forecasting institutions.

**The Bank of Finland's Monetary Policy and Research Department is responsible for the domestic macroeconomic forecast in cooperation with the Eurosystem.** Forecasting and analysing the macroeconomy is one of the most important functions of the Bank of Finland.

**The BMPE forecast for the euro area can be considered a bottom-up forecast**. This means that the national macroeconomic forecasts are first projected by the respective national central banks' staff and are thereafter aggregated to euro area level. The euro area forecast is first presented to the ECB's Governing Council and is then published. The Bank of Finland's macroeconomic forecast for the BMPE projection is also closely linked to its public finances assessment and short-term inflation forecast.

**In addition to the BMPE forecasts, the Bank of Finland produces less comprehensive interim forecasts in March and September.** These are technical updates, where the latest June or December forecast is updated with the most recent data, information provided by short-term model forecasts for the upcoming quarters, and updated external assumptions received from the ECB regarding the international operating environment and financial conditions for the coming years. ECB staff similarly also update the BMPE economic projections in March and August. These interim updates are known as the macroeconomic projection exercise (MPE) forecasts.

**The Bank of Finland employs a sophisticated approach to economic forecasting. It uses a dynamic stochastic general equilibrium (DSGE) model known as 'Aino' as its core forecasting model, and in addition various smaller satellite models.** The Aino model (Kilponen et al., 2016) is central to the forecasting process, as it provides a comprehensive framework that integrates various aspects of the economy and characterizes interdependencies between key variables and sectors in the economy. Put simply, the Aino model is a representation of the Finnish economy.

This article outlines the features and use of the Aino model and complementary satellite models, and the procedures involved in generating accurate forecasts and ensuring a high level of consistency in the forecast numbers and narrative.

## The Aino DSGE model is at the core of the forecast

**The Bank of Finland has a long history of using economic and statistical models to prepare forecasts and assess policy options**. It has relied on such models since the early 1970s and currently uses the Aino 2.0 model as its main tool for forecasting the Finnish economy and conducting scenario analyses.

**Schools of economic thought differ in the emphasis they give to various economic shocks as drivers of business cycles.** The real business cycle theory sees the growth fluctuations in technological advancement as the central source of business cycles. The Aino model builds on this concept, but integrates features of so-called New Keynesian models, such as wage and price rigidities (slowly adjusting wages and prices) and monopolistic firms (businesses with market power), into its structure.

Taking into account rigidities and imperfect competition brings these models significantly closer to the actual functioning of the macroeconomy compared to real business cycle models. **As a New Keynesian small open economy DSGE model, Aino provides a comprehensive characterization of the Finnish economy. This has been the motivation for its use as a central tool for economic analysis and forecasting at the Bank of Finland.** The Aino model also shares similarities with models employed by other central banks, such as Sweden's Riksbank with its Maja model, and the ECB's New Area-Wide Model (NAWM).

**DSGE models are built on economic theory and calibrated or estimated using observed statistical data.** The Aino model represents a small open economy, meaning it accounts for Finland's interactions with the global economy, including trade and financial flows. The Finnish economy is affected by global developments, but Finnish developments hardly affect the global economy. This asymmetry is also accounted for in the model.

**One of the most important uses of New Keynesian DSGE models is to assess how monetary policy, and consequently variations in interest rates, affect the economy**. With Finland being a small member of the eurozone, the ECB's monetary policy is treated in the Aino model as exogenous to developments in the domestic economy.[4]

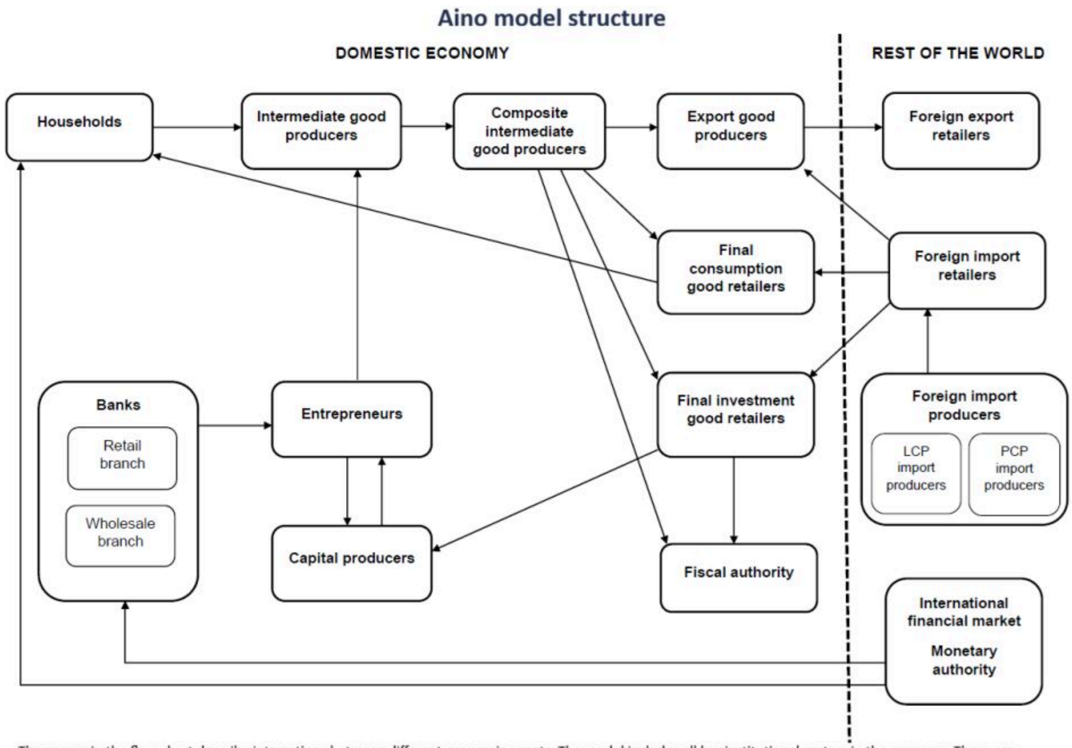
**In DSGE models, the economy is assumed to follow a long-term growth trend, but with cyclical deviations from this trend due to business cycle movements stemming from various kinds of economic shocks**. If the economy is not subjected to new disturbances, the impact of a shock will subside over time and the economy will return to its original equilibrium, in other words to its long-term growth trend. General equilibrium models, such as Aino, have been developed especially for analysing business cycle dynamics.

