

## An Update of FR-BDF Basic Model Elasticities and the FR-BMEs Model: A Simplified Forecasting Platform for Banque de France Macroeconomic Interim Projections

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### ABSTRACT

This paper has two objectives. First, it updates the set of Basic Model Elasticities (BMEs) of the Banque de France's semi-structural macroeconomic model for France (FR-BDF), initially presented in 2020. Since then, FR-BDF has been enhanced with detailed blocks for household credit and housing markets, corporate financing, and fully re-estimated following the release of national accounts in base 2020. The BMEs reported here reflect these improvements and remain constructed under an orthogonality principle, providing analytical responses to isolated shocks that can be combined to design alternative scenarios. Second, the paper introduces FR-BMEs, a simplified, linearized model based on FR-BDF BMEs, which has been used since March 2024 for interim projections. While this approach improves efficiency, it reduces the granularity of projections, notably for public finances and household income. FR-BMEs also supports policy analysis, including model-based forecast-error decomposition. We illustrate this with a post-mortem of the 2024 GDP growth forecast error from the December 2023 Banque de France's projection. Actual growth reached 1.1 % versus a forecast of 0.9 %, implying a +0.2pp error. This discrepancy mainly reflects historical data revisions (+0.16pp) and, to a lesser extent, changes in Eurosystem assumptions (+0.05pp). By coincidence, revisions in public finance assumptions (+0.28 pp) and errors in expert judgement (- 0.28pp) offset each other.

Keywords: Semi-Structural Modelling, Macroeconomic Forecasting, Macroeconomic Policy Analysis

JEL classification: E17, E6

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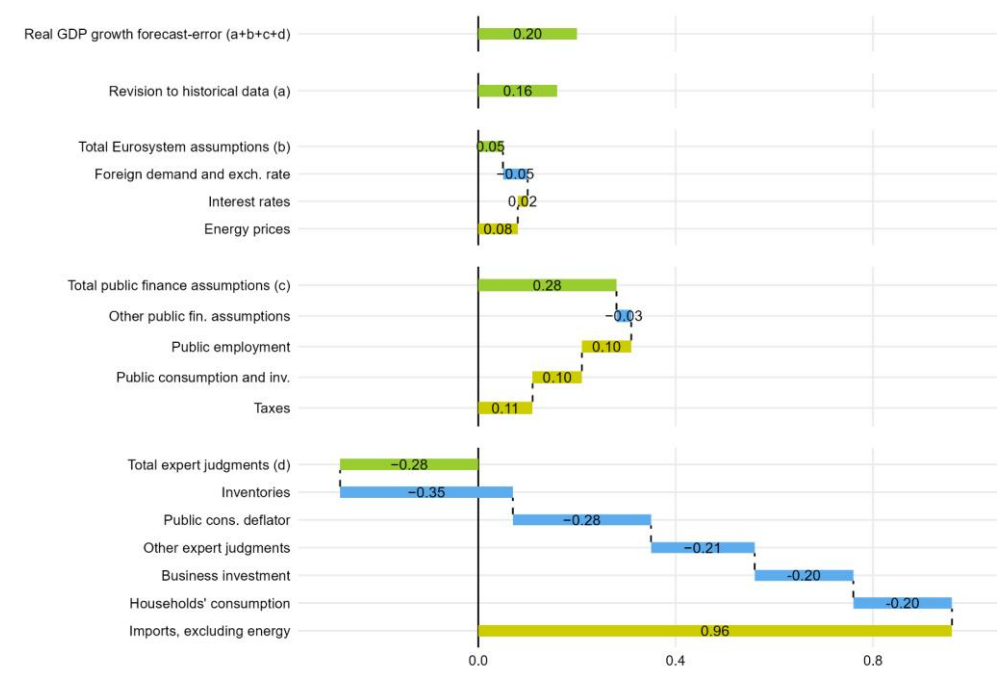
## NON-TECHNICAL SUMMARY

This paper presents two developments in the macroeconomic modelling tools used by the Banque de France for forecasting and policy analysis.

The first is an updated set of Basic Model Elasticities (BMEs), which describe how the macroeconomic model FR BDF reacts to a range of standardized shocks. BMEs are constructed according to an orthogonality principle, meaning that only one variable is perturbed at a time and that only the endogenous core of the model remains activated. This allows the elasticities to be interpreted as analytical building blocks: their effects can be combined additively to construct alternative scenarios or to explore the transmission of different types of shocks. These elasticities have been recalculated following the full re estimation of the FR-BDF model in 2024, a process that incorporated the national accounts rebased to 2020 and integrated new modelling blocks, including household credit and housing, as well as corporate financing.

The second contribution is the introduction of FR BMEs, a simplified and linearised forecasting platform derived directly from these elasticities. Since March 2024, FR BMEs has been used for the Banque de France’s interim projection exercises conducted in March and September, while the full FR BDF model remains the benchmark for the semi annual Eurosystem Broad Macroeconomic Projection Exercises. The simplified model substantially improves operational efficiency during interim projection rounds, in which most revisions stem from updated data and changes in technical or fiscal assumptions. This gain in efficiency, however, comes with certain trade offs, as FR BMEs does not generate detailed projections for public finances or for household income, savings, and corporate margins. Nonetheless, FR BMEs remains fully consistent with the dynamics of FR BDF and is well suited both for forecasting and for counterfactual analysis.

**Figure 1. Breakdown of 2024 real GDP growth forecast error (observed data-forecast)**



Reading note: Errors on assumptions provided by the Eurosystem led to underestimate 2024 real GDP growth by 0.05 pp, with the impact of the error on foreign demand and exchange rate assumptions being more than offset by the impact of the error on interest rate and energy price assumptions. Overall, errors on Eurosystem assumptions have had a relatively small impact on the total forecast error of 0.20 pp.

Sources: Insee (National account data as of May 2025) and Banque de France forecast (December 2023 BMPE)

The paper illustrates the usefulness of this framework through a model based decomposition of the 2024 real GDP growth forecast error associated with the December 2023 projection. Actual GDP growth reached 1.1 percent in 2024, compared with a forecast of 0.9 percent. Using FR BMEs, the

paper decomposes this 0.2 percentage point forecast error into distinct and interpretable components. Revisions to historical national accounts data account for most of the discrepancy, contributing +0.16 percentage point, through an upward revision of the 2024 carry over. Updated international and technical assumptions contribute +0.05 percentage point, with small and offsetting errors in foreign demand, energy prices, and interest rates. Public finance assumptions—particularly regarding public investment, employment, and tax revenues—contribute +0.28 percentage point. These factors are offset almost entirely by expert judgement errors, which subtract –0.28 percentage point and stem largely from unexpected developments in domestic demand and imports.

Overall, the paper illustrates how the BMEs and the FR BMEs model enhance transparency and analytical clarity in the forecasting process. They make it possible to translate changes in assumptions or incoming data into a coherent macroeconomic projection, to disentangle the different origins of forecast errors, and to provide policymakers with internally consistent and readily interpretable scenarios for the French economy.

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## Actualisation des BMEs du modèle FR-BDF et développement du modèle FR-BMEs : une plateforme simplifiée pour les projections macroéconomiques intermédiaires de la Banque de France

### RÉSUMÉ

Cet article poursuit deux objectifs. Il actualise, d'une part, l'ensemble des Basic Model Elasticities (BMEs) du modèle macroéconomique semi-structurel de la Banque de France pour la France (FR-BDF), initialement présenté en 2020. Depuis lors, FR-BDF a été enrichi de blocs détaillés relatifs au crédit aux ménages et au marché du logement, au financement des entreprises, et a fait l'objet d'une réestimation complète à la suite de la publication des comptes nationaux en base 2020. Les BMEs présentées ici reflètent ces évolutions et demeurent construites selon un principe d'orthogonalité, afin de fournir des réponses analytiques à des chocs isolés pouvant être combinées pour élaborer des scénarios alternatifs. Il introduit, d'autre part, FR-BMEs, une version simplifiée et linéarisée de FR-BDF fondée sur ces BME, utilisée depuis mars 2024 pour les projections intermédiaires. Si cette approche permet des gains d'efficacité, elle réduit la granularité des projections, notamment pour les finances publiques et le revenu des ménages. FR-BMEs constitue également un outil d'analyse économique, en particulier pour la décomposition, fondée sur le modèle, des erreurs de prévision. L'article l'illustre à partir d'une analyse a posteriori de l'erreur de prévision de la croissance du PIB en 2024 dans la projection de la Banque de France de décembre 2023. La croissance observée s'est établie à 1,1 %, contre une prévision de 0,9 %, soit une erreur de +0,2 point de pourcentage. Cet écart s'explique principalement par les révisions des données historiques (+0,16 point) et, dans une moindre mesure, par l'évolution des hypothèses de l'Eurosystème (+0,05 point). De manière fortuite, les révisions des hypothèses de finances publiques (+0,28 point) et les erreurs de jugement d'expertise (-0,28 point) se compensent exactement.

**Mots-clés :** modélisation macroéconomique semi-structurelle, prévision macroéconomique et analyse de politique économique

Les Documents de travail reflètent les idées personnelles de leurs auteurs et n'expriment pas nécessairement la position de la Banque de France. Ils sont disponibles sur [publications.banque-france.fr](https://publications.banque-france.fr)

## Acknowledgments

This work is the result of three collective efforts.

First, it builds on the outstanding contribution of the macroeconomic modelling team, whose current members are Anna Petronevitch, Caterina Seghini, and Harri Turunen, along with former members Ugo Dubois and Anastasia Zhutova. They successfully managed a major transition of IT infrastructure—moving from the TROLL language to Matlab/Dynare—with the invaluable support of Stéphane Adjemian, Michel Juillard, and Sébastien Villemot from the Dynare development team, while simultaneously re-estimating the FR-BDF model in 2024. We are also deeply grateful to Matthieu Lemoine, former head of the Macroeconomic Studies and Forecasting Division, and to Camille Thubin and Bruno Ducoudré, current head and deputy head, for their leadership in overseeing the re-estimation project, IT developments, and shadow forecast exercises during the June 2024 BMPE.

Second, this paper reflects the collective work of the macroeconomic forecasting team, who are also its authors. Alice Carroy and David Sabes computed the BMEs in 2024–2025 for the annual submission to the ECB. Pierre Aldama and Raphaël Martin developed the FR-BMEs model and its forecasting infrastructure from June 2023 to March 2024, with continuous support from Guy Lévy-Rueff, Hervé Le Bihan, Yannick Kalantzis, Matthieu Lemoine, Camille Thubin, and Bruno Ducoudré. David Sabes, assisted by Héloïse Girod, designed the post-mortem infrastructure used in this paper, while Mylène Sabatini produced the 2024 post-mortem exercise and also contributed to FR-BMEs development. Finally, all team members regularly use FR-BMEs for forecasting, revision analysis, and policy applications.

Third, the development of the FR-BMEs model also required a substantial effort from the Public Finance Division. We would like to thank Kéa Baret, Marion Cochard, Niamh Dunne, Caroline Jarret, and Circé Maillet for their continuing efforts to help us rationalize the way the FR-BDF and FR-BMEs models interact with the MAPU model, and for developing new tools to analyze the effects of fiscal policy shocks in our projections.

Last but not least, we would like to express our gratitude to Jean-François Ouvrard, former head of the Macroeconomic Studies and Forecasting Division and former deputy director of Macroeconomic Analysis and Forecasting, who co-authored the initial paper on which this work is firmly grounded.

# 1 Introduction

This paper has two objectives. First, it is an update of [Aldama and Ouvrard \(2020\)](#) that presented a set of Basic Model Elasticities (BMEs, henceforth) of the Banque de France macroeconomic model for France (FR-BDF). Since 2019, FR-BDF has evolved in several dimensions and the present BMEs account for these improvements and evolutions. First, it has been extended with a detailed block for households' credit demand and house prices ([Bove et al., 2020](#)) and a detailed financing block for non-financial corporations ([Dees et al., 2022](#)). More recently, FR-BDF has been fully re-estimated by the macroeconomic modelling team at Banque de France's Macroeconomic Studies and Forecasting Division following the publication of national accounts in base 2020 and the publication of balance sheets accounts in base 2020. Therefore, the present paper is largely an outcome of this re-estimation project. Details about the changes made and estimation results are extensively discussed in [Dubois et al. \(2026\)](#).<sup>1</sup> Second, we present the FR-BMEs model, which is the simplified forecasting platform used for Banque de France's interim macroeconomic projections in March and September, since March 2024, while the comprehensive FR-BDF model continues to be used for the Broad Macroeconomic Projection Exercises (BMPE), conducted in June and December. This model may be seen as a linearized, simplified version of FR-BDF. It builds on the updated BMEs of FR-BDF. It is used for both macroeconomic forecasting and policy analysis, including model-based forecast-error decomposition, also called "post-mortem" exercise. In this paper, we propose an application to the 2024 real gross domestic product (GDP) growth forecast error based on the December 2023 BMPE.

First, the paper is dedicated to describing the main BMEs of FR-BDF. Those BMEs are "pure" shocks and respect an "orthogonality principle": for each BME, we shock only one variable of interest and any reaction of the other variables covered by another BME is deactivated, in order to let only the endogenous core of the model work (price, demand, labour market, etc.). The resulting BMEs are thus "analytical" in the sense that they give the model's reaction to a specific shock, without being "realistic" in the sense that, in reality, the economy is affected by a combination of shocks and the different variables involved interact with each other. Put differently, the orthogonality principle implies that the effects of any combination of these analytical shocks on macroeconomic variables are additive, allowing the construction of scenarios by summing their individual impacts.

For example, to describe a full alternative scenario on the international environment, it may seem necessary to combine at least one shock on oil prices and one on global demand. Similarly, a monetary policy decision will *a priori* affect both short-term and long-term rates and the exchange rate.

By respecting this principle of orthogonality and assuming that the model is linear (which is a satisfying approximation most of the time), this paper provides the building blocks that forecasters and policy analysts can combine through simple addition to construct internally consistent alternative scenarios. This practice is common within the Eurosystem, from which the name « Basic Model Elasticities » (BMEs) originates ([European Central Bank, 2016](#)), and it is the same approach as the "variantes" provided by Insee and French Treasury in the Mésange working paper ([Bardaji et al., 2017](#)).

As in [Aldama and Ouvrard \(2020\)](#), we recall some basic principles underlying the construction of these shocks.

- The FR-BDF model makes agents' expectations explicit. Agents' expectations can be either fully consistent with the model –meaning that agents are fully aware of all the model dynamics between endogenous and exogenous variables but also of the future path of exogenous variables–, or they can be based on a satellite VAR model representing a reduced-form macroeconometric model –and in this case agents only know specific variables dynamics.<sup>2</sup> Here, we use the version of the model with VAR-based expectations,

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<sup>1</sup>An additional paper by [Turunen et al. \(2023\)](#) developed stochastic simulations of the FR-BDF model to describe and compute probabilities of events and risk around the forecast based on model uncertainty.

<sup>2</sup>See [Lemoine et al. \(2019\)](#) for a full presentation and [Dubois et al. \(2026\)](#) for an update.

the one used during the forecasting exercises.

- To construct these BMEs, we use an unconditional projection as a baseline<sup>3</sup> and simulate counterfactual scenarios around this baseline, from 2024-Q1 to 2033-Q4. Shocks occur in the first quarter of the simulation and are persistent for 10 years. The size of the shocks is fixed *arbitrarily* such that a simple proportionality rule allows calculating impacts of specific scenarios on headline macro variables.
- For all BMEs, we assume that the shock only affects France but not its partners, even when this assumption is unrealistic by nature (e.g., oil price BME). Taking into account spillover effects from our trade partners would modify the return to equilibrium linked to relative price mechanisms. By combining several BMEs (e.g., oil, competitor prices and world demand), the practitioner can construct these realistic scenarios.<sup>4</sup>
- Finally, no macroeconomic model, however detailed, can address all economic policy questions. We can only provide a macro-level and aggregate perspective here, and one should mobilize other tools must be employed to examine specific sectoral dynamics or distributional effects within households.

A word of caution is required here: the shocks presented in this paper should *never* be interpreted as "*the model of the Banque de France forecasts that (...)*" or "*Banque de France states that (...)*". Forecasting and policy analysis involves far more than simply feeding data into a model and pressing "run" to generate a forecast. In practice, macroeconomists working with large-scale macro models often depart from model outputs when empirical evidence, external information or alternative models suggest different *and* more accurate results.

Overall, FR-BDF properties have not evolved substantially since 2019. We confirm the strong influence of monetary and financial shocks through expectations, as well as the significant effects of structural shocks (labour efficiency or productivity, the equilibrium unemployment rate and labour force participation rate). Compared to the 2019 version of FR-BDF, the response of investment to long-term interest rates is now stronger due to a change in expectations formation regarding the trend of investment target. Another notable change is the explicit role of real labour income and social transfers in households' short-run consumption equation. This modelling choice particularly alters the response to public finance shocks. For more details about changes made with respect to the first version of FR-BDF, the reader must refer to [Dubois et al. \(2026\)](#).

Second, the paper introduces the FR-BMEs model: a linearised, parsimonious version of FR-BDF. This model specifically builds on FR-BDF's BMEs and, therefore, shares the same dynamic properties as FR-BDF. We briefly review the model structure as well as its use in a forecasting context before moving to the post-mortem of the 2024 real GDP growth forecast error.

In December 2023, we projected real GDP to grow by 0.9% in 2024 whereas it ended up to grow by 1.1% according to annual national accounts for 2024 published in May 2025, implying a positive forecast error of 0.2 percentage point. From an accounting perspective, this forecast error is broken down into a negative surprise in import volumes, which contributed positively to GDP growth, and a negative surprise in domestic demand and inventories, both of which contributed negatively to GDP growth. We decompose the GDP forecast-error into four components: changes to historical data, revisions in Eurosystem technical and international assumptions, revisions in public finance assumptions, and expert judgement.<sup>5</sup> We find that the 0.2 pp forecast error on GDP breaks down as follows: +0.16 pp related to historical data revision; +0.05 pp effect of the Eurosystem international and technical assumptions; +0.28 pp effect of revised public finance assumptions; and finally -0.28 pp from experts judgements, largely driven by a significant forecast-error on imports (excluding energy) and forecast errors on household consumption, business investment and public consumption deflator.

<sup>3</sup>By "unconditional simulation" we mean a simulation in which econometric equations' residuals are set to 0, allowing convergence toward long-run targets in error-correction equations. Yet, this unconditional simulation is realised using recent assumptions from the Eurosystem as well as updated historical data. In any case, FR-BDF is quasi-linear (except in some areas) and its BMEs are not-that-much sensitive to the baseline simulation we use.

<sup>4</sup>As mentioned in Section 3.1.1, the ECB has developed a "BME tool" that transform these BMEs to account for intra-Euro area spillover effects.

<sup>5</sup>In practice, the expert judgement component encompasses both 'pure' expert judgement and adjustments reflecting determinants or transmission channels that are not explicitly captured by the model.

The rest of the paper is organized as follows. Section 2 describes the updated BMEs of FR-BDF in four subsections: external shocks, monetary and financial shocks, public finance shocks and structural shocks. Section 3 of the paper presents the FR-BMEs model. Subsection 3.1 provides a general overview of the model's structure and explains how a macroeconomic model can be constructed from BMEs. Subsection 3.2 provides additional details on FR-BMEs' use in a forecasting context, particularly regarding how we define "shocks" and the incorporation of expert judgements. Last subsection 3.3 presents a 'post-mortem' (or model-based forecast-error decomposition) realised with the FR-BMEs model for the 2024 real GDP growth forecast error of the Banque de France December 2023 projections. Finally, section 4 offers some concluding remarks.