**Economic shocks can stem from various sources,** such as changes in foreign demand, disruptions in financial markets, shifts in domestic markups[5], wages or consumer preferences. These shocks can, in turn, give rise to upswings or downturns, potentially leading to overheating of the economy or triggering recessions. For example, a fall in foreign demand for Finnish exports may lead to a downturn in the economy, because when Finnish exports decline, the demand for domestic inputs may consequently cool down too.

It is typical for general equilibrium models that **shocks have both direct and indirect effects** on real variables such as private consumption, exports and gross domestic product (GDP), as well as on relative prices. For example, if wages rise unexpectedly in Finland, firms' production costs will increase. The immediate consequence of wage increases is an increase in the cost level and a subsequent upward pressure on prices. If, at the same time and all else being equal, wages elsewhere in the world remain unchanged, Finnish firms may experience reduced price competitiveness, which could lead to lower demand for Finnish goods abroad.

**The structure of the Aino model is illustrated in Chart 1**. The model includes all key institutional sectors in the economy. These are households, firms, banks and the government sector, each making decisions based on incentives and constraints. For example, households consume, work and save; firms produce goods and set prices; banks lend to businesses; and the government sector collects taxes and spends on public services. These agents interact in markets, and their behaviour is influenced by various shocks − such as changes in productivity, foreign demand or interest rates − that the model simulates to understand their impact on the economy.[6]

Chart 1.




The arrows in the flow chart describe interactions between different economic agents. The model includes all key institutional sectors in the economy. These are households, firms, banks and the government sector, each making decisions based on incentives and constraints. For example, households consume, work and save; firms produce goods and set prices; banks lend to businesses; and the government sector collects taxes and spends on public services. LCP means local currency pricing, i.e. businesses that price their products in euros. PCP means producer currency pricing, i.e. businesses that price their products in foreign currency.

Source: Bank of Finland.



The description of households in the model has been simplified to make the model more straightforward for use in forecasting. **The model therefore has only one type of representative household**, and this is meant to capture the behaviour of the household sector as a whole. The representative household maximizes its utility and adjusts its consumption habits slowly.

One of the features of Aino is its ability to **incorporate financial frictions and banking sector dynamics**. The model includes a monopolistically competitive banking sector, which allows it to simulate how changes in banking regulation, such as banks' capital requirements, or in lending conditions affect the broader economy.

**The model also captures wage and price rigidities, meaning that wages and prices do not adjust instantly** to changes in economic conditions – an important aspect when analysing short-term fluctuations. This is important because the slow adjustment of wages and prices forces economic actors to adapt to cyclical fluctuations by adjusting quantities (e.g. by adjusting employment or the quantities sold by firms).

**In short, Aino is a structural model that simulates the Finnish economy and helps to understand its functioning.** The model builds on economic theory and is estimated using Bayesian methods, which combine the prior knowledge and beliefs of economists with observed data to improve forecast accuracy.[7] As a DSGE model, Aino consists of a system of mathematical equations that illustrate the interdependencies between the key variables of the Finnish economy, such as GDP, inflation and foreign trade. The model helps the Bank of Finland's economists interpret developments in the Finnish economy and assess the likely effects of future developments in, for example, the global economy. The Aino model is continuously being developed further at the Bank of Finland.[8]

## The forecasting process needs a robust information and data analytics system

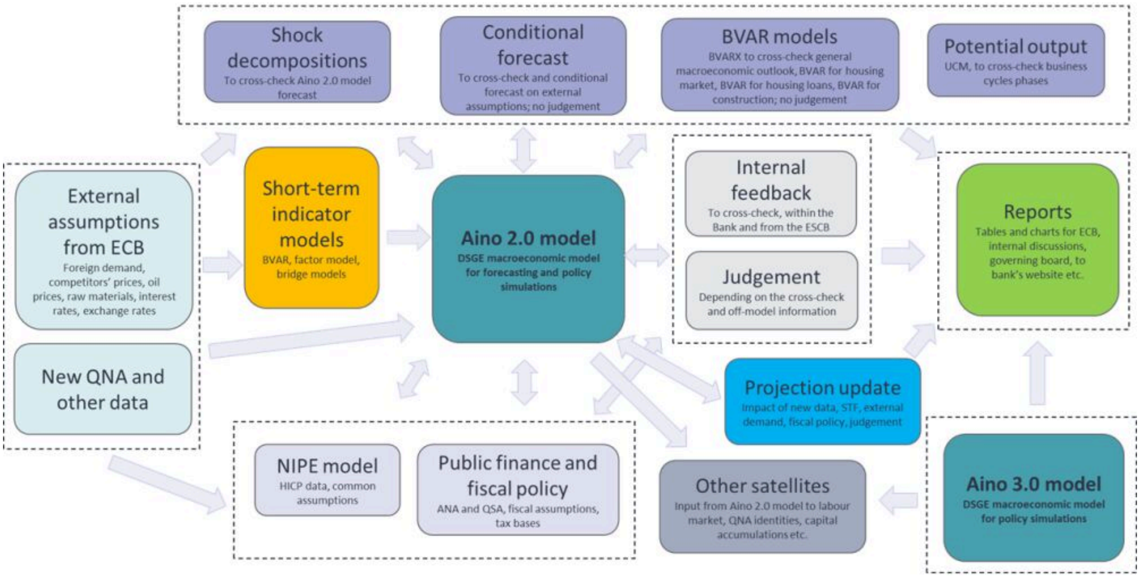
**Forecasting techniques and information systems have developed rapidly over the course of the last 20 years.** They now allow for richer and more efficient ways of forecasting and using models in forecasting than when the Aino model was originally introduced in 2004. Because the forecast for the Finnish economy is produced in cooperation with the Eurosystem and forms an input into the euro area forecast, the timeline and procedural requirements of the June and December forecasting rounds are set by the ECB. To successfully manage the forecasting process in line with the requirements and within a given schedule, it is essential to have an easy-to-use and robust information system as a tool for preparing macroeconomic forecasts. The Bank of Finland's forecasting hub, incorporating the Aino model and integrated elements, is illustrated in Chart 2.

**The Aino model is used in an in-house and on-premise forecasting system featuring a state-of-the-art user interface.** It includes robust versioning of forecasting rounds and the interim steps within each round. Both the data and the model codes used in each round are saved and well documented. In other words, all forecast rounds are recorded including the ongoing current forecast. This enables the forecasters to return to previous versions of forecast outcomes and reproduce results if there is a need.

**Matlab software is a key application in forecasting with the Aino model** as well as the various satellite models. Aino uses Matlab together with suitable add-ons. Excel is used as a user interface and primary reporting system.

Chart 2.

**Bank of Finland's forecasting hub: The core Aino model and integrated elements**




The DSGE model Aino 2.0 stands at the core of the Bank of Finland's forecasting process and serves as a central hub for integrating various elements. STF means short term forecast; QNA means quarterly National Accounts; ANA means annual National Accounts; QSA means Quarterly Sectoral Accounts; BVAR(X) means Bayesian vector autoregressive model (with exogenous variables); UCM means unobserved component model; NIPE means Narrow Inflation Projection Exercise; and HICP means Harmonized Index of Consumer Prices.

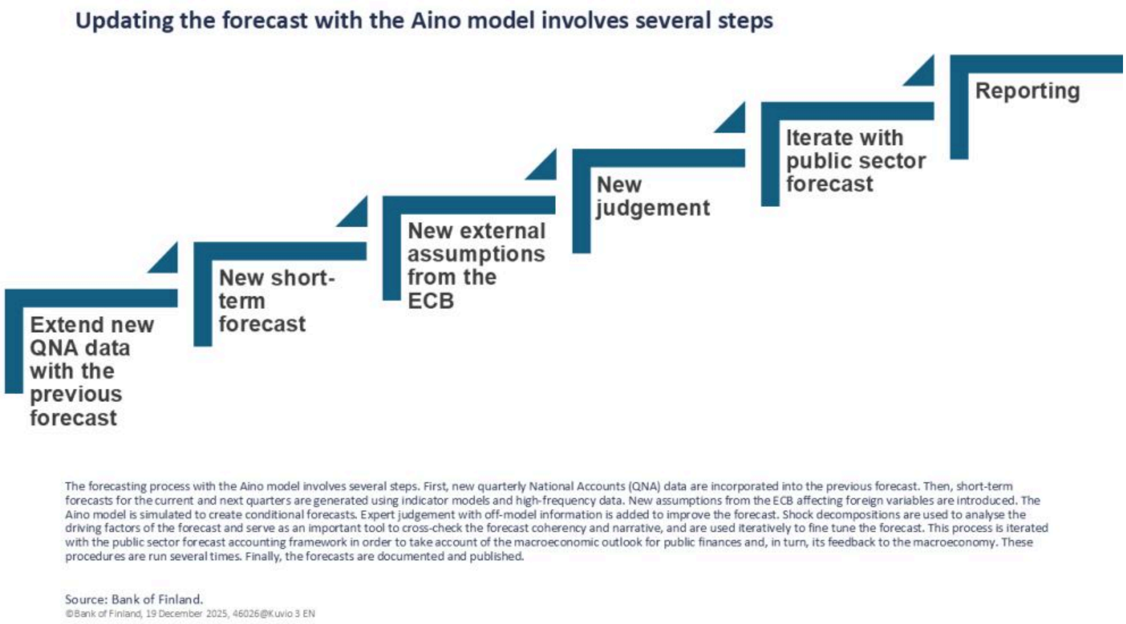
Source: Bank of Finland.