## 2 Main Basic Model Elasticities of the FR-BDF model

First, this section describes the main Basic Model Elasticities (BMEs) of FR-BDF. These shocks are grouped into four categories: subsection 2.1 focuses on external shocks, subsection 2.2 covers monetary and financial shocks, subsection 2.3 is dedicated to fiscal shocks, and finally subsection 2.4 presents three structural (supply-side) shocks.

All shocks described in this section propagate within a New Keynesian, demand-driven semi-structural model characterised by nominal and real rigidities. Regardless of their origin, shocks first disturb the balance between aggregate supply and aggregate demand. Firms then modify output and employment only incompletely and progressively, reflecting supply constraints, while prices and wages only adjust gradually due to nominal and real frictions. This delayed adjustment generates movements in the output gap and the unemployment gap, which are central to the model's dynamics. Through these channels — together with firms' pro-cyclical mark-up behaviour — initial disturbances propagate to activity, investment, imports and labour demand.

A second transmission mechanism common to all BMEs is the central role of expectations, which shape household consumption and investment, business investment, wage formation, labour demand and inflation dynamics. Expected permanent income drives consumption smoothing; expected unemployment and inflation influence nominal wages through the wage Phillips curve; and expected inflation determines the real cost of capital, strongly affecting investment. Expectations are formed through a satellite VAR (E-SAT), implying that shocks propagate through lagged observations of the output gap, inflation, and key macroeconomic variables (unemployment, wage growth, etc.) in the Polynomial-Adjustment-Cost (PAC) equations governing macroeconomic behaviour.<sup>6</sup> This expectations block is what gives many BMEs — especially monetary and structural/supply-side shocks — their broad, economy-wide effects beyond the variable initially perturbed.

Finally, the economy converges to a new supply-demand equilibrium through wage and price adjustments and through the external trade channel. Price and wage equations transmit initial pressures to all domestic and external deflators, progressively affecting competitiveness and exports — whose high import content makes foreign trade a powerful adjustment margin. Under the assumption of an exogenous monetary policy, these mechanisms operate without feedback from interest-rate or exchange-rate rules, so adjustment proceeds via relative prices, real wages and net exports. Automatic stabilisers transmit the shock to public finances, completing a unified transmission structure that is common to all shocks.

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<sup>6</sup>See Lemoine et al. (2019) and Dubois et al. (2026) for a detailed presentation of expectations in FR-BDF.

## 2.1 External shocks

### 2.1.1 World demand

The shock considered consists of a direct and persistent 1% increase in global demand for French goods and services. Results are shown in Table 1. This external shock constitutes a pure demand disturbance and illustrates the way in which demand and supply adjust within the model.

French exports respond immediately to the additional foreign demand, with a high short-run elasticity (close to one in the first year). The associated increase in activity prompts firms to expand labour demand and investment, leading to a decline in unemployment. Moreover, the positive output gap — defined as the difference between actual GDP and the model's long-term potential GDP — raises inflation expectations. In the absence of a monetary policy response, the resulting upward pressure on prices lowers the real cost of capital, thereby providing an additional stimulus to investment.

At the same time, firms raise their prices in line with pro-cyclical mark-up behaviour. Falling unemployment and rising prices support higher nominal wages, although real wages (deflated by the consumption deflator) decline. This counter-cyclical pattern of real wages reflects nominal wage rigidity (relative to the productivity cycle) as well as the direct impact of the output gap on the value-added deflator of market sectors, which amplifies price dynamics through Phillips-curve mechanisms. Despite the increase in nominal wage growth, real wages per worker fall due to lagged wage indexation to consumer price inflation that is significantly below unity. With higher employment, however, the aggregate real wage bill still rises.

The household saving rate declines slightly, reflecting both the fall in real interest rates and income-smoothing behaviour from the second year onwards. Private consumption reacts only marginally to the shock, owing to consumption smoothing and the absence of a strong short-run transmission channel between activity and consumption. Overall, domestic demand contributes moderately to GDP growth (+0.05 pp after two years), mainly through business investment and private consumption.

Imports increase strongly and rapidly, both in response to higher exports – given their high import content – and to the expansion in domestic demand. Nevertheless, the contribution of net exports to GDP remains positive, reaching +0.21 pp after two years.

Price and wage-setting mechanisms drive up export deflators, gradually eroding price competitiveness. As a result, export growth never attains an apparent elasticity of one with respect to the world-demand shock, and exports even begin to decline modestly after the first year. Competitiveness-related rebalancing mechanisms therefore gradually come into play.

The impact of the shock on GDP is strongest in the first two years and then gradually declines. With the output gap remaining positive, inflation stays persistently elevated, and prices continue to increase above the baseline scenario over the subsequent four years. The public deficit, however, is durably reduced as a result of higher activity, mechanically lowering the public debt-to-GDP ratio.

Over the longer term, the effects on GDP fade. As firms continue to raise prices, the resulting erosion of real wages weighs on household purchasing power, leading to a decline in private consumption (-0.05% after ten years). Moreover, higher export prices dampen external demand, generating a more moderate increase in exports (+0.69% after ten years, compared with +0.88% after four years). Together, these developments contribute to a more subdued long-run trajectory for real GDP.

In this version of the BME, the absence of international closure plays a key role. A demand shock originating in one partner country would generate qualitatively similar effects in all other countries, thereby strengthening demand for France on the one hand and limiting the loss of price competitiveness on the other, as partner countries would also face inflationary pressures.

**Table 1: Responses of main macroeconomic variables in level to a +1% increase in world demand to France**

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.25	0.26	0.24	0.23	0.21	0.15	0.23	0.25	0.25	0.26
Private consumption	0.01	0.03	0.03	0.02	0.01	-0.05	0.00	0.01	0.02	0.02
Public consumption	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Total investment	0.16	0.16	0.13	0.11	0.10	0.08	0.11	0.16	0.18	0.18
Business investment	0.23	0.23	0.18	0.16	0.16	0.18	0.18	0.23	0.26	0.26
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.10	0.14	0.12	0.08	0.05	-0.06	0.00	0.12	0.14	0.14
Exports	0.97	0.95	0.92	0.88	0.83	0.69	0.97	0.97	0.97	0.97
Imports	0.39	0.42	0.44	0.44	0.44	0.36	0.38	0.38	0.40	0.40
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	0.04	0.05	0.04	0.04	0.02	-0.02	0.03	0.04	0.05	0.05
Net exports	0.21	0.21	0.20	0.20	0.19	0.17	0.20	0.21	0.20	0.20
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.04	0.11	0.17	0.22	0.26	0.40	0.01	0.03	0.05	0.07
HICP excl. food and energy	0.04	0.12	0.18	0.24	0.29	0.44	0.02	0.03	0.05	0.07
GDP deflator	0.05	0.12	0.18	0.24	0.28	0.41	0.02	0.04	0.06	0.08
Unit labor costs	-0.19	-0.14	-0.08	-0.03	0.01	0.23	-0.20	-0.20	-0.19	-0.18
Compensation per employee	0.01	0.03	0.06	0.10	0.13	0.29	0.00	0.00	0.01	0.01
Productivity	0.20	0.17	0.14	0.13	0.12	0.06	0.20	0.21	0.20	0.19
Real compensation per employee	-0.03	-0.07	-0.10	-0.11	-0.12	-0.12	-0.01	-0.02	-0.03	-0.04
Imports deflator	0.01	0.02	0.05	0.08	0.12	0.23	0.00	0.00	0.01	0.01
Export deflator	0.03	0.09	0.14	0.18	0.22	0.31	0.01	0.03	0.04	0.06
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	-0.05	-0.09	-0.10	-0.10	-0.09	-0.09	-0.03	-0.04	-0.05	-0.07
Total employment (% deviation from baseline level)	0.05	0.09	0.10	0.10	0.09	0.09	0.03	0.04	0.06	0.07
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	0.02	0.01	-0.01	-0.03	-0.05	-0.10	0.03	0.03	0.02	0.02
Households saving rate (% of GDI, pp deviation from baseline level)	0.01	-0.02	-0.03	-0.05	-0.05	-0.05	0.02	0.01	0.01	0.00
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	0.08	0.09	0.10	0.10	0.09	0.10	0.06	0.07	0.08	0.08
Public debt (% of GDP)	-0.27	-0.42	-0.55	-0.65	-0.74	-1.11	-0.06	-0.12	-0.19	-0.27

### 2.1.2 Competitors' prices

The shock considered is a sustained 1% increase in the prices of foreign competitors, affecting both exports and imports. Results are shown in Table 2. This is an external shock to price competitiveness rather than to volumes. It does not originate from a depreciation of the nominal exchange rate; it is therefore a shock to competitors' prices expressed in foreign currency.

French exports increase directly by 0.18% in the first year, driven by gains in export competitiveness. Imports rise moderately due to the import content of exports. GDP increases by 0.05% in the first year, with net exports contributing around 0.05 pp. Domestic demand accelerates very moderately over the first three years, supported by private investment. In particular, business investment reacts positively to higher final demand and is also supported by the decline in the real cost of capital (in the absence of a monetary policy response), owing to higher expected inflation. Households do not benefit from the shock, as higher employment fails to offset the impact of rising inflation and lower wages per employee.

On the labour market, the reduction in both current and expected unemployment pushes nominal compensation slightly upward (+0.02% after two years), while real compensation declines (-0.06% after two years). As in the world-demand BME, the countercyclical response of real wages helps stabilise the economy by dampening the decline in households' real income, which turns negative in the first year.

The effect on GDP peaks after four years at around +0.2%, while prices continue to rise, reflecting both the negative unemployment gap (-0.07 pp after four years) and the positive output gap. The gap between activity and employment results from employment inertia, as job creation continues to increase despite the stabilisation of the shock's effects on activity. As a result of higher imported inflation and stronger activity, rising prices gradually erode the initial competitiveness gains, leading to a stabilisation of external demand's response to competitors' price shocks.

The export deflator displays an apparent elasticity of 0.20 after one year, primarily reflecting exporters' mark-up behaviour and, to a lesser extent, the import content of exports. During the first year, import prices rise by 0.30%, with slightly more than two-thirds of this increase passed through to export prices.

After ten years, the initial competitiveness gains are significantly eroded by rising domestic export prices, resulting in a more subdued increase in exports. At the same time, the transmission of higher prices to domestic goods and services weighs on private consumption, leading to a negative contribution from domestic demand to GDP. Consequently, the overall impact on GDP after ten years settles at +0.08%, almost identical to the first-year effect.

Public finances improve, with the budget balance increasing by 0.05 percentage points and the public debt-to-GDP ratio falling by -0.66 percentage points after ten years, owing to the mechanical effect of stronger activity through automatic stabilisers as well as a higher GDP deflator (+0.3 pp after ten years).

**Table 2: Responses of main macroeconomic variables in level to a +1% increase in competitors' prices**

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.05	0.14	0.18	0.19	0.18	0.08	0.00	0.03	0.07	0.09
Private consumption	0.00	0.00	0.00	-0.01	-0.02	-0.10	0.00	-0.01	-0.01	0.00
Public consumption	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Total investment	0.02	0.06	0.08	0.08	0.06	0.01	0.00	0.01	0.03	0.04
Business investment	0.03	0.10	0.12	0.12	0.10	0.07	0.00	0.02	0.05	0.07
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.00	0.02	0.05	0.05	0.02	-0.12	0.00	-0.01	0.00	0.00
Exports	0.18	0.47	0.60	0.63	0.61	0.46	0.00	0.14	0.24	0.33
Imports	0.05	0.13	0.19	0.22	0.24	0.20	0.00	0.04	0.06	0.09
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	0.00	0.01	0.02	0.01	0.00	-0.06	0.00	0.00	0.00	0.01
Net exports	0.05	0.13	0.17	0.18	0.18	0.14	0.00	0.03	0.06	0.09
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.02	0.06	0.11	0.16	0.21	0.32	0.01	0.02	0.03	0.03
HICP excl. food and energy	0.02	0.06	0.12	0.18	0.23	0.36	0.01	0.02	0.03	0.04
GDP deflator	0.01	0.05	0.10	0.16	0.21	0.32	0.00	0.01	0.01	0.02
Unit labor costs	-0.04	-0.09	-0.09	-0.06	-0.01	0.20	0.00	-0.03	-0.05	-0.07
Compensation per employee	0.00	0.02	0.04	0.06	0.09	0.22	0.00	0.00	0.00	0.01
Productivity	0.04	0.11	0.12	0.12	0.10	0.02	0.00	0.03	0.06	0.08
Real compensation per employee	-0.02	-0.06	-0.09	-0.12	-0.15	-0.16	-0.02	-0.02	-0.03	-0.04
Imports deflator	0.30	0.36	0.37	0.40	0.42	0.54	0.22	0.30	0.33	0.35
Export deflator	0.20	0.29	0.37	0.43	0.49	0.61	0.13	0.19	0.22	0.25
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	-0.01	-0.03	-0.06	-0.07	-0.07	-0.05	0.00	0.00	-0.01	-0.02
Total employment (% deviation from baseline level)	0.01	0.04	0.06	0.07	0.08	0.06	0.00	0.00	0.01	0.02
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	-0.01	-0.02	-0.03	-0.06	-0.08	-0.15	-0.01	-0.01	-0.01	-0.01
Households saving rate (% of GDI, pp deviation from baseline level)	-0.01	-0.01	-0.03	-0.04	-0.05	-0.05	-0.01	-0.01	-0.01	-0.01
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	0.01	0.04	0.06	0.07	0.07	0.05	0.00	0.01	0.01	0.02
Public debt (% of GDP)	-0.05	-0.18	-0.31	-0.41	-0.48	-0.66	0.00	-0.01	-0.02	-0.05

### 2.1.3 Oil prices

The shock considered is a permanent 10% increase in the price of oil in euros, starting from an initial price of 55 euros per barrel of Brent. Results are shown in Table 3. Given the low substitutability of energy consumption, the transmission of crude oil price shocks to final consumer prices is nonlinear. Hence, owing to this non-linearity, a 10% increase in the oil price does not have the same impact whether the baseline price is 55 or, for instance, 100 euros. We therefore recommend interpreting this BME as a 5.5-euro increase in the price of a barrel and, for example, multiplying it by 10/5.5 to obtain the effect of a 10-euro shock.

The rise in oil prices immediately feeds through to import deflators and to the final energy prices faced by households. Indirect transmission via labour costs is also significant. After one year, total HICP increases by 0.21 pp, including a contribution of around 0.04 pp from HICP excluding energy and food, which itself rises by 0.05 pp. The transmission to export prices is also sizable, while the GDP deflator remains virtually unchanged after one year.

The resulting loss of household purchasing power gradually weighs on private consumption, which falls by 0.04 pp after one year, as well as on household investment. Nevertheless, households initially absorb a substantial share of the shock through their saving rate, which declines by 0.06 pp in the first year due to consumption-smoothing behaviour, consistent with consumption being indexed to permanent income. In addition, rising export prices erode price competitiveness and reduce exports. It is worth noting that this shock is asymmetric, as it affects France but not its trading partners. A realistic BME of a global oil-price shock would naturally combine this shock with an identical one affecting partner countries, which would *a priori* mitigate price-competitiveness losses but also generate an additional negative external-demand shock.

Falling demand reduces GDP, which in turn lowers employment and business investment. Nominal wages increase slightly via indexation mechanisms, but real wages decline, reflecting the impact of higher expected unemployment on wage dynamics. The deterioration of the domestic macroeconomic environment exerts downward pressure on prices: after peaking in the first year, HICP, the GDP deflator and the export deflator all begin to decline in the second year. After ten years, the impact on the GDP deflator reaches a trough of -0.20%, reflecting the fading downward pressure from domestic demand on economic activity. Thus, this price-feedback mechanism gradually stabilises economic conditions.

Finally, the shock deteriorates the public deficit and public debt, owing to automatic stabilisers and to the lower GDP deflator.

**Table 3:** Responses of main macroeconomic variables in level to a +10% increase in oil prices, from the level of 55 euro per barrel

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	-0.04	-0.09	-0.12	-0.13	-0.13	-0.11	-0.01	-0.03	-0.05	-0.06
Private consumption	-0.04	-0.06	-0.07	-0.08	-0.08	-0.06	-0.03	-0.04	-0.05	-0.05
Public consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total investment	-0.02	-0.06	-0.07	-0.08	-0.08	-0.09	-0.01	-0.02	-0.03	-0.04
Business investment	-0.03	-0.08	-0.10	-0.11	-0.12	-0.13	-0.01	-0.02	-0.04	-0.05
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	-0.02	-0.07	-0.07	-0.07	-0.07	-0.05	0.00	-0.01	-0.03	-0.05
Exports	-0.05	-0.15	-0.20	-0.22	-0.22	-0.14	0.00	-0.03	-0.07	-0.10
Imports	-0.02	-0.03	-0.03	-0.04	-0.03	0.01	-0.01	-0.02	-0.02	-0.02
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	-0.03	-0.05	-0.06	-0.06	-0.06	-0.04	-0.02	-0.03	-0.03	-0.04
Net exports	-0.01	-0.04	-0.06	-0.07	-0.07	-0.07	0.01	-0.01	-0.02	-0.03
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.21	0.21	0.21	0.19	0.16	0.04	0.20	0.20	0.21	0.22
HICP excl. food and energy	0.05	0.05	0.05	0.03	0.00	-0.13	0.04	0.04	0.05	0.06
GDP deflator	0.01	0.00	-0.03	-0.06	-0.09	-0.20	0.01	0.01	0.01	0.01
Unit labor costs	0.05	0.09	0.10	0.08	0.06	-0.08	0.01	0.06	0.07	0.08
Compensation per employee	0.02	0.03	0.02	0.01	-0.02	-0.13	0.00	0.03	0.03	0.03
Productivity	-0.03	-0.07	-0.07	-0.07	-0.07	-0.05	-0.01	-0.03	-0.04	-0.05
Real compensation per employee	-0.13	-0.11	-0.08	-0.06	-0.04	-0.02	-0.15	-0.13	-0.13	-0.12
Imports deflator	0.44	0.46	0.44	0.41	0.39	0.27	0.38	0.45	0.47	0.47
Export deflator	0.24	0.25	0.23	0.20	0.18	0.10	0.21	0.25	0.26	0.26
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.01	0.02	0.04	0.05	0.06	0.06	0.00	0.00	0.01	0.01
Total employment (% deviation from baseline level)	-0.01	-0.03	-0.04	-0.06	-0.06	-0.06	0.00	0.00	-0.01	-0.01
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	-0.12	-0.12	-0.11	-0.09	-0.08	-0.03	-0.11	-0.11	-0.12	-0.12
Households saving rate (% of GDI, pp deviation from baseline level)	-0.06	-0.05	-0.03	-0.01	0.00	0.03	-0.07	-0.06	-0.06	-0.06
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.04	-0.05	-0.06	-0.07	-0.07	-0.08	-0.03	-0.03	-0.04	-0.04
Public debt (% of GDP)	0.06	0.15	0.25	0.33	0.41	0.75	0.01	0.02	0.04	0.06

## 2.2 Monetary and financial shocks

### 2.2.1 Short-term interest rates

The shock under consideration is a permanent 100 basis point increase in the short-term interest rate (3-month Euribor, annualised). Results are shown in Table 4. In line with the orthogonality principle, we assume that this shock to short-term rates does not spill over to long-term sovereign yields or to household and corporate borrowing rates. This BME highlights the central role of expectations in the FR-BDF model, since the short-term rate influences the economy exclusively through this channel — most notably via expected permanent income, the anticipated unemployment gap and inflation expectations.

Household consumption and investment decline, as households anticipate a fall in their permanent disposable income and face a higher real cost of housing credit due to lower expected inflation. On the corporate side, the real cost of capital also rises as inflation expectations fall, leading to a contraction in investment from the second year onwards. The resulting slowdown in activity reduces import demand.