## Projection update: the steps of making a new forecast

**The forecasting process with the Aino model involves several steps.** The forecast is created in cooperation between the model and the economist. The forecast is not created directly by the model, but in combination with the possible judgement of economists. The model is used to assess the internal consistency of the forecast. This process is conducted multiple times during a forecast round (Chart 3).

Chart 3.




**To understand how and why a forecast has changed from the previous forecast, it is essential to examine the different components involved in the projection update process.** These components are new data, nowcasting (i.e. short-term forecast), external assumptions and expert judgement, each playing a pivotal role in shaping the final forecast (Table 1). In addition to these and if need be, it is possible to estimate the impact of fiscal policy.

| Comparison to previous forecast (June BMPE 2024) | | | | | |
|---|---|---|---|---|---|
| **Difference in GDP growth rate, percentage points** | **2022** | **2023** | **2024** | **2025** | **2026** |
| New data | 0.0 | -0.2 | 0.1 | 0.1 | 0.0 |
| New short term (t+1, t+2) | 0.0 | 0.0 | -0.1 | -0.2 | 0.0 |
| New external assumptions* | 0.0 | 0.0 | -0.0 | 0.0 | 0.1 |
| Judgement | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | |
| GDP Sep 2024 BoF interim | 1.3 | -1.2 | -0.5 | 1.1 | 1.8 |

*Source: Bank of Finland.*

| Comparison to previous forecast (June BMPE 2024) | | | | | |
|---|---|---|---|---|---|
| GDP June 2024 BMPE | 1.3 | -1.0 | -0.5 | 1.2 | 1.7 |
| *Assumptions taking effect as of 2024Q4 | | | | | |
| The table shows an example from the Bank of Finland's September 2024 Interim Forecast, illustrating where the GDP forecast has changed from the previous forecast. The upper section of the table shows the difference in the GDP growth rate, in percentage points. The lower section of the table shows growth rates as year-on-year percentages. External assumptions take effect as of 2024Q4. The new short term is the nowcast for the current (t+1) and next quarter (t+2). | | | | | |

*Source: Bank of Finland.*

**The first component is new data.** This involves the incorporation of new quarterly National Accounts (QNA) data, released after the previous forecast, into the existing forecast. This step ensures that the most recent and accurate information is used as the foundation for the forecasts. Data updates provide real-time insights into economic trends and enable the model to adjust its predictions accordingly. By continuously integrating fresh data, the model remains responsive to the latest developments in the economy. The most important QNA data needed in the forecast consists of GDP data and data on its sub-components such as private consumption, public consumption, private investment, exports and imports. Furthermore, labour market data, such as the wage sum, hours of work and the number of employees, are used in the model and its satellites.

**Second, nowcasting models are utilized to assess short-term economic conditions and generate forecasts for the current and next quarters, especially concerning GDP.** These models are necessary because of the considerable time lag before the release of QNA data. The models rely on high-frequency data to produce real-time predictions of quarter-on-quarter GDP growth. High-frequency data refers to economic indicators that are updated more frequently than traditional quarterly or even monthly data. Examples of high-frequency data include daily financial market prices, monthly labour market data, retail sales, and consumer and business surveys. By incorporating such information, the forecasting process can respond more quickly to recent economic developments, allowing for more timely and accurate short-term projections. With these nowcasts, the Bank of Finland can capture immediate economic signals and refine its forecasts with greater accuracy.