Prices fall overall, reflecting both the direct impact of weaker activity and two expectation-driven channels. First, the decline in expected inflation is rapidly transmitted to actual inflation. Second, the positive expected unemployment gap pushes nominal and real wages down. The resulting slowdown in prices mechanically improves price competitiveness, boosting exports from the second year onwards and partly offsetting the recessionary impact of the short-term rate increase. After ten years, exports rise by 0.30%, which contributes to a much more moderate long-run impact of short-rate increases on real GDP. The disinflationary effect of the rate increase persists throughout the horizon, reaching  $-0.15\%$  after four years and  $-0.50\%$  after ten years on HICP.

Foreign trade acts as the main stabilisation mechanism in the medium term: exports increase owing to price-competitiveness gains, while imports decline in line with weaker domestic demand, contributing positively to GDP. However, this effect is not sufficient to offset the contractionary impact of higher short-term rates on all components of domestic demand, with particularly pronounced effects on household and business investment through lower inflation expectations, weaker activity (for firms) and reduced permanent income (for households).

Since the short-rate shock does not spill over to long-term sovereign yields in FR-BDF, the public sector's interest burden remains unaffected. Public finances therefore deteriorate solely via automatic stabilisers, under the assumption of no fiscal-policy reaction.<sup>7</sup>

The budget balance deteriorates by  $-0.12$  percentage point of GDP and the public debt-to-GDP ratio increases by 0.47 percentage point over the next four years. This deterioration continues over the ten-year horizon, with the budget balance declining by  $-0.14$  percentage point and the debt ratio increasing by 1.23 percentage points.

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<sup>7</sup>In the BMEs, fiscal policy is assumed to be exogenous: no fiscal rule is activated to stabilise public debt, and no discretionary fiscal instrument is used to stabilise economic activity beyond automatic stabilisers.

**Table 4:** Responses of main macroeconomic variables in level to a +100bp increase in short-term interest rate

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	-0.03	-0.09	-0.12	-0.13	-0.13	-0.04	0.00	-0.02	-0.04	-0.06
Private consumption	-0.04	-0.09	-0.13	-0.15	-0.16	-0.14	0.00	-0.04	-0.06	-0.07
Public consumption	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Total investment	-0.08	-0.35	-0.53	-0.62	-0.65	-0.65	0.00	-0.04	-0.11	-0.19
Business investment	-0.10	-0.40	-0.60	-0.70	-0.75	-0.79	0.00	-0.06	-0.13	-0.22
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	-0.12	-0.52	-0.81	-0.93	-0.97	-0.86	0.00	-0.05	-0.15	-0.26
Exports	0.00	0.01	0.02	0.05	0.09	0.30	0.00	0.00	0.00	0.00
Imports	-0.03	-0.09	-0.13	-0.14	-0.15	-0.07	0.00	-0.03	-0.04	-0.06
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	-0.04	-0.13	-0.18	-0.22	-0.23	-0.22	0.00	-0.03	-0.06	-0.08
Net exports	0.01	0.04	0.06	0.08	0.10	0.18	0.00	0.01	0.02	0.02
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.00	-0.03	-0.08	-0.15	-0.21	-0.50	0.00	0.00	-0.01	-0.01
HICP excl. food and energy	-0.01	-0.04	-0.09	-0.16	-0.23	-0.55	0.00	0.00	-0.01	-0.01
GDP deflator	-0.01	-0.03	-0.08	-0.13	-0.19	-0.44	0.00	0.00	-0.01	-0.01
Unit labor costs	0.01	-0.02	-0.09	-0.18	-0.26	-0.63	0.00	0.02	0.02	0.01
Compensation per employee	0.00	-0.04	-0.09	-0.16	-0.24	-0.60	0.00	0.00	-0.01	-0.01
Productivity	-0.02	-0.02	0.00	0.01	0.02	0.03	0.00	-0.02	-0.02	-0.02
Real compensation per employee	0.00	-0.01	-0.03	-0.05	-0.08	-0.19	0.00	0.00	0.00	0.00
Imports deflator	0.00	0.00	-0.01	-0.03	-0.06	-0.22	0.00	0.00	0.00	0.00
Export deflator	0.00	-0.02	-0.06	-0.10	-0.14	-0.33	0.00	0.00	0.00	-0.01
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.02	0.07	0.12	0.14	0.14	0.07	0.00	0.01	0.02	0.04
Total employment (% deviation from baseline level)	-0.02	-0.08	-0.13	-0.15	-0.14	-0.07	0.00	-0.01	-0.02	-0.04
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	-0.01	-0.03	-0.05	-0.06	-0.06	-0.01	0.00	0.00	-0.01	-0.02
Households saving rate (% of GDI, pp deviation from baseline level)	0.03	0.05	0.07	0.08	0.09	0.11	0.00	0.03	0.04	0.05
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.02	-0.06	-0.10	-0.12	-0.13	-0.14	0.00	-0.01	-0.02	-0.03
Public debt (% of GDP)	0.04	0.16	0.31	0.47	0.61	1.23	0.00	0.01	0.02	0.04

## 2.2.2 Long-term interest rates

We now consider a sustained 100 basis point increase in nominal long-term interest rates (at the 10-year and 5-year maturities), applied exclusively through the term-premium component. Results are shown in Table 5. This shock is transmitted to the economy via its effects on all bank lending rates, corporate bond rates and the real cost of capital. Unlike a short-term interest rate shock, the long-term rate has no direct effect on expectations, as it does not enter the satellite Vector Autoregressive (VAR) model used to construct them. It does, however, affect expectations indirectly through its impact on the output gap and inflation.

In the short term, the rise in long-term rates reduces GDP by  $-0.11\%$ . Household consumption contracts markedly ( $-0.15\%$  in the first year), reflecting the upward pressure of higher long-term lending rates on the equilibrium saving rate. Private investment also declines: household investment falls moderately ( $-0.19\%$ ), while business investment contracts more sharply ( $-0.43\%$ ).

The impacts of higher long-term rates on business and household investment become more pronounced from the second year onwards, reaching  $-2.87\%$  and  $-3.46\%$ , respectively, in the fourth year. Although not reported in Table 5, the elasticity of the business investment target<sup>8</sup> to the capital-cost shock is around  $-3.2\%$ , while that of the household investment target is  $-2.9\%$ .<sup>9</sup> These two components of private investment account for most of the contraction in GDP. Compared with the previous version of FR-BDF, the specification of the business investment equation has been revised to reduce the dampening effects from expectations — namely the delayed response of investment relative to its target.<sup>10</sup> These dampening effects arise because, under VAR expectations, agents anticipate the shock to be temporary and therefore do not fully adjust factor demand to its long-run target. In the updated FR-BDF, these effects remain but are substantially attenuated, making the response of business investment closer to its long-run target impact.

Household consumption remains weak and recovers only marginally by the fourth year. Purchasing power benefits from lower prices, nominal wage rigidity and higher net financial income resulting from the increase in long-term interest rates. However, the rebound in consumption is constrained by the rise in the long-term saving rate, driven by a moderate intertemporal-substitution effect acting on the consumption target. After ten years, household consumption increases by  $0.40\%$ , as higher property income raises expected permanent income and boosts consumption, thereby moderating the overall long-term impact of higher long-term interest rates on GDP.

While the effect on unemployment is broadly similar to that observed in the short-rate BME, the impact on nominal wages and prices is more limited in the case of a long-term rate shock. This difference reflects the structure of expectations and the absence of a direct link from long-term rates to these expectations.

Public finances deteriorate more sharply than in the short-rate BME, mainly owing to the increase in the interest burden. This contributes to the widening of the public deficit ( $-0.31$  pp of GDP after four years,  $-0.39$  pp after ten years) and to a stronger increase in public debt dynamics ( $1.25$  pp of GDP after four years,  $2.91$  pp after ten years).

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<sup>8</sup>By *target*, we refer to the equilibrium level of an endogenous variable in the model's error-correction equations.

<sup>9</sup>The response of the business investment target to an interest-rate shock exhibits nonlinear properties. It is computed using an average measure of the real cost of capital over the recent period. For instance, in 2024, the real cost of capital (including depreciation) is estimated at  $15.0\%$  per year (around  $3.8\%$  at a quarterly rate). Given that the equilibrium business investment equation is in logs (Dubois et al., 2026), the effect of a 100 basis point shock on long-term interest rates and therefore on the real cost of capital is

$$-\sigma \times \log \left( \frac{15+1}{15} \right) = -3.2\%,$$

with  $\sigma = 0.49$  the elasticity of substitution between capital and labour. In contrast, the household investment target depends on the quarterly real long-term bank lending rate, with a semi-elasticity of  $-11.5$ . The effect is therefore  $-11.5 \times 1/4 = -2.9\%$ , and does not depend on the level of interest rates.

<sup>10</sup>In Aldama and Ouvrard (2020), the response of business investment was significantly smaller than the response of its target.

**Table 5:** Responses of main macroeconomic variables in level to a +100bp increase in long-term interest rate

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	-0.11	-0.29	-0.38	-0.40	-0.38	-0.21	-0.01	-0.07	-0.14	-0.20
Private consumption	-0.15	-0.25	-0.22	-0.18	-0.10	0.40	-0.02	-0.12	-0.20	-0.25
Public consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total investment	-0.29	-1.28	-2.04	-2.43	-2.62	-2.63	0.00	-0.16	-0.38	-0.64
Business investment	-0.43	-1.63	-2.43	-2.87	-3.11	-3.36	-0.01	-0.26	-0.58	-0.91
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	-0.19	-1.52	-2.87	-3.46	-3.65	-3.14	0.00	-0.03	-0.21	-0.51
Exports	0.00	0.01	0.05	0.10	0.16	0.24	0.00	0.00	0.00	0.00
Imports	-0.11	-0.30	-0.39	-0.42	-0.39	-0.03	-0.01	-0.08	-0.15	-0.20
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	-0.15	-0.42	-0.56	-0.62	-0.63	-0.36	-0.01	-0.10	-0.20	-0.28
Net exports	0.04	0.12	0.18	0.22	0.24	0.14	0.00	0.03	0.05	0.08
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	-0.01	-0.07	-0.15	-0.23	-0.28	-0.28	0.00	-0.01	-0.01	-0.03
HICP excl. food and energy	-0.01	-0.08	-0.17	-0.25	-0.31	-0.30	0.00	-0.01	-0.02	-0.03
GDP deflator	-0.01	-0.08	-0.17	-0.25	-0.30	-0.25	0.00	-0.01	-0.02	-0.03
Unit labor costs	0.09	0.21	0.23	0.18	0.11	-0.18	0.01	0.06	0.12	0.17
Compensation per employee	0.00	-0.01	-0.04	-0.08	-0.13	-0.31	0.00	0.00	0.00	0.00
Productivity	-0.09	-0.23	-0.27	-0.26	-0.24	-0.13	-0.01	-0.06	-0.12	-0.17
Real compensation per employee	0.01	0.05	0.10	0.13	0.14	-0.03	0.00	0.00	0.01	0.02
Imports deflator	0.00	-0.01	-0.03	-0.07	-0.11	-0.19	0.00	0.00	0.00	0.00
Export deflator	-0.01	-0.06	-0.13	-0.19	-0.23	-0.19	0.00	0.00	-0.01	-0.02
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.01	0.06	0.11	0.13	0.13	0.08	0.00	0.01	0.02	0.03
Total employment (% deviation from baseline level)	-0.01	-0.07	-0.11	-0.14	-0.14	-0.09	0.00	-0.01	-0.02	-0.03
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	-0.06	0.02	0.18	0.35	0.52	1.12	0.00	-0.11	-0.07	-0.07
Households saving rate (% of GDI, pp deviation from baseline level)	0.07	0.23	0.35	0.45	0.52	0.59	0.02	0.01	0.12	0.15
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.06	-0.18	-0.26	-0.31	-0.34	-0.39	0.00	-0.05	-0.08	-0.12
Public debt (% of GDP)	0.14	0.51	0.89	1.25	1.56	2.91	0.00	0.03	0.07	0.14

### 2.2.3 Nominal effective exchange rate

The shock considered is a sustained appreciation of the nominal effective exchange rate of the euro of +10% (including the dollar).<sup>11</sup> Results are shown in Table 6. This shock affects the economy through the prices of extra-EA export and import competitors (about 55% of our exports), and also through the oil price in euros, assuming it remains fixed on world markets in dollars. These two channels have a downward impact on inflation but they have an opposite effect on activity: the loss of price competitiveness is unfavorable while the fall in the price of oil in euros is favorable. Finally, the shock does not affect our euro area partner countries.

Nominal exchange rate appreciation leads to a loss of competitiveness of French exports, which contract by -0.95% in the first year. Imports also fall sharply (-0.28%), reflecting the high import content of exports. However, this decline is partially offset by gains in price competitiveness of foreign competitors, which lower the price of French imports and foster their penetration into the domestic market. Transmission to export prices is also significant, but reduced compared to imports.

The effects on foreign trade gradually spill over to other demand components. Total investment declines by 0.33% after 4 years. Household consumption is restrained but continues to grow modestly thanks to lower oil prices. The combined impact of lower expected inflation, a higher real cost of capital, and weaker overall activity explains the contraction in investment.

Prices decline, by 0.75% for the GDP deflator and 1.16% for consumer prices, respectively, after four years. In addition to the import prices channel, two domestic channels account for the fall in prices. On the one hand, higher expected unemployment weights on wages and the wage-price spiral (through the market value-added price equation). On the other hand, the generalized effect of the output gap in the model, operating through expectations and, in the short run, via specific equations such as the value-added price equation, further contributes to the fall in prices.

The reduction in nominal wages is markedly less pronounced than the decline in consumer prices (-0.33% after four years, compared to -1.16%). Consequently, real wages are up by +0.73% after four years. Combined with falling prices, this increase fully offsets the negative impact of higher unemployment on households real gross disposable income. After ten years, private consumption increases more significantly (+0.56%), resulting in a more moderate impact of the nominal exchange rate shock on economic activity (-0.24%).

The fall in prices partly restores the price competitiveness of exports, which has deteriorated due to the appreciation of the effective exchange rate. Exports stabilize over the next 3 years and beyond 4 years, the balance is restored through wage and price adjustments, allowing French exports to regain market share.

Finally, public finances are deteriorating due to the effect of automatic stabilizers. The budget balance widens by -0.25 percentage points of GDP and the public debt increases by 1.71 percentage points of GDP after 4 years, and by -0.14 and 2.37 percentage points after 10 years.

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<sup>11</sup>We chose to no longer present a separate USD/EUR shock.

**Table 6:** Responses of main macroeconomic variables in level to a +10% appreciation in nominal effective exchange rate, including the USD/EUR exchange rate

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	-0.21	-0.64	-0.81	-0.82	-0.74	-0.24	0.03	-0.15	-0.30	-0.43
Private consumption	0.08	0.10	0.12	0.16	0.23	0.56	0.06	0.08	0.09	0.09
Public consumption	0.00	-0.01	-0.01	-0.01	-0.01	-0.03	0.00	0.00	0.00	-0.01
Total investment	-0.09	-0.31	-0.37	-0.33	-0.25	0.05	0.01	-0.05	-0.12	-0.20
Business investment	-0.16	-0.51	-0.58	-0.52	-0.43	-0.21	0.02	-0.10	-0.22	-0.34
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.02	-0.09	-0.22	-0.21	-0.08	0.66	0.00	0.05	0.02	0.00
Exports	-0.95	-2.50	-3.11	-3.27	-3.20	-2.54	0.00	-0.73	-1.29	-1.74
Imports	-0.28	-0.86	-1.22	-1.44	-1.56	-1.47	0.03	-0.21	-0.39	-0.55
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	0.02	-0.01	-0.02	0.02	0.08	0.35	0.04	0.03	0.02	0.01
Net exports	-0.24	-0.64	-0.81	-0.86	-0.83	-0.59	-0.01	-0.18	-0.32	-0.44
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	-0.43	-0.65	-0.91	-1.16	-1.36	-1.77	-0.36	-0.40	-0.45	-0.50
HICP excl. food and energy	-0.17	-0.40	-0.68	-0.94	-1.16	-1.61	-0.10	-0.15	-0.20	-0.25
GDP deflator	-0.07	-0.25	-0.50	-0.75	-0.96	-1.33	-0.03	-0.05	-0.08	-0.12
Unit labor costs	0.13	0.36	0.33	0.18	-0.03	-0.88	-0.02	0.08	0.20	0.28
Compensation per employee	-0.05	-0.12	-0.22	-0.33	-0.46	-0.92	0.00	-0.05	-0.06	-0.08
Productivity	-0.18	-0.48	-0.55	-0.51	-0.43	-0.04	0.02	-0.13	-0.26	-0.36
Real compensation per employee	0.31	0.45	0.60	0.73	0.82	0.83	0.26	0.28	0.32	0.36
Imports deflator	-1.84	-2.18	-2.27	-2.37	-2.49	-2.89	-1.39	-1.84	-2.02	-2.10
Export deflator	-1.18	-1.74	-2.12	-2.45	-2.72	-3.20	-0.78	-1.13	-1.33	-1.47
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.03	0.15	0.26	0.30	0.30	0.20	0.00	0.02	0.04	0.07
Total employment (% deviation from baseline level)	-0.03	-0.16	-0.27	-0.32	-0.32	-0.20	0.00	-0.02	-0.04	-0.07
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	0.22	0.26	0.33	0.43	0.53	0.78	0.21	0.21	0.22	0.23
Households saving rate (% of GDI, pp deviation from baseline level)	0.11	0.14	0.19	0.23	0.26	0.19	0.12	0.11	0.11	0.12
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.01	-0.14	-0.22	-0.25	-0.24	-0.14	0.06	0.01	-0.03	-0.07
Public debt (% of GDP)	0.20	0.78	1.31	1.71	1.98	2.37	-0.01	0.02	0.09	0.20

## 2.2.4 House prices

The shock considered is an immediate and sustained 10% increase in house prices. Results are shown in Table 7. This shock initially affects the economy through two channels. First, household investment reacts via an arbitrage mechanism between purchases of existing housing and new construction.<sup>12</sup> Second, rents — and therefore HICP inflation — are assumed to respond to rising house prices. The underlying assumption is that the increase in house prices reflects higher expected rents that subsequently materialise. However, the model does not incorporate household wealth effects, which are generally estimated to be small at the macroeconomic level in France.

The effect of the shock on GDP stems from household investment, which gradually converges toward a long-run elasticity of 0.38 with respect to the increase in house prices. The resulting rise in activity then spills over into business investment.

Inflation rises due to the widening of the output gap and the positive effect of the decline in the unemployment rate on wage dynamics. Despite a slight loss in household purchasing power, consumption remains stable supported by higher inflation expectations and a lower expected real interest rate, which also explains the decline in the saving rate. By contrast, losses in price competitiveness dampen exports, with the export deflator rising by 0.11% after five years, while imports increase in line with domestic demand.

The effects on the budget balance are limited and slightly positive, via automatic stabilisers. Public debt declines by 0.33 percentage point of GDP after four years, and by 0.56 percentage point after ten years.

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<sup>12</sup>According to the model, an increase in the relative price of existing housing (with respect to the consumption deflator) boosts household investment, as the relative price of new housing declines.

**Table 7: Responses of main macroeconomic variables in level to a +10% increase in house prices**

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.05	0.14	0.12	0.11	0.10	0.07	0.00	0.03	0.07	0.11
Private consumption	-0.01	0.00	0.00	-0.01	-0.02	-0.06	-0.01	-0.01	-0.01	-0.01
Public consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total investment	0.32	0.86	0.84	0.83	0.83	0.88	0.00	0.20	0.43	0.65
Business investment	0.04	0.12	0.10	0.08	0.07	0.08	0.00	0.02	0.05	0.08
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	1.33	3.44	3.33	3.26	3.26	3.41	0.00	0.85	1.79	2.64
Exports	0.00	-0.02	-0.04	-0.06	-0.08	-0.14	0.00	0.00	0.00	-0.01
Imports	0.04	0.10	0.10	0.09	0.08	0.04	0.00	0.02	0.05	0.08
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	0.07	0.19	0.18	0.17	0.17	0.16	0.00	0.04	0.09	0.14
Net exports	-0.01	-0.04	-0.05	-0.06	-0.07	-0.09	0.00	-0.01	-0.02	-0.03
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.02	0.05	0.09	0.11	0.13	0.18	0.01	0.02	0.02	0.03
HICP excl. food and energy	0.02	0.06	0.09	0.12	0.14	0.20	0.01	0.02	0.03	0.03
GDP deflator	0.03	0.06	0.10	0.12	0.14	0.18	0.02	0.02	0.03	0.04
Unit labor costs	-0.04	-0.09	-0.05	-0.01	0.01	0.10	0.00	-0.02	-0.05	-0.08
Compensation per employee	0.01	0.02	0.03	0.04	0.06	0.13	0.00	0.01	0.01	0.01
Productivity	0.05	0.11	0.08	0.06	0.05	0.03	0.00	0.03	0.06	0.09
Real compensation per employee	-0.04	-0.05	-0.07	-0.07	-0.07	-0.06	-0.04	-0.03	-0.04	-0.04
Imports deflator	0.00	0.01	0.02	0.04	0.06	0.11	0.00	0.00	0.00	0.00
Export deflator	0.02	0.04	0.07	0.09	0.11	0.14	0.01	0.01	0.02	0.02
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	-0.01	-0.03	-0.05	-0.05	-0.04	-0.04	0.00	0.00	-0.01	-0.02
Total employment (% deviation from baseline level)	0.01	0.04	0.05	0.05	0.04	0.04	0.00	0.00	0.01	0.02
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	-0.02	-0.02	-0.04	-0.05	-0.06	-0.11	-0.03	-0.02	-0.02	-0.02
Households saving rate (% of GDI, pp deviation from baseline level)	-0.01	-0.01	-0.03	-0.04	-0.04	-0.04	-0.01	-0.01	-0.01	-0.01
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	0.02	0.05	0.06	0.05	0.05	0.05	-0.01	0.01	0.02	0.04
Public debt (% of GDP)	-0.07	-0.21	-0.28	-0.33	-0.37	-0.56	0.00	-0.01	-0.04	-0.07

## 2.3 Public finance shocks

### 2.3.1 Government intermediate consumption

The shock considered is a permanent increase in general government consumption (in volume) of 1 percentage point of GDP over ten years, implemented through higher intermediate consumption. Results are shown in Table 8. We neutralise price effects by assuming that public sector wages remain at their baseline level. Monetary policy does not react to the shock and there is therefore no negative effect via interest rates or the nominal exchange rate. However, the real effective exchange rate adjusts to the impact of the demand shock on prices.

In the first year, GDP increases by almost 1 percentage point, and the effect is maximal during that year: the government consumption multiplier amounts to 0.94 in the first year (0.96 in the third quarter). The shock affects activity directly (via the supply-use identity) and indirectly through multiplier effects on household investment (+0.39 percent) and business investment (+0.69 percent), while the consumption multiplier remains small. A sharp increase in imports (+0.48 percent) dampens the overall impact on activity.

Employment rises significantly alongside the expansion in activity (+0.17 percent in the first year and +0.33 percent in the third year). The decline in unemployment and in expected unemployment gradually pushes nominal wages upward through the Phillips curve, which lifts prices from the second year onwards via the factor-price frontier.

Prices start rising in the first year, by around +0.15 percent. Because of the demand shock, the output gap widens and firms increase value-added prices by raising their margins. The rise in value-added prices is passed through to consumer and export prices. Higher nominal wages and rising unit labour costs further amplify price pressures.

Households experience sizable gains in purchasing power despite rising prices and the negative short-run response of real wages to the demand shock. The household saving rate increases slightly in the short term due to the inertia of permanent income, but then tends to fall as the expected real long-term interest rate declines. This latter effect would not materialise if monetary policy reacted to the increase in activity. The effects on household and business investment are substantial, operating both via the influence of expected inflation on the real cost of capital and via the direct impact of stronger activity and income.

Exports gradually deteriorate due to the loss of price competitiveness. The balance between supply and demand is restored through an appreciation of the real exchange rate and the adjustment of foreign trade flows.

Public finances deteriorate as the fiscal stimulus is entirely financed by net borrowing. Public debt increases by 1.44 percentage points of GDP over the first four years, and the fiscal balance deteriorates by -0.64 percentage point of GDP after four years. Public debt decreases on impact because of the strong negative snowball effect (driven by higher nominal growth and the large stock of net financial public debt) combined with an average tax rate above 40 percent.

As in all BMEs presented in this paper, the fiscal rule stabilising the public debt-to-GDP ratio is deactivated. Therefore, because the shock corresponds to a permanent 1 percentage point increase in public consumption ex ante, the public balance deteriorates permanently, as no automatic mechanism reduces the deficit through lower transfers or higher taxes.<sup>13</sup> In this case, the public balance deteriorates by 0.7 percentage point of GDP ten years after the shock, while public debt is higher by 5 percentage points at the same horizon.

Hence, the mechanisms described here apply to all public finance BMEs. We therefore do not systematically comment on dynamics beyond the five-year horizon in the following sections, except when they display significant deviations.

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<sup>13</sup>In the FR-BDF model, such a fiscal rule exists for the public sector, as well as stabilisation rules for the financial, non-financial and NPISH sectors; see [Lemoine et al. \(2019\)](#).

**Table 8:** Responses of main macroeconomic variables in level to a +1% of GDP increase in real government intermediate consumption

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.94	0.89	0.79	0.69	0.61	0.47	0.91	0.96	0.96	0.94
Private consumption	0.04	0.08	0.07	0.04	0.00	-0.14	0.01	0.04	0.06	0.07
Public consumption	4.10	4.01	3.96	3.97	3.99	3.98	4.14	4.11	4.09	4.06
Total investment	0.49	0.50	0.40	0.32	0.29	0.24	0.32	0.51	0.57	0.57
Business investment	0.69	0.68	0.55	0.49	0.47	0.51	0.54	0.69	0.77	0.77
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.39	0.49	0.37	0.22	0.09	-0.20	0.00	0.46	0.55	0.54
Exports	-0.02	-0.12	-0.27	-0.42	-0.56	-0.91	0.00	-0.01	-0.02	-0.04
Imports	0.48	0.50	0.48	0.44	0.39	0.11	0.46	0.48	0.50	0.50
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	1.13	1.14	1.11	1.09	1.06	0.98	1.08	1.13	1.15	1.15
Net exports	-0.18	-0.24	-0.32	-0.39	-0.44	-0.51	-0.16	-0.18	-0.19	-0.21
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.15	0.40	0.59	0.74	0.85	1.19	0.05	0.12	0.19	0.25
HICP excl. food and energy	0.17	0.43	0.65	0.81	0.93	1.31	0.06	0.13	0.20	0.28
GDP deflator	0.18	0.45	0.65	0.80	0.90	1.21	0.06	0.14	0.22	0.29
Unit labor costs	-0.74	-0.49	-0.26	-0.07	0.08	0.66	-0.81	-0.79	-0.72	-0.66
Compensation per employee	0.02	0.10	0.20	0.32	0.42	0.87	0.00	0.01	0.03	0.05
Productivity	0.77	0.59	0.46	0.38	0.33	0.20	0.82	0.81	0.76	0.71
Real compensation per employee	-0.10	-0.26	-0.35	-0.39	-0.41	-0.34	-0.03	-0.08	-0.12	-0.17
Imports deflator	0.01	0.07	0.18	0.29	0.39	0.70	0.00	0.01	0.01	0.03
Export deflator	0.13	0.33	0.50	0.62	0.71	0.90	0.04	0.10	0.15	0.21
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	-0.16	-0.29	-0.31	-0.29	-0.27	-0.25	-0.09	-0.14	-0.19	-0.23
Total employment (% deviation from baseline level)	0.17	0.30	0.33	0.30	0.28	0.26	0.09	0.15	0.19	0.24
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	0.08	0.00	-0.08	-0.15	-0.21	-0.31	0.10	0.09	0.07	0.05
Households saving rate (% of GDI, pp deviation from baseline level)	0.03	-0.07	-0.13	-0.17	-0.18	-0.15	0.07	0.04	0.01	-0.01
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.63	-0.60	-0.61	-0.64	-0.67	-0.73	-0.66	-0.64	-0.62	-0.61
Public debt (% of GDP)	-0.12	0.33	0.86	1.44	2.03	4.94	0.01	-0.01	-0.05	-0.12

### 2.3.2 Public compensation

The shock considered is a sustained ex ante increase of 1 percentage point of GDP in public wages including employers' social contributions (i.e. public compensation).<sup>14</sup> Results are shown in Table 9. This corresponds to an increase in public consumption in value terms through its deflator component, while productivity and employment in the public sector remain constant. In a novel variant, we also present a shock to public employment.

GDP rises by 0.2% in the first year and reaches a maximum effect of 0.23% after four years. Compared with the shock to public consumption in volume terms, the effects on activity are significantly smaller and are transmitted only gradually. Indeed, the increase in public wages does not directly affect demand in volume, unlike a real public consumption shock. Household nominal income increases, while the households' consumption deflator reacts with a delay. As a result, household purchasing power rises by 0.89% in the first year and remains close to this level thereafter.

The shock therefore transmits indirectly and gradually through disposable income, expected permanent income and the responses of household consumption and investment. The effect then spreads to the other components of aggregate demand. In response to the large income shock, the household saving rate increases by roughly 0.4 percentage point of disposable income in the first year, before falling back to around +0.2 percentage point above baseline after four years.

Household consumption and investment both increase by 0.64% after four years. Business investment grows more moderately (+0.16% after four years), mainly due to stronger activity and a lower real cost of capital driven by higher expected inflation. Exports decline by -0.1% owing to the loss of price competitiveness, while imports increase by 0.27% as domestic demand expands.

Consumer prices rise gradually (0.2% after four years), reflecting the combined effect of higher employment (via the wage Phillips curve) and stronger activity (via the impact of the output gap on the value-added price).

The divergence between the GDP deflator and consumer prices arises from the specific nature of the shock: the increase in public wages feeds fully into the public-sector value-added deflator, which explains the strong rise in the GDP deflator. Real compensation per employee increases markedly (1.91% after one year) and remains close to this level thereafter. It is worth noting that the increase in public wages has no direct effect on wages in the market sector, but only indirect effects through the unemployment gap.

Regarding public finances, the ex ante increase in public wage growth deteriorates the fiscal balance by -0.41 percentage point of GDP in the first year. In addition to standard macroeconomic second-round effects, the negative impact on the public balance is attenuated because public wages are taxed.<sup>15</sup> Finally, the public debt-to-GDP ratio declines by -0.52 percentage point in the first year before beginning to rise gradually after two years.

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<sup>14</sup>Compared with [Aldama and Ouvrard \(2020\)](#), the shock differs in size: in the previous version it was defined as a 1 percentage point of GDP increase in public wages excluding employers' contributions. The corresponding increase in public compensation was therefore larger than 1 percentage point of GDP.

<sup>15</sup>Given the aggregate tax rate is close to 0.40, one would expect an effect of approximately -0.6 percentage point of GDP on the public balance.

**Table 9:** Responses of main macroeconomic variables in level to a +1% of GDP increase in public sector wages per capita

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.20	0.22	0.23	0.23	0.22	0.21	0.16	0.21	0.22	0.22
Private consumption	0.44	0.50	0.57	0.64	0.69	0.81	0.38	0.46	0.47	0.47
Public consumption	0.01	0.03	0.04	0.03	0.01	-0.05	-0.01	0.01	0.01	0.02
Total investment	0.12	0.18	0.21	0.24	0.27	0.35	0.07	0.11	0.14	0.16
Business investment	0.16	0.18	0.16	0.16	0.16	0.19	0.11	0.16	0.19	0.19
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.11	0.32	0.51	0.64	0.74	0.98	0.00	0.08	0.15	0.20
Exports	0.00	-0.02	-0.06	-0.10	-0.15	-0.32	0.00	0.00	0.00	-0.01
Imports	0.19	0.22	0.24	0.27	0.28	0.26	0.16	0.19	0.20	0.20
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	0.27	0.34	0.39	0.43	0.46	0.52	0.22	0.28	0.29	0.30
Net exports	-0.07	-0.11	-0.16	-0.21	-0.25	-0.32	-0.06	-0.07	-0.08	-0.08
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.03	0.09	0.14	0.20	0.24	0.43	0.01	0.02	0.04	0.05
HICP excl. food and energy	0.03	0.10	0.16	0.22	0.27	0.48	0.01	0.03	0.04	0.06
GDP deflator	1.20	1.26	1.32	1.39	1.45	1.63	1.18	1.19	1.21	1.22
Unit labor costs	1.77	1.78	1.83	1.89	1.96	2.19	1.80	1.76	1.76	1.77
Compensation per employee	1.94	1.94	1.97	2.02	2.08	2.29	1.95	1.94	1.93	1.93
Productivity	0.16	0.15	0.14	0.13	0.12	0.10	0.15	0.18	0.17	0.16
Real compensation per employee	1.91	1.86	1.83	1.83	1.84	1.85	1.94	1.92	1.90	1.89
Imports deflator	0.00	0.01	0.04	0.07	0.10	0.24	0.00	0.00	0.00	0.00
Export deflator	0.03	0.07	0.12	0.16	0.20	0.33	0.01	0.02	0.03	0.04
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	-0.04	-0.07	-0.09	-0.09	-0.10	-0.11	-0.02	-0.03	-0.04	-0.05
Total employment (% deviation from baseline level)	0.04	0.07	0.09	0.10	0.10	0.11	0.02	0.03	0.04	0.05
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	0.89	0.92	0.92	0.92	0.90	0.84	0.87	0.89	0.90	0.91
Households saving rate (% of GDI, pp deviation from baseline level)	0.37	0.36	0.30	0.23	0.17	0.01	0.39	0.35	0.36	0.37
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.41	-0.43	-0.43	-0.44	-0.45	-0.48	-0.41	-0.41	-0.41	-0.42
Public debt (% of GDP)	-0.52	-0.15	0.23	0.62	1.01	2.93	-0.11	-0.24	-0.38	-0.52

### 2.3.3 Government investment

The shock under consideration is a sustained ex ante increase in real public investment equivalent to 1 percentage point of GDP. Results are shown in Table 10. It is important to note that this represents a pure public demand shock: FR-BDF does not incorporate mechanisms to capture potential supply-side effects of public investment, such as impacts on labour productivity, private investment, or the accumulation of public capital. Monetary policy does not react to the shock.

GDP increases by 0.85% in the first year, which is 0.1 percentage point lower than the impact of the real government consumption shock discussed earlier, despite both shocks being of identical ex ante size and directly affecting demand for goods and services. This difference reflects the higher import content of investment relative to public consumption. The contribution of the other components of domestic demand is also smaller owing to general equilibrium effects. GDP peaks at 0.87% in the third and fourth quarters, before gradually falling to 0.66% after four years. An analysis of contributions to growth indicates that this hump-shaped profile originates from domestic demand, which reaches its maximum effect in the second year through multiplier dynamics. By contrast, exports gradually deteriorate due to the loss of price competitiveness.

Employment adjusts gradually to the demand shock and displays a hump-shaped pattern similar to GDP, rising by 0.15% in the first year and peaking at 0.30% after three years, before starting to decline from the fourth year onwards.

Consumer prices increase by 0.14% in the first year due to Phillips-curve effects. On the one hand, the positive output gap pushes prices up directly through the value-added price. On the other hand, the unemployment gap is negative (-0.15 percentage point in the first year), which endogenously raises nominal compensation per employee (via expected unemployment) from the second year onwards (+0.09% after two years and +0.29% after four years). Rising domestic prices gradually spread to export and import deflators, further worsening the price competitiveness of French exporters.

The impact on public finances is more negative than in the BME for public consumption, reflecting the smaller effects on activity. Public debt increases by around 1.6 percentage points of GDP after four years, while the public deficit widens by around 0.7 percentage point of GDP over the same horizon.

Taking into account supply-side effects of public investment would likely alter these results significantly, particularly through higher long-run GDP and a narrower output gap.<sup>16</sup> The empirical literature based on VARs or Local Projections (LPs) generally finds that government investment multipliers exceed those of public consumption (Ilzetzi et al., 2013), although estimates vary widely (Clemens et al., 2025).

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<sup>16</sup>See Bonam et al., eds (2024), who conduct such an experiment using the EA-BDF model (Aldama et al., 2022), a euro-area framework combining FR-BDF with a medium-scale semi-structural model for the rest of the euro area, augmented with productivity shocks to mimic the impact of public capital in the production function. In that case, long-run government investment multipliers exceed 1.5 after 60 quarters under model-consistent expectations and active monetary policy (see Chart 12, p. 60).

**Table 10:** Responses of main macroeconomic variables in level to a +1% of GDP increase in real government investment

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.85	0.83	0.75	0.66	0.59	0.44	0.82	0.86	0.87	0.87
Private consumption	0.04	0.07	0.07	0.04	0.00	-0.13	0.01	0.04	0.05	0.06
Public consumption	0.00	0.00	0.01	0.01	0.01	0.02	0.00	0.00	0.00	0.00
Total investment	4.97	5.17	5.20	5.18	5.15	5.08	4.73	4.96	5.07	5.12
Business investment	0.69	0.67	0.52	0.46	0.44	0.45	0.54	0.69	0.76	0.76
Public investment	23.20	23.35	23.60	23.87	24.08	23.96	23.14	23.19	23.22	23.25
Households investment	0.35	0.45	0.35	0.22	0.09	-0.19	0.00	0.41	0.50	0.49
Exports	-0.02	-0.11	-0.24	-0.39	-0.52	-0.85	0.00	-0.01	-0.02	-0.04
Imports	0.76	0.78	0.76	0.73	0.68	0.41	0.73	0.75	0.77	0.78
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	1.15	1.18	1.17	1.16	1.14	1.05	1.08	1.14	1.17	1.17
Net exports	-0.28	-0.34	-0.42	-0.49	-0.54	-0.62	-0.26	-0.27	-0.29	-0.31
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.14	0.36	0.54	0.69	0.80	1.12	0.05	0.11	0.17	0.23
HICP excl. food and energy	0.15	0.40	0.60	0.76	0.87	1.23	0.05	0.12	0.18	0.25
GDP deflator	0.16	0.41	0.60	0.74	0.84	1.12	0.05	0.12	0.19	0.26
Unit labor costs	-0.68	-0.47	-0.26	-0.09	0.06	0.61	-0.73	-0.72	-0.66	-0.61
Compensation per employee	0.02	0.09	0.19	0.29	0.39	0.81	0.00	0.01	0.03	0.04
Productivity	0.70	0.56	0.45	0.38	0.32	0.19	0.74	0.73	0.70	0.65
Real compensation per employee	-0.09	-0.24	-0.33	-0.37	-0.39	-0.32	-0.03	-0.07	-0.11	-0.16
Imports deflator	0.01	0.07	0.17	0.27	0.36	0.66	0.00	0.01	0.02	0.03
Export deflator	0.12	0.30	0.46	0.58	0.66	0.84	0.04	0.09	0.14	0.19
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	-0.15	-0.26	-0.29	-0.28	-0.25	-0.24	-0.08	-0.13	-0.17	-0.21
Total employment (% deviation from baseline level)	0.15	0.27	0.30	0.29	0.26	0.24	0.08	0.13	0.17	0.21
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	0.07	0.00	-0.08	-0.14	-0.20	-0.30	0.09	0.08	0.06	0.05
Households saving rate (% of GDI, pp deviation from baseline level)	0.02	-0.06	-0.12	-0.16	-0.17	-0.14	0.07	0.03	0.01	-0.01
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.66	-0.63	-0.63	-0.66	-0.68	-0.76	-0.69	-0.66	-0.65	-0.64
Public debt (% of GDP)	-0.02	0.45	0.99	1.57	2.18	5.20	0.03	0.04	0.02	-0.02

### 2.3.4 Public employment

This BME is defined as a shock to public employment equivalent to an increase of 1 percentage point of GDP in public consumption, assuming a constant wage per worker in the public sector. Results are shown in Table 11. This corresponds to the creation of approximately 510,000 public sector jobs by 2024. As the public consumption deflator is modelled as a weighted average of public wages per worker and the consumption deflator, the shock has no impact on the price of public consumption. It is therefore similar to a real government consumption shock, except that it includes an additional transmission channel through the response of households' real disposable income and consumption.