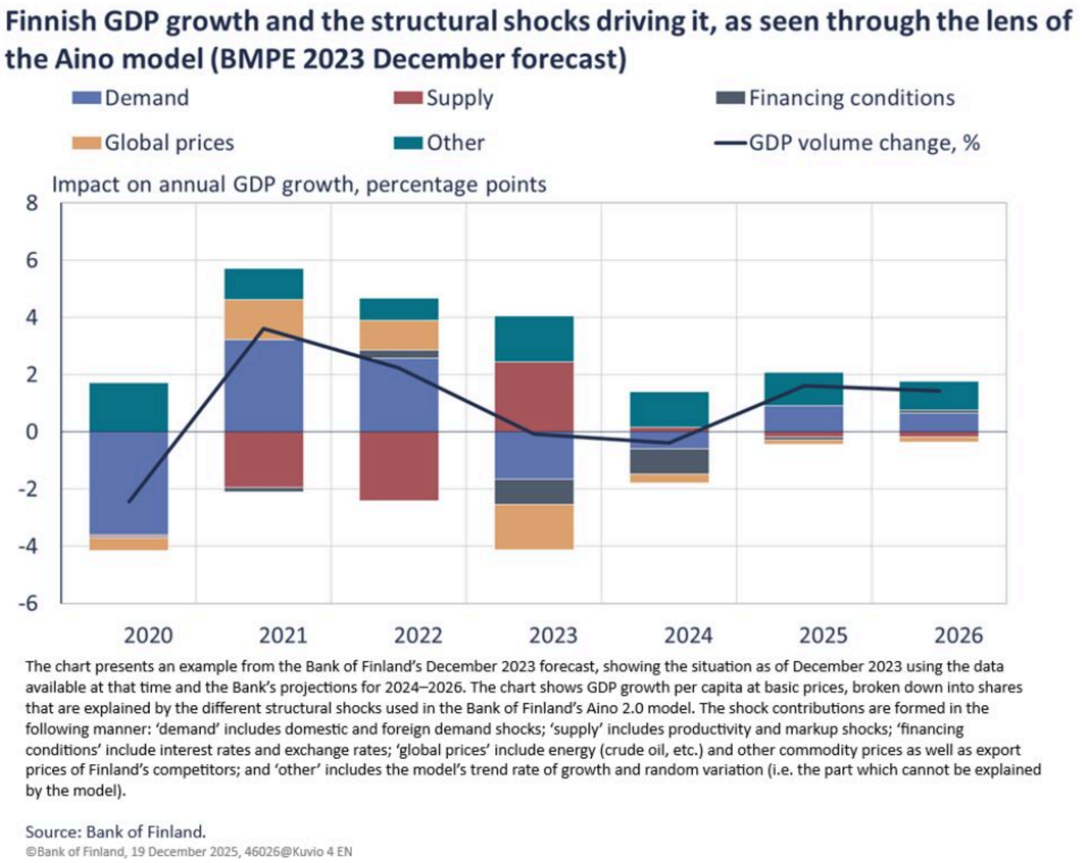
**The third component for the forecast is a set of assumptions that describe the international environment in which the Finnish economy operates.** As the Bank of Finland forecast is produced in cooperation with the Eurosystem and forms part of the euro area forecast, the external assumptions for the international environment are provided by the ECB and are used by all euro area countries. These assumptions encompass various foreign variables that affect the domestic economy, such as prices of commodities and energy, exchange rates, interest rates and export demand. Finland is a small open economy and therefore the external assumptions made are particularly important in forecasting the path of the Finnish economy. By incorporating these external factors, the model creates conditional forecasts that take account of international factors. As soon as new external assumptions become available, their effects on the real economy and on inflation are reported and analysed. This step ensures that the forecasts are not solely based on domestic data but also consider the broader global economic context.

**Finally, expert judgement is a vital component that further refines the forecasts.** Economists add new information to the forecast on the basis of insights into macroeconomic dynamics that the simplified structure and internal logic of the model are unable to capture. Off-model information, such as sector-specific insights, internal discussions, peer review scrutiny from other ESCB central banks, and analysis of the shocks that are driving the economy (shock decompositions), are integrated into the model to enhance its accuracy (Chart 4). This step allows for the incorporation of qualitative factors that may not be captured by the quantitative models alone. It allows economists to use their experience and knowledge in order to consider the limitations and possible biases of the model. The iterative process of adding expert judgement and off-model information continues until the forecasts are deemed to have reached a satisfactory level of consistency.

**The great advantage of using a DSGE model in forecasting is its ability to interpret observed and projected future business cycle fluctuations through the lens of the underlying economic shocks** that cause them, providing a theoretically grounded narrative for the forecast. A shock decomposition provides a breakdown of each economic variable, at each point in time, into a combination of the underlying economic shocks driving its evolution.

**The final shock decompositions produced with the Aino model incorporate the observed data, assumptions and expert judgement.** The Finnish economy has gone through a number of major disruptions in recent years, which have led to significant cyclical fluctuations. The Bank of Finland's Aino 2.0 model can be used to interpret cyclical fluctuations and to assess the significance of different economic shocks in terms of these fluctuations. Chart 4 breaks down GDP growth in 2020–2026 into factors that explain the economic fluctuations of the data and the forecast made in December 2023. For example, after the initial shock caused by the COVID-19 pandemic, the recovery of domestic and foreign demand strongly supported economic growth ('demand' in Chart 4), but the widespread supply disruptions caused by the pandemic also slowed economic growth in 2021 and 2022 ('supply' in Chart 4). These abrupt changes in demand and supply combined with the rise in raw material prices driven by Russia's war in Ukraine led to a surge in global prices.

Chart 4.