Real GDP increases by 1.0% in the first year, before gradually declining to 0.54% four years after the shock. While most of the positive effect on activity stems from the direct contribution of public consumption to GDP, an additional contribution arises from the increase in households' purchasing power (+0.25% after four years), which stimulates private consumption (from +0.25% in the first year to +0.39% in the fourth). For comparison, private consumption increases by only 0.04% in the first year following a public intermediate consumption shock. In the short run, this stronger crowding-in effect on private consumption explains the larger fiscal multiplier associated with a public employment shock compared with a government intermediate consumption shock.

The response of prices is also magnified relative to the government consumption shock. HICP increases by 0.21% in the first year as a result of stronger demand, and by 1.92% in the fourth year owing to second-round effects on employment and wages. Positive effects on total employment push private-sector wages upward through the wage Phillips curve. Higher unit labour costs raise the value-added deflator, feeding through to all domestic deflators. Rising prices deteriorate the external price competitiveness of French exporters. Compared with the government consumption shock, the response of real exports is markedly negative (-0.8% in the fourth year), implying a contribution of almost -0.7% from net exports to real GDP four years after the shock.

Regarding public finances, increasing public employment combines the usual effect of higher real GDP (similar to a government consumption shock) with an additional positive impact through higher household income and therefore a broader tax base. As a result, the government balance deteriorates only modestly: by -0.15 percentage point of GDP in the first year and by -0.07 percentage point in the fourth year. The public debt-to-GDP ratio does not increase — even four years after the shock — but instead declines steadily owing to both higher nominal GDP and the limited deficit. In the long run, the effects of public employment shocks differ markedly from those of government consumption shocks presented in Section 2.3.1. Owing to the large effect on nominal GDP (the GDP deflator increases by 4% after ten years), the public debt-to-GDP ratio rises by only 0.1 percentage point of GDP over the same horizon.

These results for public finance variables call for some discussion.

- First, given the model's design (with an exogenous labour force), newly recruited public-sector employees mechanically reduce the absolute number of unemployed workers and thus lower unemployment benefit payments. As a consequence, the government does not actually increase its total public spending (including transfers) by 1% of GDP, which explains why the shock has a smaller effect on the public balance compared with a standard public consumption shock. Moreover, rather than reducing the absolute number of unemployed workers, the shock could also *increase* the labour force by encouraging additional workers to enter the labour market.
- Second, the model may overestimate the fiscal gain from lower unemployment benefits by overstating the number of insured unemployed workers, since it assumes universal coverage by design. In reality, in 2024, among registered individuals at France Travail, only 65% had opened insurance rights, and only 45% of them were actually receiving financial assistance.<sup>17</sup>

<sup>17</sup>See <https://www.insee.fr/fr/statistiques/7767061?sommaire=7767424>.

**Table 11: Responses of main macroeconomic variables in level to an increase of 1 percentage point of GDP in public consumption**

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	1.00	0.93	0.76	0.54	0.29	-0.78	0.95	1.01	1.02	1.01
Private consumption	0.25	0.32	0.36	0.39	0.38	-0.04	0.18	0.25	0.28	0.30
Public consumption	3.96	3.99	3.99	3.99	3.99	3.98	3.95	3.96	3.97	3.97
Total investment	0.51	0.51	0.38	0.26	0.12	-0.68	0.33	0.52	0.59	0.59
Business investment	0.71	0.62	0.40	0.24	0.09	-0.90	0.56	0.71	0.78	0.77
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.43	0.66	0.63	0.49	0.30	-0.73	0.00	0.47	0.61	0.64
Exports	-0.02	-0.17	-0.44	-0.80	-1.20	-2.96	0.00	-0.01	-0.03	-0.05
Imports	0.57	0.67	0.78	0.88	0.93	0.52	0.51	0.55	0.59	0.61
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	1.22	1.27	1.28	1.27	1.24	0.87	1.13	1.21	1.25	1.27
Net exports	-0.21	-0.33	-0.51	-0.73	-0.95	-1.66	-0.18	-0.20	-0.23	-0.25
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.21	0.72	1.32	1.92	2.49	4.59	0.06	0.15	0.25	0.37
HICP excl. food and energy	0.23	0.79	1.45	2.11	2.74	5.04	0.07	0.17	0.27	0.40
GDP deflator	0.25	0.74	1.26	1.77	2.24	3.95	0.08	0.19	0.31	0.43
Unit labor costs	0.76	1.43	2.27	3.12	3.92	6.59	0.68	0.64	0.77	0.94
Compensation per employee	0.14	0.67	1.29	1.95	2.62	5.16	0.04	0.05	0.17	0.31
Productivity	-0.61	-0.76	-0.98	-1.16	-1.30	-1.42	-0.64	-0.59	-0.60	-0.63
Real compensation per employee	-0.02	0.10	0.25	0.42	0.59	1.16	0.00	-0.07	-0.03	0.01
Imports deflator	0.01	0.11	0.29	0.53	0.82	2.21	0.00	0.01	0.01	0.03
Export deflator	0.17	0.53	0.94	1.36	1.76	3.11	0.05	0.12	0.20	0.29
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	-1.57	-1.64	-1.68	-1.64	-1.53	-0.63	-1.55	-1.56	-1.58	-1.59
Total employment (% deviation from baseline level)	1.61	1.69	1.74	1.71	1.59	0.64	1.59	1.60	1.62	1.64
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	0.30	0.32	0.30	0.25	0.15	-0.47	0.32	0.28	0.30	0.31
Households saving rate (% of GDI, pp deviation from baseline level)	0.04	-0.01	-0.06	-0.13	-0.21	-0.37	0.11	0.03	0.01	0.00
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.15	-0.11	-0.07	-0.07	-0.10	-0.46	-0.17	-0.16	-0.14	-0.13
Public debt (% of GDP)	-0.69	-0.89	-1.04	-1.15	-1.16	0.10	-0.12	-0.29	-0.48	-0.69

### 2.3.5 Social benefits and transfers

In this BME, we simulate a sustained ex ante increase of 1 percentage point of GDP in social benefits excluding unemployment benefits. Results are shown in Table 12. In contrast, unemployment benefits are endogenous to the unemployment rate and therefore react endogenously to the shock. The shock directly affects household disposable income and transmits to the economy via expected permanent income. In this sense, it is a pure demand shock (particularly in the absence of an active tax rule to stabilise debt), and the model does not feature any effects on labour supply.

The transmission of the shock is thus broadly similar to that of the BME on public wages, except for the indexation of certain incomes to the GDP deflator. The effects on GDP are relatively strong in the first year (+0.29 percent) and continue to rise, reaching 0.39 percent after five years, driven primarily by household consumption.

The main transmission channel is household spending, through the direct and positive effect of real social transfers on consumption in the short run. Households benefit from an increase in effective purchasing power and anticipate higher permanent income following the rise in real gross disposable income ( $\bar{y}$ ). However, the shock is partially dampened by real wage inertia, which declines countercyclically due to nominal rigidities.

Households respond to the increase in permanent income by gradually raising their consumption of goods and services. However, the increase in consumption is more gradual than the rise in real gross disposable income (GDI), and the saving rate increases in the short term by nearly 0.6 percentage point of GDI before gradually returning to baseline. Household investment reacts with greater inertia and increases more slowly than consumption. The rise in domestic demand pushes imports upward, while higher domestic prices gradually erode the price competitiveness of exporting firms and reduce French exports.

GDP and consumer prices rise through the usual Phillips-curve mechanisms. Firms increase their markups in the short term due to the widening output gap and the upward pressure it exerts on the value-added price. Nominal wages rise gradually from the second year onwards, further increasing the VA price. These price increases are then transmitted to the export deflator, driving the adjustment mechanism through foreign trade and export price competitiveness.

On the public finance side, the social-benefit shock has a more adverse impact on the budget balance and public debt than previous public expenditure shocks (intermediate consumption, public sector wages, investment, and public employment). The government balance worsens by -0.75 percentage point of GDP in the first year before stabilising at about -0.7 percentage point due to automatic stabilisers. Public debt increases by 2.81 percentage points of GDP after five years and by 5.33 percentage points after ten years, in the absence of any measures to reduce the deficit.

**Table 12:** Responses of main macroeconomic variables in level to a +1% of GDP increase in social transfers

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.29	0.34	0.37	0.39	0.39	0.36	0.23	0.30	0.31	0.32
Private consumption	0.65	0.77	0.89	1.00	1.07	1.19	0.53	0.66	0.69	0.70
Public consumption	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Total investment	0.17	0.27	0.34	0.40	0.45	0.55	0.09	0.16	0.21	0.23
Business investment	0.24	0.28	0.27	0.28	0.29	0.35	0.16	0.23	0.27	0.28
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.16	0.50	0.81	1.02	1.18	1.46	0.00	0.12	0.23	0.31
Exports	0.00	-0.04	-0.09	-0.16	-0.23	-0.53	0.00	0.00	-0.01	-0.01
Imports	0.27	0.33	0.38	0.41	0.43	0.38	0.23	0.27	0.29	0.30
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	0.40	0.48	0.57	0.64	0.69	0.80	0.31	0.40	0.42	0.44
Net exports	-0.10	-0.14	-0.19	-0.24	-0.29	-0.43	-0.08	-0.10	-0.11	-0.12
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.04	0.13	0.22	0.31	0.39	0.71	0.01	0.03	0.06	0.08
HICP excl. food and energy	0.05	0.14	0.24	0.34	0.43	0.78	0.02	0.04	0.06	0.08
GDP deflator	0.05	0.15	0.24	0.34	0.42	0.74	0.02	0.04	0.06	0.09
Unit labor costs	-0.23	-0.21	-0.17	-0.12	-0.07	0.29	-0.21	-0.25	-0.25	-0.23
Compensation per employee	0.01	0.03	0.07	0.12	0.17	0.47	0.00	0.00	0.01	0.01
Productivity	0.24	0.24	0.24	0.24	0.24	0.18	0.21	0.26	0.26	0.25
Real compensation per employee	-0.03	-0.09	-0.13	-0.17	-0.20	-0.25	-0.01	-0.02	-0.04	-0.05
Imports deflator	0.00	0.02	0.06	0.10	0.15	0.39	0.00	0.00	0.00	0.00
Export deflator	0.04	0.11	0.18	0.26	0.32	0.55	0.01	0.03	0.04	0.06
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	-0.05	-0.10	-0.13	-0.14	-0.15	-0.18	-0.02	-0.04	-0.06	-0.07
Total employment (% deviation from baseline level)	0.05	0.10	0.13	0.15	0.16	0.18	0.02	0.04	0.06	0.07
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	1.42	1.45	1.44	1.41	1.37	1.17	1.38	1.41	1.43	1.44
Households saving rate (% of GDI, pp deviation from baseline level)	0.63	0.57	0.46	0.34	0.24	-0.02	0.68	0.62	0.62	0.62
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.75	-0.72	-0.70	-0.69	-0.68	-0.67	-0.78	-0.75	-0.75	-0.74
Public debt (% of GDP)	0.52	1.14	1.72	2.28	2.81	5.33	0.16	0.29	0.41	0.52

### 2.3.6 Direct taxes

The shock considered is a permanent ex ante increase of 1 percentage point of GDP in direct taxes levied on all agents: households (around 80 percent of the total), non-financial and financial corporations (around 20 percent), and the rest of the world (around 1 percent). Results are shown in Table 13. The additional revenue is fully allocated to reducing the general government deficit.

For private agents, two mechanisms are at work. For households, the tax increase reduces purchasing power and therefore gradually lowers consumption and investment. However, labour supply is not affected by the increase in taxes. For firms, the rise in corporate taxes does not directly influence investment or employment decisions.

In line with this description, the BME essentially operates as a levy on purchasing power, which falls by 1.25 percentage points in the first year. Household consumption and investment decrease accordingly, although the initial impact of this significant and sudden shock is largely mitigated by a sharp decline in the household saving rate.

Nevertheless, the decline in GDP remains moderate in the first year (-0.1 percentage point). It increases over time as the household saving rate gradually returns to its initial level and the shock is increasingly passed through to household spending. Lower activity reduces employment, business investment and prices, further weighing on household purchasing power over time. At the same time, lower export prices generate price-competitiveness gains that support exports, providing a stabilisation mechanism that partly offsets the decline in domestic demand.

The impact on the government budget balance amounts to close to +1 percentage point of GDP in the first year, but it is reduced in subsequent years as the deterioration in the macroeconomic environment weighs on government revenues and on unemployment-related expenditure. After five years, the net effect on the deficit amounts to 0.88 percentage point. Consequently, public debt decreases significantly by around -3.1 percentage points of GDP after four years, and by -7.27 percentage points after ten years.

**Table 13: Responses of main macroeconomic variables in level to a +1% of GDP increase in direct taxes**

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	-0.10	-0.29	-0.35	-0.38	-0.38	-0.36	0.00	-0.07	-0.14	-0.20
Private consumption	-0.23	-0.62	-0.80	-0.92	-1.00	-1.16	-0.01	-0.16	-0.31	-0.43
Public consumption	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Total investment	-0.06	-0.24	-0.33	-0.39	-0.43	-0.55	0.00	-0.03	-0.08	-0.13
Business investment	-0.08	-0.24	-0.28	-0.29	-0.30	-0.37	0.00	-0.05	-0.10	-0.16
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	-0.07	-0.43	-0.75	-0.96	-1.11	-1.40	0.00	0.00	-0.09	-0.19
Exports	0.00	0.01	0.05	0.11	0.18	0.49	0.00	0.00	0.00	0.00
Imports	-0.10	-0.26	-0.34	-0.38	-0.41	-0.39	0.00	-0.07	-0.13	-0.18
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	-0.14	-0.39	-0.51	-0.59	-0.65	-0.78	-0.01	-0.10	-0.19	-0.27
Net exports	0.04	0.10	0.16	0.21	0.26	0.41	0.00	0.03	0.05	0.07
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	-0.01	-0.07	-0.16	-0.25	-0.33	-0.65	0.00	0.00	-0.01	-0.03
HICP excl. food and energy	-0.01	-0.08	-0.17	-0.27	-0.36	-0.72	0.00	0.00	-0.01	-0.03
GDP deflator	-0.01	-0.08	-0.18	-0.27	-0.36	-0.68	0.00	-0.01	-0.02	-0.03
Unit labor costs	0.09	0.21	0.20	0.16	0.10	-0.23	0.00	0.06	0.12	0.16
Compensation per employee	0.00	-0.01	-0.04	-0.08	-0.13	-0.42	0.00	0.00	0.00	0.00
Productivity	-0.09	-0.22	-0.24	-0.24	-0.23	-0.19	0.00	-0.06	-0.12	-0.17
Real compensation per employee	0.01	0.05	0.10	0.15	0.18	0.24	0.00	0.00	0.01	0.02
Imports deflator	0.00	-0.01	-0.03	-0.07	-0.12	-0.36	0.00	0.00	0.00	0.00
Export deflator	-0.01	-0.06	-0.13	-0.21	-0.28	-0.51	0.00	0.00	-0.01	-0.02
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.01	0.06	0.11	0.13	0.14	0.17	0.00	0.01	0.02	0.03
Total employment (% deviation from baseline level)	-0.01	-0.07	-0.11	-0.14	-0.15	-0.18	0.00	-0.01	-0.02	-0.03
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	-1.25	-1.33	-1.34	-1.32	-1.30	-1.17	-1.21	-1.24	-1.27	-1.30
Households saving rate (% of GDI, pp deviation from baseline level)	-0.87	-0.61	-0.46	-0.34	-0.25	0.00	-0.99	-0.91	-0.82	-0.75
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	0.97	0.91	0.88	0.88	0.88	0.93	1.00	0.98	0.96	0.94
Public debt (% of GDP)	-0.89	-1.61	-2.34	-3.07	-3.77	-7.27	-0.25	-0.48	-0.69	-0.89

### 2.3.7 Value-Added Tax

The shock considered is a permanent ex ante increase in the VAT rate that raises government revenues by 1 percentage point of GDP. Results are shown in Table 14. The shock affects household consumption and investment expenditures that are subject to VAT.

On impact, the shock generates a sharp rise in consumer prices and investment deflators. The GDP deflator, which incorporates VAT, also increases markedly. The rise in consumer prices immediately reduces household purchasing power, although the increase in nominal wages partially offsets this effect.

The increase in wages, in turn, raises production costs. However, the value-added deflator does not increase after the shock. First, it is not directly affected by the VAT shock. Second, it declines in the short run due to weaker value-added price dynamics associated with lower economic activity (Phillips-curve effects). Third, although nominal wages rise following the VAT shock, the degree of wage indexation to consumer prices is limited (around 0.4), so the wage-price loop does not compensate for the initial negative effect of lower activity on the VA deflator. As a result, the export deflator remains broadly unchanged or even declines slightly.

GDP contracts by 0.16% in the first year and by 0.41% after four years. In the first year, household consumption is the principal contributor to the decline in activity, falling by -0.33%. From the second year onwards, the reduction in output is amplified by a decline in private investment, driven by weaker activity (for business investment) and lower permanent income (for household investment). Exports are broadly unaffected by the shock, while imports fall in line with domestic demand. Consequently, net exports contribute positively to GDP, partially offsetting the decline in domestic demand.

Employment contracts and the unemployment rate rises by 0.17 percentage point after four years. The resulting unemployment gap weighs on nominal wage growth, which stabilises four years after the shock. In the long run, the economy stabilises through declining nominal wages, which restore price competitiveness and support export growth.

Regarding public finances, the VAT increase significantly improves the budget balance, which strengthens by 0.7-0.8 percentage point of GDP over the first four years. Public debt decreases by -3.74 percentage points of GDP after five years and by -6.14 percentage points after ten years.

**Table 14:** Responses of main macroeconomic variables in level to a +1% of GDP increase in indirect taxes (VAT)

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	-0.16	-0.27	-0.34	-0.41	-0.46	-0.53	-0.12	-0.15	-0.17	-0.20
Private consumption	-0.33	-0.46	-0.58	-0.69	-0.78	-1.01	-0.29	-0.32	-0.35	-0.38
Public consumption	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total investment	-0.17	-0.43	-0.54	-0.62	-0.69	-0.90	-0.05	-0.13	-0.21	-0.29
Business investment	-0.19	-0.46	-0.62	-0.72	-0.80	-1.03	-0.08	-0.16	-0.23	-0.31
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	-0.25	-0.68	-0.76	-0.85	-0.94	-1.30	0.00	-0.17	-0.35	-0.49
Exports	0.00	0.01	0.01	0.02	0.03	0.15	0.00	0.00	0.00	0.00
Imports	-0.15	-0.23	-0.28	-0.32	-0.35	-0.41	-0.12	-0.14	-0.16	-0.19
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	-0.22	-0.35	-0.43	-0.51	-0.58	-0.76	-0.16	-0.20	-0.23	-0.27
Net exports	0.06	0.08	0.09	0.10	0.11	0.22	0.04	0.05	0.06	0.07
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	1.25	1.30	1.33	1.32	1.30	1.05	1.23	1.22	1.26	1.28
HICP excl. food and energy	1.25	1.31	1.33	1.33	1.30	1.03	1.23	1.22	1.26	1.29
GDP deflator	1.01	1.03	1.04	1.04	1.02	0.82	1.02	1.01	1.01	1.01
Unit labor costs	0.31	0.44	0.50	0.50	0.48	0.22	0.11	0.37	0.37	0.38
Compensation per employee	0.18	0.26	0.30	0.27	0.23	-0.08	0.00	0.24	0.23	0.23
Productivity	-0.13	-0.18	-0.20	-0.23	-0.25	-0.30	-0.11	-0.13	-0.14	-0.15
Real compensation per employee	-1.04	-0.97	-0.94	-0.97	-1.00	-1.12	-1.22	-0.98	-0.98	-0.99
Imports deflator	0.00	0.00	-0.01	-0.01	-0.02	-0.11	0.00	0.00	0.00	0.00
Export deflator	-0.01	-0.01	-0.02	-0.03	-0.05	-0.19	0.00	-0.01	-0.01	-0.01
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.03	0.08	0.13	0.17	0.20	0.23	0.01	0.02	0.03	0.05
Total employment (% deviation from baseline level)	-0.03	-0.09	-0.14	-0.18	-0.21	-0.23	-0.01	-0.02	-0.03	-0.05
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	-0.88	-0.90	-0.93	-0.98	-1.00	-1.02	-0.94	-0.84	-0.85	-0.87
Households saving rate (% of GDI, pp deviation from baseline level)	-0.46	-0.39	-0.31	-0.25	-0.19	-0.01	-0.55	-0.43	-0.44	-0.43
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	0.76	0.74	0.73	0.71	0.69	0.68	0.74	0.77	0.76	0.76
Public debt (% of GDP)	-1.33	-1.99	-2.64	-3.21	-3.74	-6.14	-0.33	-0.67	-1.00	-1.33

### 2.3.8 Employees' social contributions

The shock considered is a permanent ex ante increase of 1 percentage point of GDP in social contributions paid by employees. Results are shown in Table 15. The shock shares similar characteristics with the direct-tax BME presented above.

In the model's Phillips curve, wage formation depends on changes in gross wages, which are driven by inflation, productivity trends and unemployment expectations. Households therefore cannot negotiate gross wages sufficiently to offset the increase in their social contributions. As a result, the shock operates in a manner similar to a direct tax increase. However, compared with the direct-tax BME, the impact on household disposable income is larger, since households bear the entirety of the 1 percentage point increase in GDP, whereas previously the burden was shared between households and firms. The BME therefore operates as a direct hit to household purchasing power, which falls by -1.42 percentage points in the first year. Consumption and investment decline accordingly, although the shock is initially absorbed to a large extent by a sharp fall in the household saving rate (-0.99 percentage point in the first year).

Despite this large income effect, the decline in activity remains moderate in the first year (-0.12 percentage point). It increases over time as the household saving rate returns to its initial level and the shock is increasingly transmitted to household spending. The medium-run multiplier, as in the direct-tax BME, is close to 0.4. In addition, lower activity reduces employment, business investment and prices, with the negative effect on household purchasing power peaking at -1.52 percent in the third year. At the same time, lower export prices generate price-competitiveness gains that support exports, which partially dampens the decline in domestic demand.

From the first year onward, the government budget balance improves by 0.8 percentage point of GDP, but the gain diminishes in subsequent years as the weaker macroeconomic environment reduces government revenues and increases unemployment-related expenditure. After four years, the net effect on the deficit stands at 0.72 percentage point of GDP. Public debt falls sharply, declining by -2.99 percentage points after five years and by -5.76 percentage points after ten years.

**Table 15: Responses of main macroeconomic variables in level to a +1% of GDP increase in employees social contributions**

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	-0.12	-0.32	-0.40	-0.43	-0.43	-0.41	-0.01	-0.08	-0.16	-0.22
Private consumption	-0.26	-0.70	-0.91	-1.04	-1.13	-1.32	-0.01	-0.18	-0.35	-0.49
Public consumption	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Total investment	-0.07	-0.27	-0.38	-0.44	-0.48	-0.60	0.00	-0.03	-0.09	-0.15
Business investment	-0.09	-0.27	-0.31	-0.31	-0.32	-0.38	0.00	-0.05	-0.12	-0.18
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	-0.08	-0.49	-0.85	-1.09	-1.26	-1.58	0.00	0.00	-0.10	-0.22
Exports	0.00	0.02	0.06	0.12	0.20	0.55	0.00	0.00	0.00	0.00
Imports	-0.11	-0.30	-0.38	-0.43	-0.46	-0.43	-0.01	-0.08	-0.15	-0.21
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	-0.16	-0.45	-0.58	-0.67	-0.73	-0.88	-0.01	-0.11	-0.21	-0.30
Net exports	0.04	0.12	0.18	0.23	0.29	0.46	0.00	0.03	0.05	0.08
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	-0.01	-0.08	-0.18	-0.28	-0.37	-0.74	0.00	-0.01	-0.02	-0.03
HICP excl. food and energy	-0.01	-0.09	-0.20	-0.31	-0.41	-0.82	0.00	-0.01	-0.02	-0.03
GDP deflator	-0.01	-0.09	-0.20	-0.31	-0.41	-0.77	0.00	-0.01	-0.02	-0.03
Unit labor costs	0.10	0.23	0.23	0.18	0.11	-0.27	0.00	0.07	0.14	0.18
Compensation per employee	0.00	-0.02	-0.05	-0.10	-0.15	-0.47	0.00	0.00	0.00	0.00
Productivity	-0.10	-0.25	-0.27	-0.27	-0.26	-0.21	0.00	-0.07	-0.14	-0.19
Real compensation per employee	0.01	0.06	0.12	0.17	0.21	0.28	0.00	0.00	0.01	0.02
Imports deflator	0.00	-0.01	-0.04	-0.08	-0.14	-0.41	0.00	0.00	0.00	0.00
Export deflator	-0.01	-0.07	-0.15	-0.23	-0.31	-0.59	0.00	0.00	-0.01	-0.02
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.02	0.07	0.12	0.15	0.16	0.20	0.00	0.01	0.02	0.03
Total employment (% deviation from baseline level)	-0.02	-0.07	-0.13	-0.16	-0.17	-0.20	0.00	-0.01	-0.02	-0.04
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	-1.42	-1.50	-1.52	-1.50	-1.47	-1.33	-1.37	-1.41	-1.44	-1.47
Households saving rate (% of GDI, pp deviation from baseline level)	-0.99	-0.70	-0.52	-0.39	-0.28	0.00	-1.13	-1.03	-0.93	-0.85
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	0.83	0.76	0.73	0.72	0.72	0.75	0.87	0.84	0.82	0.80
Public debt (% of GDP)	-0.74	-1.29	-1.86	-2.43	-2.99	-5.76	-0.22	-0.41	-0.59	-0.74

### 2.3.9 Employers' social contributions

The shock under consideration is a permanent and ex ante increase of 1 percentage point of GDP in private employers' social contributions. It is mainly transmitted through two channels. Results are shown in Table 16. On the one hand, labour costs rise sharply, which affects labour demand and employment. On the other hand, the increase in labour costs pushes up the value-added (VA) deflator via the factor price frontier of market sectors.

The rise in the VA deflator, which is the central deflator in the model's price formation mechanism, drives up all demand deflators. This price surge has several consequences. On the supply side, it limits the increase in real wages, which from the second year onward grows significantly more slowly than nominal wages. This in turn helps limit the extent of the employment adjustment, although it remains substantial after four years (-0.52 percent for total employment).

Compared with the previous version of FR-BDF, dampening effects related to expectations in the salaried-employment equations are smaller, leading to an employment response roughly twice as large.<sup>18</sup> Given that the shock is equivalent to a +2.7 percent increase in labour costs in the market sector, and assuming a labour-demand elasticity of -0.49, the long-run elasticity of the target for salaried employment in market sectors to the shock in employers' social contributions would be close to -1.3 percent.

On the demand side, the increase in domestic and export prices worsens price competitiveness and weighs on exports, which fall significantly. Rising inflation also contributes to a further deterioration in household purchasing power, particularly given the only partial indexation of wages to prices. This decline in purchasing power is partly cushioned by a fall in the saving rate, but household consumption nonetheless decreases significantly.

As in the direct-tax BME, the ex post effect on the government deficit is close to, but slightly below, 1 percentage point of GDP in the first year. This improvement remains positive but gradually diminishes in subsequent years as the deterioration in macroeconomic conditions weighs on tax revenues and increases unemployment-related expenditure.

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<sup>18</sup>In the first estimate of FR-BDF (Lemoine et al., 2019), the trend of target salaried employment in market sectors under VAR-based expectations was anchored to an exogenous long-run level of employment, based on the labour force and the equilibrium unemployment rate. This specification magnified dampening effects following a labour-cost shock, as agents expected the shock to be temporary insofar as it had no impact on the trend of the employment target.

**Table 16:** Responses of main macroeconomic variables in level to a +1% of GDP increase in employers social contributions

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	-0.02	-0.13	-0.31	-0.49	-0.62	-0.69	0.00	-0.01	-0.02	-0.04
Private consumption	-0.03	-0.17	-0.36	-0.54	-0.70	-1.12	0.00	-0.02	-0.04	-0.07
Public consumption	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Total investment	0.00	-0.03	-0.12	-0.25	-0.38	-0.64	0.00	0.00	-0.01	-0.01
Business investment	-0.01	-0.02	-0.08	-0.17	-0.26	-0.48	0.00	0.00	-0.01	-0.01
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.00	-0.09	-0.35	-0.69	-0.99	-1.52	0.00	0.00	0.00	-0.01
Exports	-0.01	-0.12	-0.32	-0.51	-0.66	-0.57	0.00	0.00	-0.01	-0.03
Imports	-0.01	-0.03	-0.08	-0.16	-0.27	-0.68	0.00	-0.01	-0.01	-0.02
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	-0.02	-0.10	-0.22	-0.35	-0.47	-0.75	0.00	-0.01	-0.02	-0.04
Net exports	0.00	-0.03	-0.09	-0.15	-0.17	0.04	0.00	0.00	0.00	-0.01
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.13	0.48	0.71	0.81	0.80	0.21	0.00	0.08	0.18	0.27
HICP excl. food and energy	0.15	0.53	0.78	0.89	0.88	0.23	0.00	0.09	0.20	0.30
GDP deflator	0.16	0.56	0.83	0.97	0.99	0.51	0.00	0.10	0.21	0.33
Unit labor costs	1.91	1.88	1.89	1.89	1.86	1.19	1.95	1.92	1.90	1.89
Compensation per employee	1.94	1.97	1.97	1.92	1.81	1.01	1.95	1.93	1.94	1.95
Productivity	0.03	0.08	0.08	0.03	-0.04	-0.18	0.00	0.02	0.04	0.05
Real compensation per employee	1.83	1.52	1.26	1.05	0.88	0.39	1.95	1.88	1.80	1.71
Imports deflator	0.01	0.08	0.21	0.35	0.46	0.48	0.00	0.00	0.01	0.02
Export deflator	0.11	0.40	0.62	0.75	0.78	0.37	0.00	0.07	0.15	0.22
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.04	0.21	0.38	0.50	0.56	0.50	0.00	0.02	0.06	0.09
Total employment (% deviation from baseline level)	-0.04	-0.21	-0.39	-0.52	-0.58	-0.51	0.00	-0.02	-0.06	-0.10
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	-0.08	-0.37	-0.64	-0.84	-0.99	-1.18	0.00	-0.04	-0.11	-0.18
Households saving rate (% of GDI, pp deviation from baseline level)	-0.05	-0.17	-0.24	-0.26	-0.24	-0.05	0.00	-0.02	-0.06	-0.10
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	0.91	0.84	0.74	0.65	0.59	0.50	0.91	0.91	0.90	0.89
Public debt (% of GDP)	-1.00	-2.03	-2.79	-3.32	-3.72	-5.23	-0.23	-0.47	-0.73	-1.00

## 2.4 Structural shocks

### 2.4.1 Labour efficiency

The shock under consideration is a permanent ex ante increase of 1 percent in trend labour efficiency in the market sector, which corresponds to a similar increase in labour productivity over the medium term. Results are shown in Table 17. Labour productivity in the non-market sector remains unchanged relative to the baseline. We use a different definition of the shock than in [Aldama and Ouvrard \(2020\)](#): we assume a permanent increase in labour efficiency, while [Aldama and Ouvrard \(2020\)](#) assumed a gradual increase of labour efficiency over a 16-quarter horizon. The different responses to the shock are mainly driven by this different definition of the shock

The shock is transmitted through several channels. First, it immediately affects firms' labour demand, households' consumption through expected permanent income, and the value-added (VA) price, all of which depend directly on trend efficiency. Second, it influences nominal wages, which are indexed to the labour-efficiency trend. Finally, it propagates to the rest of the model via expectations, as the output gap depends on long-term GDP, which in turn depends on trend labour efficiency. In the first year, long-term GDP increases by 0.6 percentage point and the output gap widens by -0.3 percentage point, reflecting effective GDP growth of 0.3 percentage point. Real GDP increases on impact mostly through household consumption and the expected permanent income.

Labour demand decreases as firms incorporate productivity gains, and employment falls by up to -0.4 percentage point after five years. After ten years, the labour market has absorbed around half of the shock, with an overall effect of -0.2 percentage point on total employment and the unemployment rate. In the model's steady state, the shock is neutral for employment, assuming an unchanged equilibrium unemployment rate.

The decline in the GDP deflator and consumer prices results directly from the increase in labour efficiency through its downward effect on the VA deflator, which then transmits to all demand deflators. The efficiency shock also generates competitiveness gains, with export prices declining by -0.19 percentage point after four years and -0.53 percentage point after ten years. Import prices also fall, partly following the decline in the VA price. This reflects importers' behaviour, as they reduce margins to avoid losing market share.

Despite the decline in employment, households anticipate a lasting increase in their permanent income in real terms. Two cumulative effects explain this outcome: first, the rise in long-term GDP, which directly lifts permanent household income; and second, the increase in household purchasing power due to lower consumer prices. Consequently, household consumption and investment grow more dynamically than real gross disposable income (GDI), which increases less rapidly than expected permanent income, leading to a fall in the short-term saving rate. Business investment increases much less: the decline in expected inflation raises the real cost of capital, offsetting the short-term stimulus from higher demand.

Competitiveness gains lead to a gradual increase in exports, while imports rise initially due to stronger domestic demand before gradually decreasing as price competitiveness improves.

Finally, the shock improves public finances, with a reduction in the government deficit of around 0.2 percentage point of GDP in the first year. Public debt declines steadily, from -0.36 percentage point of GDP in the first year to -0.72 percentage point after ten years. The positive effect of automatic stabilisers (via higher real growth) is partly offset by higher unemployment-benefit expenditure and by lower inflation.

**Table 17:** Responses of main macroeconomic variables in level to to a permanent increase of +1% in labour efficiency in the market sector

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.31	0.37	0.38	0.40	0.43	0.64	0.08	0.36	0.41	0.40
Private consumption	0.62	0.59	0.51	0.46	0.43	0.50	0.18	0.77	0.81	0.74
Public consumption	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Total investment	0.18	0.24	0.23	0.27	0.32	0.52	0.03	0.17	0.25	0.27
Business investment	0.24	0.26	0.22	0.26	0.33	0.63	0.05	0.25	0.32	0.33
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.18	0.38	0.46	0.53	0.57	0.71	0.00	0.09	0.27	0.35
Exports	0.01	0.04	0.08	0.13	0.17	0.48	0.00	0.00	0.01	0.02
Imports	0.20	0.04	-0.08	-0.15	-0.18	-0.13	0.08	0.28	0.25	0.19
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	0.39	0.38	0.33	0.31	0.31	0.38	0.10	0.46	0.50	0.47
Net exports	-0.07	-0.01	0.05	0.10	0.13	0.27	-0.03	-0.10	-0.09	-0.07
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	0.07	0.07	0.01	-0.06	-0.15	-0.62	-0.03	0.06	0.11	0.12
HICP excl. food and energy	0.07	0.08	0.01	-0.07	-0.16	-0.68	-0.03	0.07	0.12	0.13
GDP deflator	-0.06	-0.13	-0.20	-0.25	-0.32	-0.71	-0.03	-0.06	-0.07	-0.09
Unit labor costs	0.40	0.18	0.03	-0.18	-0.37	-0.99	0.69	0.38	0.29	0.25
Compensation per employee	0.72	0.67	0.68	0.59	0.46	-0.16	0.76	0.73	0.70	0.68
Productivity	0.32	0.49	0.65	0.77	0.83	0.84	0.07	0.35	0.42	0.43
Real compensation per employee	0.76	0.78	0.85	0.81	0.74	0.52	0.78	0.77	0.75	0.74
Imports deflator	-0.01	-0.03	-0.05	-0.09	-0.12	-0.35	0.00	-0.01	-0.01	-0.01
Export deflator	-0.04	-0.10	-0.15	-0.19	-0.24	-0.53	-0.02	-0.04	-0.05	-0.06
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.00	0.12	0.26	0.35	0.38	0.19	0.00	-0.01	0.00	0.03
Total employment (% deviation from baseline level)	0.00	-0.12	-0.27	-0.37	-0.39	-0.20	0.00	0.01	0.00	-0.03
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	0.49	0.50	0.52	0.49	0.48	0.56	0.47	0.51	0.51	0.50
Households saving rate (% of GDI, pp deviation from baseline level)	-0.11	-0.08	0.01	0.04	0.05	0.06	0.24	-0.22	-0.26	-0.20
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	0.19	0.15	0.10	0.06	0.05	0.10	0.13	0.22	0.22	0.20
Public debt (% of GDP)	-0.36	-0.50	-0.56	-0.58	-0.58	-0.72	-0.04	-0.15	-0.26	-0.36

## 2.4.2 Labour force

The shock under consideration is a permanent 1 percent ex ante increase in the labour force.<sup>19</sup> Results are shown in Table 18. This is an exogenous labour-supply shock. As in the other shocks, we assume unchanged fiscal policy; therefore, public employment remains exogenous and does not increase following the shock.

The shock is transmitted through three main channels. First, at the time of the shock, employment can be considered fixed, generating a sharp increase in both the number of unemployed and the effective unemployment rate. Therefore, the shock influences nominal wages growth, through expected unemployment gap. Second, it affects the households' expected permanent income and therefore consumption, which is once again the main transmission channel of the shock in the short run. Finally, it propagates to the rest of the model via expectations, as the output gap depends on long-term GDP, which in turn depends on trend labour force.

Since long-term structural unemployment is assumed to remain unchanged, long-term employment also eventually increases by 1 percent, and potential GDP immediately rises by 0.6 percentage point. Given effective GDP growth of 0.3 percentage point, the output gap widens by around -0.3 percentage point.

The diffusion mechanism of the shock then involves closing the output gap and gradually bringing the unemployment rate back toward its equilibrium level. This primarily occurs through adjustments in wages and prices. The negative output gap exerts downward pressure on inflation, while the higher unemployment rate slows real wage growth through the New Keynesian wage Phillips curve.