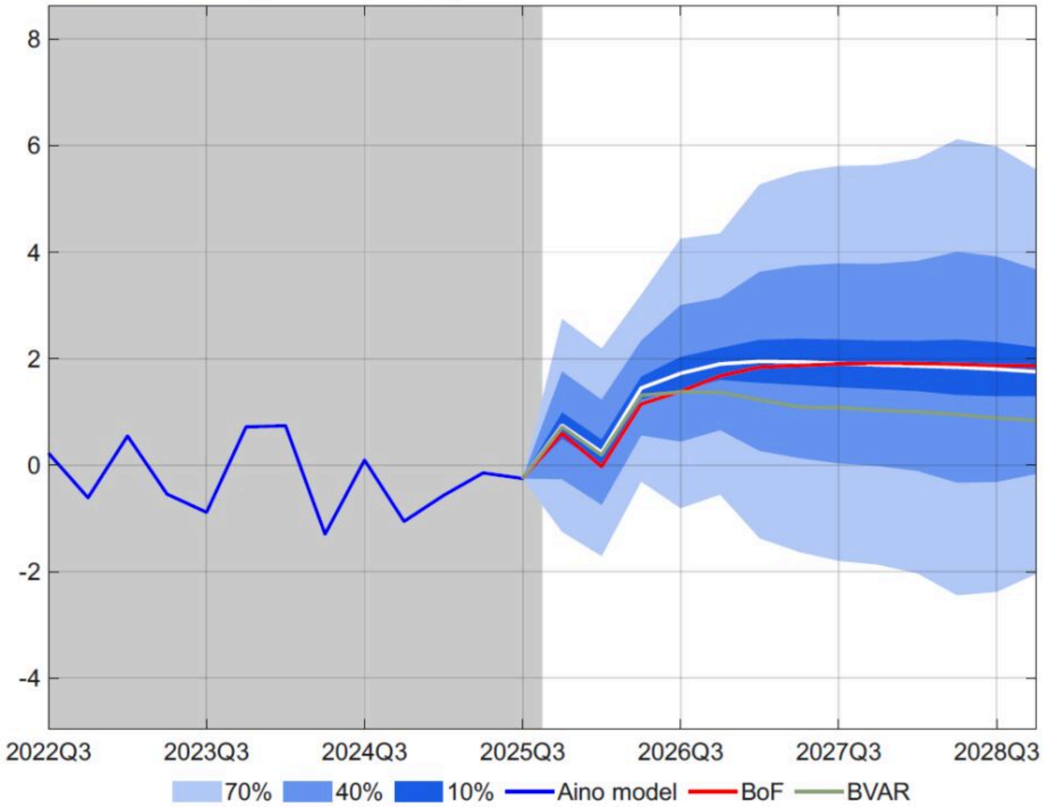



## Conditional model forecasts: new external assumptions without expert judgement

**An essential aspect of the forecasting process at the Bank of Finland is the creation of conditional model forecasts for all key macroeconomic variables.** For this purpose, the model is conditioned upon external assumptions produced by the ECB and does not include any previous or new expert judgement. The external assumptions contain development of the most important export markets of Finland, interest and exchange rates and the price of crude oil and other industrial commodities, to name just a few. These forecasts are visualized using fan charts that display the range of potential outcomes. The fan charts serve as a visual tool to assess the uncertainty surrounding the forecasts, providing a clear depiction of the possible scenarios that could unfold (Chart 5).[9]

Chart 5.

**A fictitious example of a cross-check of the baseline forecast against conditional model forecasts (year-on-year, %)**




This chart presents a fictitious example and is not a Bank of Finland forecast. The blue line and uncertainty bands represent a conditional DSGE model forecast of private consumption growth (year-on-year, %), produced with the Aino model. The red line is the baseline forecast, which includes expert judgement. The green line is a conditional BVARX forecast. Fancharts are calculated based on forecast root mean squared errors of the Aino model.

Source: Bank of Finland.



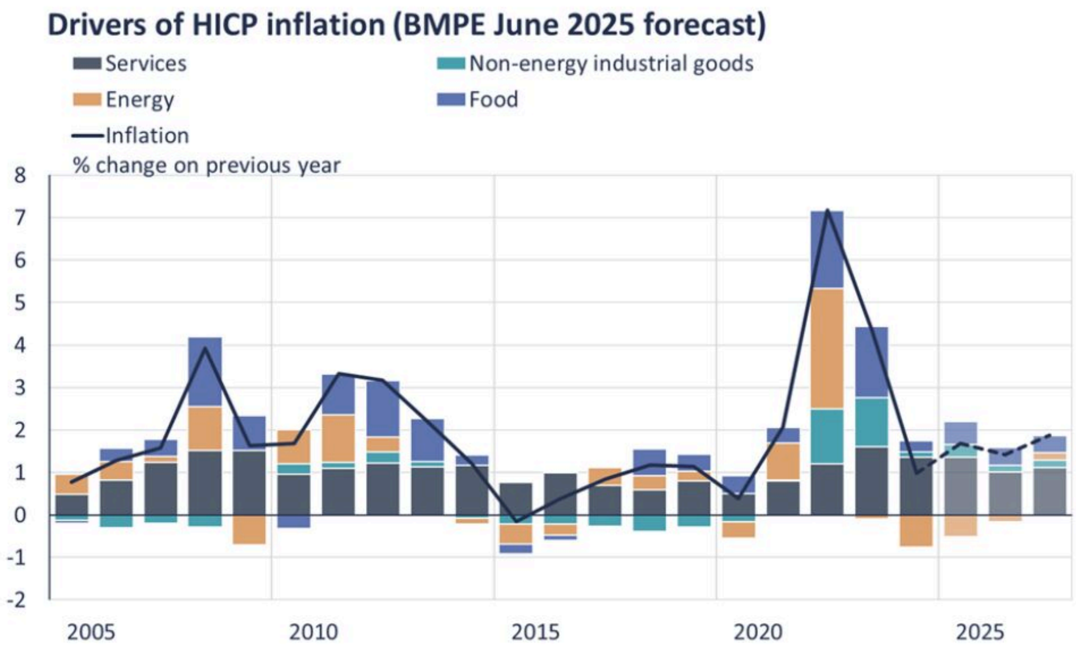
**Conditional model forecasts are a useful tool for cross-checking the baseline forecasts.** They are an instrumental device in understanding how much expert judgement in total has been included in the forecast.[10] It is also important to run conditional forecasts based on data and assumptions by using other models as well so as not to be over-reliant on just one model's outcome.[11] Unlike the baseline forecasts, these conditional forecasts do not incorporate any expert judgement and are purely model based. They help to highlight how external assumptions influence the forecast without the previous expert judgement. This contrasts with projection updates, which also take into account how the changes in assumptions since the previous forecast affect the projections while retaining the previous forecast's expert judgement.