On the demand side, higher production immediately boosts household real disposable income. Similarly to the efficiency shock, expected permanent income increases due to higher long-term GDP. In the short term, the increase in permanent income prompts households to raise consumption and investment beyond current-income growth, with a slight decline in the saving rate during the first two years. Business investment also rises due to stronger activity, although lower expected inflation increases the real cost of capital. Exports gradually benefit from lower domestic prices, making foreign trade a major contributor to GDP growth and supporting convergence toward the new long-run growth path.

The labour market absorbs the increase in the labour force only gradually. In the first year, the unemployment rate increases by 0.79 percentage point and remains near this level for four years, before starting to decline thereafter. After ten years, the unemployment rate is still 0.16 percentage point above baseline, underscoring the inertia of employment. Conversely, total employment is 0.83 percent above baseline after ten years. At steady state, assuming an unchanged equilibrium unemployment rate, the unemployment rate would eventually converge back to baseline.

The government deficit initially widens due to higher unemployment-benefit spending. It remains relatively elevated for five years and begins to decline thereafter. As a result, public debt accumulates and stabilises around 1.2 percentage points of GDP above baseline after ten years. However, the negative impact on the fiscal balance may be overstated, as new entrants into the labour market would not necessarily be eligible for unemployment insurance benefits.

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<sup>19</sup>Since FR-BDF does not include total population but only the labour force, this shock may be interpreted either as an increase in the participation rate for a fixed working-age population or as an increase in the working-age population itself.

**Table 18:** Responses of main macroeconomic variables in level to to a permanent increase of +1% in labour force

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.26	0.29	0.32	0.40	0.51	1.04	0.05	0.31	0.35	0.33
Private consumption	0.50	0.39	0.29	0.26	0.28	0.60	0.11	0.66	0.67	0.57
Public consumption	0.00	0.00	0.00	-0.01	-0.01	-0.03	0.00	0.00	0.00	0.00
Total investment	0.15	0.16	0.15	0.21	0.29	0.71	0.02	0.14	0.21	0.22
Business investment	0.19	0.19	0.15	0.23	0.34	0.84	0.03	0.21	0.27	0.27
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.14	0.25	0.28	0.35	0.45	1.02	0.00	0.07	0.23	0.27
Exports	0.01	0.06	0.15	0.28	0.43	1.21	0.00	0.00	0.01	0.02
Imports	0.14	-0.06	-0.21	-0.28	-0.31	-0.07	0.05	0.24	0.18	0.11
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	0.31	0.25	0.19	0.19	0.22	0.46	0.06	0.39	0.41	0.36
Net exports	-0.05	0.04	0.13	0.21	0.30	0.58	-0.02	-0.08	-0.06	-0.04
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	-0.07	-0.25	-0.49	-0.75	-1.00	-1.90	-0.03	-0.06	-0.08	-0.12
HICP excl. food and energy	-0.08	-0.28	-0.54	-0.82	-1.10	-2.09	-0.03	-0.07	-0.09	-0.13
GDP deflator	-0.09	-0.24	-0.44	-0.65	-0.87	-1.67	-0.04	-0.07	-0.10	-0.14
Unit labor costs	-0.15	-0.45	-0.80	-1.15	-1.48	-2.48	0.10	-0.15	-0.25	-0.30
Compensation per employee	-0.07	-0.33	-0.63	-0.95	-1.26	-2.28	-0.02	-0.03	-0.09	-0.15
Productivity	0.08	0.13	0.17	0.21	0.22	0.20	-0.13	0.12	0.16	0.15
Real compensation per employee	-0.01	-0.14	-0.28	-0.40	-0.51	-0.68	0.00	0.02	-0.02	-0.05
Imports deflator	-0.01	-0.04	-0.10	-0.19	-0.29	-0.88	0.00	-0.01	-0.01	-0.02
Export deflator	-0.06	-0.17	-0.32	-0.49	-0.66	-1.27	-0.03	-0.05	-0.07	-0.10
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	0.79	0.80	0.81	0.77	0.68	0.16	0.80	0.79	0.79	0.79
Total employment (% deviation from baseline level)	0.18	0.16	0.15	0.20	0.29	0.83	0.17	0.18	0.19	0.18
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	0.39	0.36	0.34	0.35	0.39	0.74	0.35	0.41	0.40	0.39
Households saving rate (% of GDI, pp deviation from baseline level)	-0.10	-0.02	0.05	0.08	0.09	0.12	0.20	-0.21	-0.22	-0.15
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	-0.07	-0.12	-0.16	-0.17	-0.15	0.03	-0.13	-0.05	-0.05	-0.07
Public debt (% of GDP)	-0.04	0.16	0.45	0.70	0.91	1.15	0.03	0.00	-0.03	-0.04

### 2.4.3 Equilibrium unemployment rate (NAIRU)

The shock under consideration is a permanent decrease of 1 percentage point in the equilibrium unemployment rate. Results are shown in Table 19. Like the labour-force shock, it constitutes a positive labour-supply shock that raises the employment rate in the long run, once the effects of demand shocks have dissipated.

The shock is transmitted through three main channels. First, it influences nominal wages growth, through the expected unemployment gap. Second, it affects the households' expected permanent income and therefore consumption, which is once again the main transmission channel of the shock in the short run. Finally, it propagates to the rest of the model via expectations, as the output gap depends on long-term GDP, which in turn depends on the equilibrium unemployment rate.

In the first year, the shock mechanically increases the unemployment gap by 1 percentage point, since labour demand is inelastic in the short run. As a result, the output gap widens by -0.4 percentage point: potential GDP increases by 0.6 percentage point, while effective GDP grows by only 0.2 percentage point.

The transmission mechanisms are similar to those of the labour-force shock. In the short term, the positive unemployment gap reduces nominal wage growth via the wage Phillips curve. Initially, real wages per capita remain broadly stable because the VA price adjusts autonomously to the negative output gap, reflecting procyclical pricing behaviour. From the second year onward, however, the Phillips-curve effect on the VA price is dominated by falling nominal wages, causing real wages to decline. Lower labour costs gradually stimulate labour demand, leading to a moderate increase in employment. The positive effects of the labour-supply shock become visible after four years and are still not fully realised ten years after the shock, with total employment 0.8 percent above baseline. In the long run, employment fully adjusts to the new equilibrium unemployment rate. The continued decline in wages and prices also generates competitiveness gains for French exporters.

Most of the short-run transmission of the shock operates through expectations. On the demand side, household consumption and investment increase with expected permanent income, which grows more rapidly than real gross disposable income (GDI) because households anticipate higher future income in line with higher potential GDP.<sup>20</sup> Real GDI shows little initial increase: employment only starts rising after four years, while nominal wages decline more than prices. Real GDI does not fall, however, because fiscal policy is assumed unchanged; civil servants (around 21 percent of total employment in 2024) experience an increase in purchasing power. Business investment rises due to stronger activity and expectations, although lower expected inflation raises the real cost of capital.

In the medium run, demand adjusts — consistent with FR-BDF dynamics — through the external price-competitiveness channel and net exports. This channel becomes predominant after three years, with a contribution of around 0.2 percentage point from net exports to real GDP.

On the public-finance side, the budget balance improves only marginally in the first year through automatic stabilisers and then deteriorates until year five. On the one hand, higher real activity boosts tax revenues, but on the other hand, lower inflation reduces the tax base and compresses expenditure categories such as transfers and pensions. As a result, public debt increases by nearly 0.6 percentage point of GDP after five years before gradually declining to settle at 0.4 percent above baseline after ten years.

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<sup>20</sup>In the model-consistent expectations version of FR-BDF, this channel would likewise operate, as forward-looking households anticipate higher long-run income due to the rise in the employment rate.

**Table 19:** Responses of main macroeconomic variables in level to a permanent decrease of 1 percentage point of the equilibrium unemployment rate

	Y1	Y2	Y3	Y4	Y5	Y10	Y1.Q1	Y1.Q2	Y1.Q3	Y1.Q4
<b>Real activity (% deviation from baseline level)</b>										
Real GDP	0.20	0.21	0.24	0.33	0.46	1.09	0.00	0.26	0.29	0.26
Private consumption	0.37	0.21	0.06	0.02	0.02	0.37	0.00	0.54	0.53	0.42
Public consumption	0.00	0.00	0.00	-0.01	-0.01	-0.03	0.00	0.00	0.00	0.00
Total investment	0.11	0.10	0.07	0.12	0.20	0.66	0.00	0.11	0.17	0.17
Business investment	0.15	0.12	0.09	0.16	0.28	0.85	0.00	0.17	0.22	0.21
Public investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households investment	0.11	0.13	0.08	0.11	0.19	0.80	0.00	0.05	0.18	0.21
Exports	0.01	0.07	0.19	0.36	0.56	1.55	0.00	0.00	0.01	0.02
Imports	0.09	-0.15	-0.33	-0.41	-0.45	-0.15	0.00	0.18	0.12	0.04
<b>Contributions to real GDP (pp deviation from baseline level)</b>										
Domestic demand (excl. inventories)	0.23	0.14	0.05	0.04	0.05	0.32	0.00	0.32	0.33	0.27
Net exports	-0.03	0.08	0.19	0.30	0.42	0.78	0.00	-0.06	-0.04	-0.01
Changes in inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Prices and costs (% deviation from baseline level)</b>										
HICP	-0.09	-0.32	-0.63	-0.96	-1.28	-2.40	-0.04	-0.07	-0.10	-0.15
HICP excl. food and energy	-0.10	-0.35	-0.69	-1.05	-1.40	-2.63	-0.04	-0.08	-0.12	-0.17
GDP deflator	-0.11	-0.31	-0.56	-0.84	-1.12	-2.12	-0.04	-0.09	-0.13	-0.17
Unit labor costs	-0.25	-0.59	-0.99	-1.41	-1.80	-3.03	0.00	-0.25	-0.35	-0.41
Compensation per employee	-0.06	-0.38	-0.76	-1.15	-1.53	-2.76	0.00	0.00	-0.08	-0.16
Productivity	0.19	0.21	0.23	0.27	0.28	0.28	0.00	0.24	0.27	0.25
Real compensation per employee	0.01	-0.15	-0.30	-0.44	-0.56	-0.72	0.02	0.05	0.01	-0.04
Imports deflator	-0.01	-0.05	-0.12	-0.24	-0.38	-1.13	0.00	-0.01	-0.01	-0.02
Export deflator	-0.07	-0.22	-0.42	-0.63	-0.85	-1.61	-0.03	-0.06	-0.09	-0.12
<b>Labor market</b>										
Unemployment rate (pp deviation from baseline level)	-0.01	0.00	0.00	-0.07	-0.18	-0.80	0.00	-0.01	-0.02	-0.01
Total employment (% deviation from baseline level)	0.01	0.00	0.00	0.07	0.18	0.82	0.00	0.01	0.02	0.01
<b>Households revenue</b>										
Real gross disposable income (GDI, % deviation from baseline level)	0.10	0.04	0.00	0.01	0.07	0.53	0.08	0.13	0.11	0.09
Households saving rate (% of GDI, pp deviation from baseline level)	-0.23	-0.14	-0.05	0.00	0.05	0.14	0.07	-0.34	-0.35	-0.28
<b>Public finances (pp deviation from baseline level)</b>										
Public balance (% of GDP)	0.05	0.00	-0.06	-0.07	-0.05	0.16	0.00	0.08	0.08	0.05
Public debt (% of GDP)	-0.12	0.03	0.25	0.45	0.59	0.40	0.01	-0.04	-0.09	-0.12

## 3 Forecasting and policy analysis with the FR-BMEs model

Since 2024, Banque de France's *interim* macroeconomic projections realised in March and September are produced within a new forecasting platform, the FR-BMEs model, which is built on the basic model elasticities (BMEs) of the FR-BDF model. This section provides a general and analytical overview of FR-BMEs and its use in the context of a forecasting exercise but also for policy analysis. In particular, we present a "post-mortem" exercise – a model-based decomposition of the forecast error – of the December 2023 BMPE projection for the year 2024.

### 3.1 The FR-BMEs model

#### 3.1.1 General overview

In a nutshell, the FR-BMEs model can be seen as a linearized, smaller version of the FR-BDF model. FR-BMEs is a quarterly macroeconomic model, built from FR-BDF's basic model elasticities (BMEs) for a subset of orthogonal shocks and designed to *update* an exogenous baseline forecast. This exogenous baseline forecast eventually includes a mechanical update from new historical data, by simply revising the historical data and taking on board revised carry-over effects (see 3.2). The model does not include an explicit accounting block: accounting relationships are implicitly embedded within FR-BDF's basic model elasticities<sup>21</sup>.

FR-BMEs is largely inspired by two internal models developed respectively at the ECB and at the Banque de France. Unfortunately, neither of them has been published in an ECB Occasional Paper or in a Banque de France working paper, and therefore we only briefly describe them.

A first source of inspiration is the "BME tool" developed and maintained by ECB staff and distributed to national central banks (NCBs) of the Eurosystem (European Central Bank, 2016). Using BMEs, ECB staff builds a model that can be seen as a reduced-form, linearized version of a multi-country euro area model, sharing similar properties with the aggregation of NCBs' forecasting models. In particular, the BME tool applies an algebraic transformation of 'direct impact' BMEs initially excluding trade spillovers within the euro area to incorporate these effects and compute 'total impact' BMEs. The BME tool is designed as a toolbox to produce counterfactual scenarios or 'projection updates' to various shocks (for example: commodity prices, foreign demand, short and long rates, exchange rate, fiscal shocks, etc.) both for the euro area and its member states. However, it is not designed as a forecasting model.

A second source of inspiration is the EA-BMEs model, developed at the Banque de France by L. de Charsonville, Y. Kalantzis, C. Le Gall, M. Mogliani, P.-A. Robert and A. Sigwalt. Although it has not yet been published in a working paper, one application to monetary policy appears in Bobasu et al., eds (2025). Similarly to the BME tool, the EA-BMEs model uses the Eurosystem's BMEs to build an EA-wide macroeconomic model, but augmented with a forward-looking financial block. This financial block endogenizes the short rate with a Taylor rule, the long rate with an expected term-structure equation, and the exchange rate with a real uncovered interest parity (UIP) condition. As a result, the EA-BMEs can be seen as a hybrid-expectations macroeconomic model *à la* Dornbusch where, on the real side, economic agents are backward-looking (and whose behaviour is determined by the NCBs' basic model elasticities), while on the financial side, agents are forward-looking. To solve the model, several transformations of the BMEs are required: replacing the nominal exchange rate BME by a real exchange rate one, and modifying other BMEs in order to be conditional on a constant real exchange rate, not a nominal one, and a prolongation of elasticities beyond the 4-year horizon to ensure a consistent Phillips curve across demand shocks.

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<sup>21</sup>Although, in practice, we derive some variables through accounting relationships rather than modelling them with BMEs, when it is simpler than using elasticities.

### 3.1.2 Model equations

Formally, let  $Y_t = (y_{1,t}, \dots, y_{N,t})'$  be the vector of endogenous variables modeled using BMEs, and let  $Y_t^* = (y_{1,t}^*, \dots, y_{N,t}^*)'$  be the vector of exogenous *baseline* variables mapping the endogenous variables  $Y_t$ . Let  $X_t = (x_{1,t}, \dots, x_{S,t})'$  be the vector of exogenous shocks. Finally, let  $Z_t = (z_{1,t}, \dots, z_{K,t})'$  be the vector of endogenous variables derived using (simple) accounting relationships and/or (log-)linear functions of  $Y_t$ ,  $Y_t^*$  and  $X_t$ . Therefore, the FR-BMEs model can be generally described by the system:

$$Y_t = Y_{t-1} + \Delta Y_t^* + \sum_{\ell=0}^L \Theta_{\ell} X_{t-\ell} \quad (1)$$

$$Z_t = F(Y_t, Y_t^*, X_t) \quad (2)$$

where  $\Theta_{\ell}$  is a  $(N \times S)$  matrix gathering the elasticities  $\epsilon_{\ell}^{n,s}$  of endogenous variable  $y_n$  to shock  $x_s$  at quarter  $t + \ell$  after the shock.

Equation (1) determines the BME-modeled variables. Since BMEs are computed over a 4-year horizon ( $L = 16$ ), the model includes 15 lags plus a contemporaneous term. Elasticities  $\epsilon_{\ell}^{n,s}$  are derived from those presented in the previous section.<sup>22</sup> Given that FR-BMEs has  $N = 41$  endogenous variables and  $S = 32$  shocks, it has an exceptionally large number of parameters ( $N \times S \times L$ ) despite its apparent simplicity.

Equation (2) determines the other endogenous variables, which are computed through accounting equations via the function  $F(\cdot)$ . Note that this equation does not include a complete accounting framework. As already mentioned, accounting and general equilibrium relationships are mostly implicit in FR-BMEs' coefficients in  $\Theta_{\ell}$ . For example, the effect of a shock on foreign demand directly affects real exports and indirectly real GDP through the uses and resources equilibrium via FR-BDF elasticities, even if the FR-BMEs model does not have an explicit uses and resources equilibrium equation.<sup>23</sup>

Endogenous variables  $Y_t$  and  $Z_t$  are the main macroeconomic variables: real GDP and demand components (households' consumption, investment and its sub-components, exports, imports, and variation of inventories), prices, deflators and wages, labour market variables (unemployment rate, salaried/non-salaried employment in market and non-market sector, labour force), and some headline public finance variables. Baseline exogenous variables  $Y_t^*$  exactly map the endogenous BME-modeled variables  $Y_t$ . In section 3.2, we give some details about how they are constructed in a forecasting context. More generally, these variables can be any baseline one could think of: they could be the balanced-growth path of FR-BDF for these variables, any specific projection, or even be normalized to ones.

Shocks  $X_t$  are defined as revisions of exogenous variables between two information sets and are divided into three main categories:  $X_t = (X_t^{hyp}, X_t^{gov}, X_t^{uig})'$ . First,  $X_t^{hyp}$  includes the main external and technical assumptions driving our model's projections: foreign demand, short- and long-term interest rates, nominal exchange rate, the price of Brent in euro, and the price of natural gas. All these shocks are described in sections 2.1 and 2.2.<sup>24</sup> Second, we consider shocks to public finance variables in  $X_t^{gov}$ , presented in section 2.3 (except for employees' social contributions). We detail how these shocks are constructed in a forecasting context in section 3.2. Third, we consider specific shocks labeled as experts' "add-ons" or judgement in  $X_t^{uig}$ . These shocks are not presented in this working paper since they lack a clear structural interpretation, unlike shocks to foreign demand, interest rates, or public employment. They are almost always defined as standardized +1% shocks

<sup>22</sup>A small transformation is applied to the elasticities presented in the previous section, which refer to levels instead of differences. Since FR-BMEs is written in (log-)difference for most endogenous variables, we define  $\epsilon_{\ell}^{n,s} = \Delta \log(1 + e_{\ell}^{n,s})$  where  $e_{\ell}^{n,s}$  is the original elasticity. Still, an acceptable first-order approximation would be  $\epsilon_{\ell}^{n,s} \approx \Delta e_{\ell}^{n,s}$ . For variables modeled without logarithms (e.g. the unemployment rate), we simply take the difference of the original elasticity.

<sup>23</sup>Those familiar with macroeconomic models may wonder whether the linear approximation of FR-BDF appropriately satisfies those accounting relationships with chained-price aggregation. In practice, the approximation is good, as we regularly (once a year) update FR-BMEs coefficients based on recent data.