## Satellite models and making short-term assessments with nowcasting models

**To enhance the robustness of the forecasts, the Aino model is complemented by various satellite models that provide additional insights into specific areas of the economy.** DSGE models such as Aino 2.0 have limitations on how detailed and granular they can be, and therefore it is not possible to include all economic information or all the complexities of the economy into the core model. For this reason, a wide range of satellite models are estimated and used actively. These satellites include models for inflation forecasts using the Harmonized Index of Consumer Prices (HICP), and models for labour market variables such as unemployment and employment. The output of these models serve as input for the Aino model forecast.

Inflation forecasts are one of the key elements in the background of the monetary policy decision-making and are of crucial importance to central banks. Hence, **a short term inflation projection known as the Narrow Inflation Projection Exercise (NIPE) is conducted by the ECB in cooperation with Eurosystem staff.** It is produced using a bottom-up approach in which the HICP is forecast through its sub-components and the aggregate cross-checked with other models.[12] The bottom-up approach allows identification of the drivers of inflation, which may vary over time. The NIPE forecast also uses common external assumptions prepared by the ECB, and its inputs include the macroeconomic forecast generated with the Aino model. As an example, in the recent build-up of high inflation over the years 2022–2023, energy prices were the initial drivers of inflation in Finland and the euro area, followed by other items such as food, industrial goods and services (Chart 6).

Chart 6.



This example is from the BMPE June 2025 forecast and presents the Harmonized Index of Consumer Prices (HICP) and its forecast (year-on-year, %). The contributions of the main components are produced by the Narrow Inflation Projection Exercise (NIPE) and the Aino model.

Sources: Eurostat and forecast by the Bank of Finland.



**A fiscal projection is important for the forecast and is also required by the ECB. The Bank of Finland's** fiscal forecast is not a model-based projection but is constructed by using a forecasting platform for fiscal variables, which is an accounting framework based on the sectoral tables of the National Accounts. The fiscal projection is produced jointly with the macroeconomic forecast in an iterative process. It accounts for discretionary fiscal policy measures and automatic stabilizers, as well as changes in tax bases generated by the Aino model.[13] Furthermore, the impacts of discretionary fiscal policy on the macroeconomy are assessed using the Aino model and are then fed back into the fiscal projection through the induced changes in tax bases.

**Other key satellite models include a shadow forecast that utilizes a statistical BVARX model for cross-checking the general macroeconomic outlook, as well as a model for potential output (Sariola, 2019).** Bayesian autoregressive models with exogenous variables (BVARX) are widely used in economic forecasting.[14] The potential output model, in turn, helps in forming a consistent view of the supply side (i.e. capital, labour and total factor productivity) of the economy and determining the phase of the business cycle and the available slack in the economy. Indicators to measure these include the output gap and the unemployment gap, which characterize how far the total economy is from its potential level of output and how far the unemployment rate is from structural unemployment. Other important satellite models include a model for household loans (Nyholm and Silvo, 2022), and a conditional model forecast for the housing sector. There is also a further inflation satellite model that can be used in policy simulations, in addition to the previously mentioned NIPE model.[15]

**Satellites also generally contain key QNA and other identities, which receive their input from the core Aino model.** These models do not have direct feedback into the core Aino model, with the exception of possible expert judgement that can be incorporated into the core macroeconomic forecast based on the satellite model outputs. A number of accounting identities are calculated in the satellites. These include for instance, various savings rates, capital accumulation and the current account.

**The Bank of Finland's model toolkit also includes Aino 3.0, the latest in the Aino DSGE model family that is used for scenario and policy analysis (Silvo and Verona, 2020).** The Aino 3.0 model closely follows the structure of Aino 2.0. Unlike Aino 2.0, however, the Aino 3.0 framework incorporates a limited form of household heterogeneity, a housing market, a housing construction sector, and long-term adjustable-rate mortgages. In Aino 3.0, a proportion of households are assumed to be net savers, and the rest are net borrowers with limited ability to adjust to economic shocks. This division, while simple, allows the model to capture the key macroeconomic implications of the economic constraints and vulnerabilities faced by some households. The Aino 3.0 model aims at capturing the most relevant macro-financial linkages in the Finnish economy and provides a rich laboratory for the analysis of various macroeconomic scenarios and policies.

**Nowcasting models are employed by the Bank of Finland for assessing short-term economic conditions**. These models incorporate many variables, including confidence indicators and manufacturing and labour market indicators. The set of nowcasting models includes a BVAR, a FAVAR (Factor-Augmented Vector Autoregression) and a bridge model. The BVAR model, for instance, which is specified in log-levels and incorporates over 40 variables, helps in making real-time predictions of GDP growth (Itkonen and Juvonen, 2017).[16] The results of the BVAR model are published in real time on the Bank of Finland's Nowcast web page, and an automated robot economist publishes them on social media.

## Conclusion

**The Bank of Finland's forecasting process is thorough and multifaceted, involving the core Aino 2.0 DSGE model and a host of satellite models that enhance the overall accuracy, consistency and reliability of the forecasts.** The structured procedures and the integration of various data inputs and expert judgement ensure that the forecasts are robust and reflect the current economic conditions and off-model information. The use of fan charts and conditional model forecasts further bolsters the forecasting process, providing comprehensive cross-checks and a more nuanced view of the potential economic outcomes. Finally, internal discussions within the Bank of Finland and the ESCB complement the expert judgement and improve the accuracy and consistency of the forecasts.

**No macroeconomic model can ever be considered truly complete**. Building and improving models for policy analysis is an ongoing process, with each iteration offering opportunities for further refinement and advancement. The Aino 2.0 model, actively used at the Bank of Finland for macroeconomic forecasting and scenario analysis, has undergone numerous modifications and re-estimations since its initial publication. These developments have significantly enhanced its empirical fit and forecasting performance, thereby increasing its value as a tool for policy analysis. Nevertheless, the model will undoubtedly continue to evolve, adapting to new data, methodologies and policy challenges. This continuous process of improvement will ensure that the model remains relevant and robust in a changing economic environment. In addition, improved satellite models and new short-term models, as well as models based on various methodologies, are constantly subject to examination and testing.

**It is nevertheless important to highlight that all economic models are only auxiliary tools which support and help economists to form an accurate picture of the economy.** No model is perfect or able to take into account all the complexities of the economy, and for this reason expert judgement is an important part of the forecasting process. Neither can economic models forecast crises such as wars and pandemics. Instead, they can be advantageous tools for describing the consequences of such crises and for creating alternative scenarios in an uncertain world.

## Notes

1. The Bank of Finland's Monetary Policy and Research Department is responsible for the domestic macroeconomic forecast. ↑
2. See ECB (2016), 'A guide to the Eurosystem/ECB staff macroeconomic projection exercises' and Ciccarelli et al. (2023), 'Why we need models to make projections'. ↑
3. For more on the procedures, see Obstbaum, Viertola, Sariola and Juvonen (2021), 'Miten malleja käytetään Suomen talouden ennustamisessa?' (in Finnish). ↑
4. In other words, monetary policy is not determined by the Aino model. ↑
5. That is, how much firms have market power to set their prices. ↑
6. More specifically, the Aino model incorporates monopolistic competition, intermediate goods production, importers and exporters. It accounts for nominal rigidities in the pricing of domestic intermediate goods, export and import goods, wages and lending

rates. The banking sector is also characterized by monopolistic competition and an incomplete, although relatively fast pass-through of short-term interest rates to bank lending rates. Banks are subject to binding capital requirements. Additionally, the model features adjustment costs for both physical investments and bank capital. It also includes various structural shocks, such as productivity shocks, markup shocks and monetary policy shocks. Due to the rigidities, the economy adjusts only slowly to these shocks. The rest of the world is assumed to be fully exogenous from the perspective of the domestic economy. Euro area monetary policy is also assumed to be fully exogenous. For a more technical description of the model, see Kilponen et al. (2016). ↑

7. The model is estimated using Finland's quarterly National Accounts data. Quarterly National Accounts are official statistics that provide a regular snapshot of the overall economic activity of a country, including measures such as GDP, household consumption, and investment, updated every three months. ↑
8. Recently, the Aino model was updated to use log-level data rather than data on detrended quarter-over-quarter growth rates. This has improved its forecast performance and enabled a more accurate cyclical analysis (Juvonen and Sariola, 2025). The model is periodically re-estimated using Bayesian methods. ↑
9. Fancharts are calculated on the basis of forecast root mean squared errors (FRMSE). ↑
10. Total expert judgement includes expert judgement from the previous forecast and the new additional expert judgement. ↑
11. Other models refer to e.g. BVARs. See also Chart 2. ↑
12. The sub-components are services, processed and unprocessed food, industrial goods and energy. ↑
13. Tax bases include, for example, the value of private consumption, the value of GDP, and the total wage sum. ↑
14. The parameters of the model are estimated with Bayesian estimation methods. ↑
15. The models for household loans, for the housing sector and for HICP inflation are Bayesian vector autoregressive models. ↑
16. Itkonen and Juvonen (2017), 'Nowcasting the Finnish economy with a large Bayesian vector autoregressive model', BoF Economics Review 6/2017. Link to the real time model forecast. For FAVAR, see Kostiainen, Orjasniemi and Railavo (2013), 'Lyhyen aikavälin ennustemalli Suomen kokonaistuotannolle,' BoF online, 3. ↑

## Key words

Aino model, forecast, general equilibrium model