<sup>24</sup>An exception concerns the nominal exchange rate shock. In Section 2.2.3, the shock also includes an effect on the Brent price in euros. For FR-BMEs, we compute an alternative exchange-rate BME under the assumption of a constant Brent price in euros, while still accounting for the effects of the USD/EUR exchange rate on competitors' prices – the latter being captured by the oil-price shock in euros.

to residuals of FR-BDF's main equations (e.g. household consumption, business investment, or employment). Yet, they are essential to the forecasting activity and also to perform a model-based forecast error decomposition. In other words, given the other exogenous variables in  $Y_t^*$ ,  $X_t^{hyp}$  and  $X_t^{sov}$ , add-on shocks  $X_t^{jug}$  can be used to replicate an observed path for  $Y_t$  by "inverting" the FR-BMEs model, i.e. conditioning endogenous variables  $Y_t$  on their observed values and determining the add-on shocks  $X_t^{jug}$  consistent with them. This methodology underpins the "post-mortem" exercise presented in section 3.3.

## 3.2 Forecasting with FR-BMEs

The main purpose of FR-BMEs was to serve as a simplified forecasting platform for the Banque de France *interim* projection exercises.<sup>25</sup> In this context, we chose to restrict our projections to the main macroeconomic variables. Regarding public finances, we are not able to produce public finance forecasts during interim projections. During the BMPE exercise, the FR-BDF model interacts with an annual model of public finances, allowing for a relatively detailed analysis (compared to FR-BDF). In contrast, during BDF interim projections, FR-BMEs never interacts with this annual public finance model. Public finance experts provide macroeconomic forecasters with updated measures and judgements about public finance variables, which are compared to the previous projection exercise to compute fiscal policy shocks. These shocks feed into the macroeconomic forecast but are not sufficient to produce fully tractable and communicable public finance projections. As a consequence, we neither model nor forecast the household saving ratio and business margin rate, since the quarterly profile of these variables largely depends on public finances.

A first step of the interim projection exercise is to update the *baseline* forecast variables  $Y_t^*$  with new historical data. We proceed using a mechanical update of the baseline forecast, only taking on board carry-over effects. We incorporate all new historical data up to the last observed quarter  $T$  and apply the growth rates (or absolute variations when more convenient) from the last forecast exercise to extend it. Formally, for any endogenous variable  $y_t$ , the baseline forecast is defined by:

$$y_t^* = \begin{cases} y_t^{new} & \forall t \leq T \\ y_{t-1}^* + \Delta y_t^{last} & \forall t > T \end{cases} \quad (3)$$

where  $y_t^{new}$  includes updated data (e.g. new quarterly national accounts) and  $\Delta y_t^{last}$  is the growth rate of variable  $y$  based on the last forecast. Note that  $y_t^{new}$  and  $y_t^{last}$  would be identical in the absence of new historical data. This approach has the merits of simplicity and tractability but relies on the assumption that historical data revisions do not have dynamic effects. For example, let's assume exports are revised *upward* in past quarters, pushing them above their equilibrium value (their target). In FR-BDF, this revision would imply, *all other things equal*, negative dynamic effects on exports through its error-correction equation. These effects are absent in FR-BMEs, which implicitly considers this revision as a permanent shock. Yet, forecasters have the ability to add  $X_t^{jug}$  shocks to capture these dynamic effects if they believe the revision reflects a transitory shock.

Once the baseline forecast is established, various shocks are assessed as deviations from the previous projection. For technical and international assumptions, shocks are identified by comparing the current Eurosystem assumptions with those used in the previous forecasting round. Public finance and fiscal policy shocks are also assessed as deviations from the previous assumptions provided by public finance experts. These shocks combine two sources of information: newly identified (or revised) measures since the last forecast exercise, and updated expert judgements from public finance forecasters.<sup>26</sup> Finally, expert add-ons reflect the macroeconomic forecasters' judgement. They may incorporate views on historical data revisions and whether these

<sup>25</sup>For a brief presentation of the Banque de France's macroeconomic projections platform, the reader can refer to [Angelini et al., eds \(2025\)](#)[Box 2, pages 37–39].

<sup>26</sup>These judgements may concern whether quarterly national accounts provide reliable information on public finance variables, or whether there has been a deviation from their historical determinants.

are considered permanent or transitory (cf. supra). In general, they include external inputs: short-term forecasts (or nowcasts) for real GDP, demand components, and employment; inputs for consumption prices and minimum wage from the inflation forecasters; and medium-term scenario elements (e.g., medium-run targets for wages and productivity growth). These shocks should be interpreted as ‘residual’ adjustments in a standard macroeconomic model—except that they are shocks layered on top of residuals, rather than residuals themselves.

### 3.3 A post-mortem exercise on the December 2023 BMPE projection for 2024

*Forecasting is not a “you have it or you don’t” talent. It is a skill that can be cultivated (Tetlock and Gardner, 2015).* In order to improve GDP growth projection, macroeconomists need to better understand where and why their forecasts went wrong. FR-BMEs can be used to this end, as it allows for an easy decomposition of total forecast errors into three distinct sources:

- Errors coming from changes to historical national account data, the latter being regularly revised over the three years following their first release as new information becomes available.
- Errors related to exogenous assumptions taken as an input: namely technical assumptions related to the external and financial environment and public finance assumptions.
- Residual errors encompassing improper specification, non-modeled mechanisms and expert judgements. For simplicity, we refer to them as errors from expert judgements.

This subsection will dive deeper into this methodology through the analysis of Banque de France 2024 real GDP growth forecast error published in December 2023 as part of the Broad Macroeconomic Projection Exercise (BMPE) of the ECB/Eurosystem (for other institutions’ analysis of past forecast errors, see publications of the French Treasury ([Direction Generale du Tresor, 2025](#)) and the European Central Bank ([European Central Bank, July 2024](#))).

#### 3.3.1 Banque de France 2024 real GDP growth forecast error

According to national account data released as of May 2025, 2024 real GDP growth reached 1.1%, that is +0.2 pp compared to Banque de France forecast (Figure 1 and Table 20) published as part of December 2023 BMPE. More specifically, domestic private demand was much weaker than expected and the contribution of inventories to GDP growth was much more negative than expected. On the contrary, the contribution of net exports to real GDP growth surprised positively, mainly due to subdued and lower-than-expected import growth.

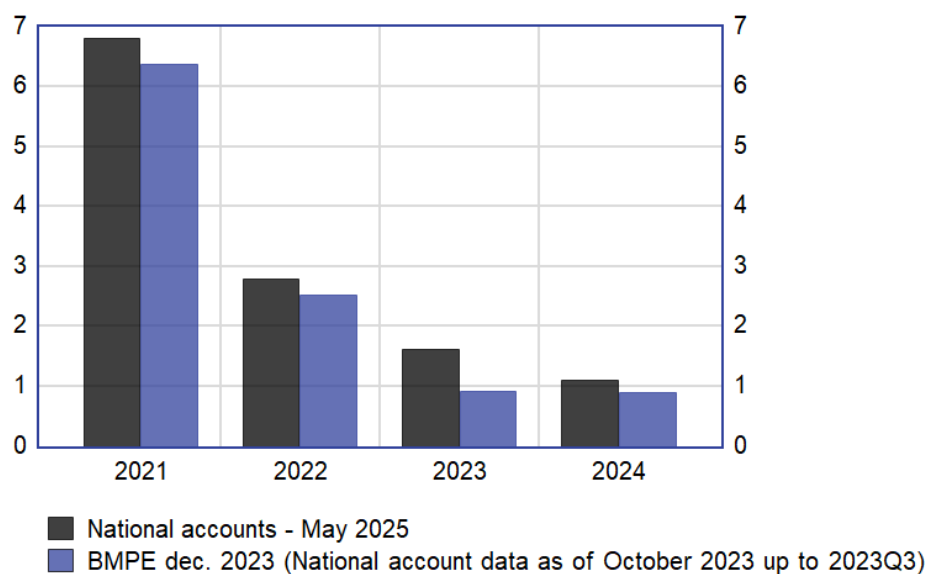
The following sections will break down the +0.2 pp total forecast error into the three error sources detailed above and delve into their main drivers.

#### 3.3.2 Impact of the carry-over effect

Historical data play a crucial role when forecasting annual real GDP growth, because the latter depends on growth dynamics in both the forecast year and the preceding year — a phenomenon known as the carry-over effect. *The carry-over effect measures how much GDP would grow in a given year if all quarterly growth rates in that year were zero, which is equivalent to assuming that quarterly GDP levels remained at their fourth-quarter level of the previous year (European Central Bank, March 2010).*

The size of the carry-over effect may be revised substantially over time. Indeed, national accounts data can be revised for up to three years after their first release, as some sources — such as tax data — become available only later. Depending on the magnitude of these revisions, the impact of historical data updates on forecasts may vary significantly from one projection round to another. This impact can be quantified easily with FR-BMEs: when the model takes as input a given vintage of national accounts data to construct its histor-

**Figure 1: Real GDP growth rate in percentage points**



Sources: Insee (national account data), Banque de France (forecast)

**Table 20: Comparison of observed data (Insee, May 2025) and forecast (2023 December BMPE) - Main macroeconomic variables for the year 2024**

	Forecast (a)	Observed data (b)	Gap (b-a)
<b>Real GDP</b>	<b>0.9</b>	<b>1.1</b>	<b>0.2</b>
Household consumption	1.5	1.0	-0.5
Public consumption	1.7	1.4	-0.3
Total investment	-0.4	-1.3	-0.9
Business investment	0.5	-1.5	-2.0
Public investment	1.7	4.7	3.0
Household investment	-4.1	-5.6	-1.5
Exports	2.0	2.4	0.4
Imports	2.1	-1.3	-3.4
HICP	2.5	2.3	-0.2
HICP excl. food and energy	2.8	2.3	-0.5
GDP deflator	2.6	2.1	-0.5
Market sector value added deflator	1.6	0.9	-0.7
<b>Contributions to real GDP (pp)</b>			
Domestic demand (excl. inventories)	1.1	0.6	-0.5
Net exports	-0.1	1.3	1.4
Changes in inventories	-0.1	-0.8	-0.7

Reading note: Annual growth rates in %, unless stated otherwise

Sources: Insee (National account data as of May 2025) and Banque de France forecast (December 2023 BMPE)

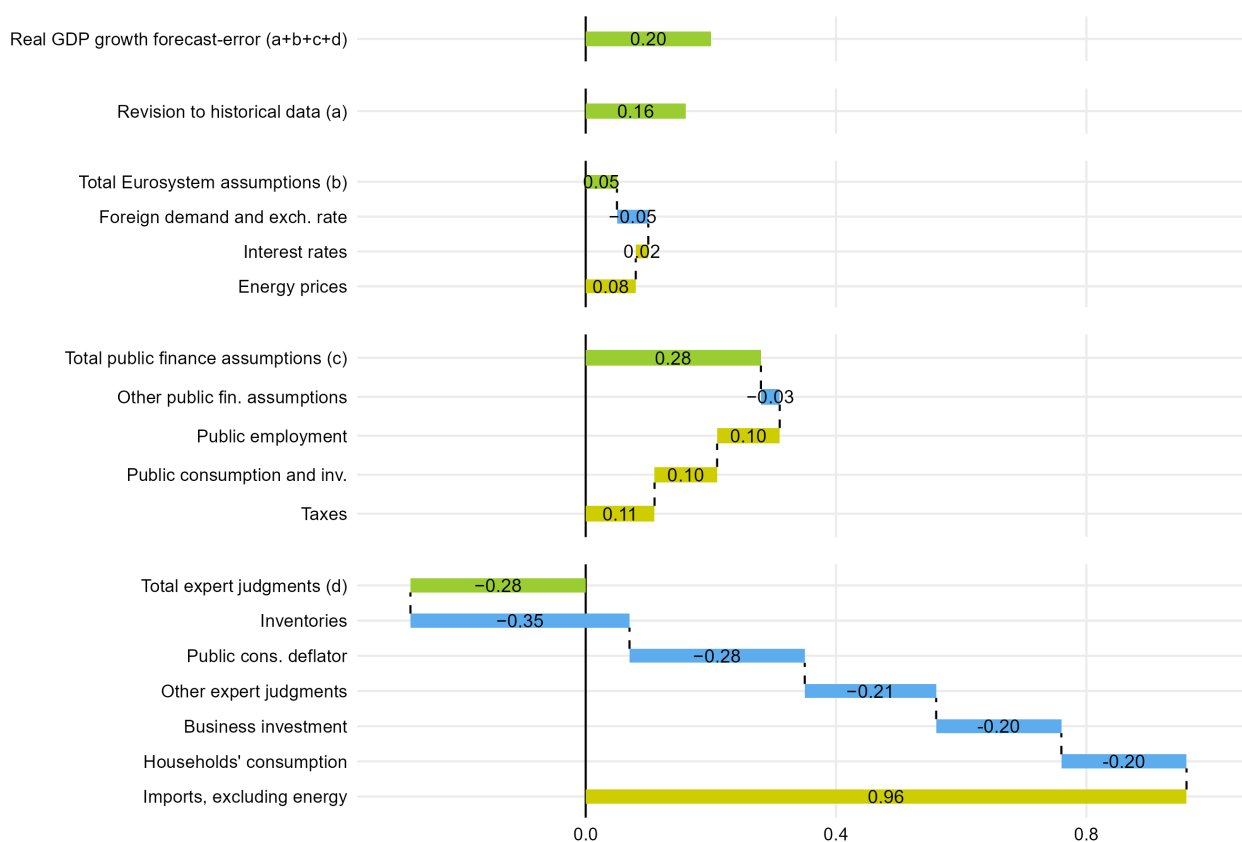
ical database, it then extends the series using quarter-on-quarter growth rates (or level variations for certain variables such as the unemployment rate) from the most recent projection exercise. The resulting updated projection therefore differs from the previous one solely because of revisions to historical data — and thus solely through changes in the estimated carry-over effect.

Two methodological options can be used to analyse the impact of historical data revisions on forecast errors:

- One may assume that the residuals of the econometric equations over the forecast horizon — which capture expert judgement — should remain unchanged regardless of historical data revisions. Under this assumption, forecasters keep residuals fixed, and the trajectory of endogenous variables (such as real GDP) adjusts mechanically.
- Alternatively, one may assume that experts would have updated the residuals in order to keep the trajectory of endogenous variables unchanged once the revised historical data were taken into account. This is the approach adopted by design in FR-BMEs. Its limitation, however, is that it implicitly treats any shock in the last observed period as permanent, whereas experts may have interpreted it as temporary and would therefore not have preserved the original forecast trajectory.

In the case of the 2024 real GDP forecast, and following the methodological choice described above, revisions to historical data had a substantial impact on the total forecast error, as the revisions to 2023 national accounts were particularly large. Between October 2023 (the date of the national accounts vintage used for the December 2023 BMPE) and May 2025, the 2024 real GDP carry-over was revised upward by +0.16 percentage point (Figure 2, line a). This estimate may be revised again in the future if national accounts for 2023 are updated in May 2026.

**Figure 2:** Breakdown of 2024 real GDP growth forecast error (observed data-forecast)



Reading note: Errors on assumptions provided by the Eurosystem led to underestimate 2024 real GDP growth by 0.05 pp, with the impact of the error on foreign demand and exchange rate assumptions being more than offset by the impact of the error on interest rate and energy price assumptions. Overall, errors on Eurosystem assumptions have had a relatively small impact on the total forecast error of 0.20 pp.

Sources: Insee (National account data as of May 2025) and Banque de France forecast (December 2023 BMPE)

### 3.3.3 Impact of revisions to exogenous assumptions

Three types of exogenous assumptions are incorporated during projection exercises:

- assumptions related to the external environment;
- assumptions related to the financial environment;
- and assumptions related to public finance related data.

The first two sets of assumptions are made at the Eurosystem level, according to methodological guidelines detailed in [European Central Bank \(2016\)](#). External environment assumptions include foreign demand, energy prices (gas and oil), nominal exchange rate, France competitors' export and import prices while assumptions related to the financial environment include short- and long-term interest rates.

Public finance data (in nominal terms) are forecasted with a dedicated in-house model, called MAPU and integrated into FR-BDF (through an iterative process to ensure convergence between both forecasts). When analyzing GDP growth forecast errors, errors in public finance assumptions are orthogonal to errors related to macroeconomic effects (which affect tax bases, for instance). The latter are accounted for in other categories, including carry-over effects, updated technical and international assumptions, or expert-judgement errors.

Errors stemming from external and financial assumptions had a negligible impact on the total 2024 real GDP growth forecast error as they were relatively small (0.05) and broadly offset each other (Figure 2, line b). Specifically, foreign demand was slightly overestimated but the negative impact on GDP growth was offset by the positive impact of overestimating gas prices and interest rates (Figure 3).

On the public finance side, the forecast error mainly stems from the underestimation of public investment and employment and the overestimation of taxes that led to underestimate real GDP growth by 0.28 pp (Figure 2, line c).

### 3.3.4 Impact of expert judgements

After accounting for the impact of historical data revisions and updated exogenous assumptions, the remaining gap between observed data and the projections generated by FR-BMEs corresponds to what we label expert-judgement errors (see above).

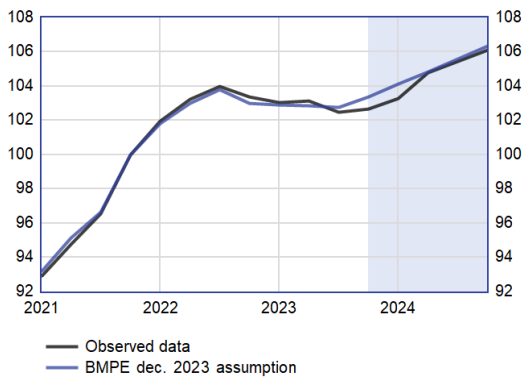
By computing new shocks to close this gap, FR-BMEs can provide an estimate of the contribution of expert-judgement errors for each modelled macroeconomic variable (see Section 3.2 for details on the use of judgementshocks to match observed data). Expert-judgement errors include both active judgements (cases in which experts deliberately deviated from the model's spontaneous results) and model errors (cases in which experts did not intervene but the model's projections ultimately proved incorrect).

In the December 2023 BMPE, expert-judgement errors led to an overestimation of 2024 real GDP growth by 0.28 percentage point (Figure 2, line d). The largest contributors were changes in inventories (0.35 pp), the public-consumption deflator (0.28 pp), business investment (0.20 pp) and household consumption (0.20 pp). However, these errors were almost entirely offset by overestimated imports (0.96 pp). Interestingly, in this case study, the forecast error attributed to expert judgements happened to offset the forecast error originating from public-finance assumptions — a pure coincidence, resulting from the fact that the total forecast error (0.2 pp) was almost equal to the sum of the effects of historical data revisions and Eurosystem assumptions (0.21 pp).

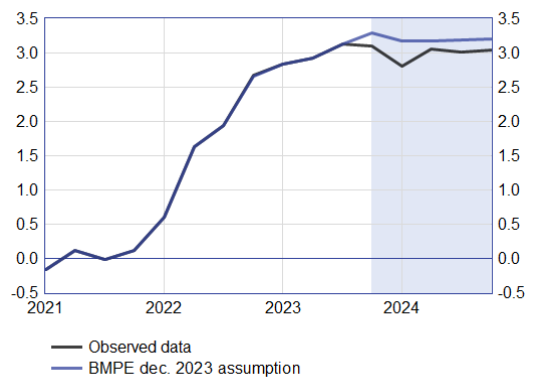
In a context of weaker-than-expected private domestic demand and corporate inventories, import growth turned out negative and much weaker than anticipated. Combined with slightly stronger-than-expected export growth, this resulted in a higher-than-expected contribution of net exports to real GDP growth in 2024. The forecast error in the decomposition of real GDP growth between domestic and external demand also affected the public-finance forecast, as tax revenues tend to be much weaker when GDP growth is driven by net exports rather than by domestic demand. Finally, the forecast error on real public-consumption growth

**Figure 3: External and financial environment assumptions**

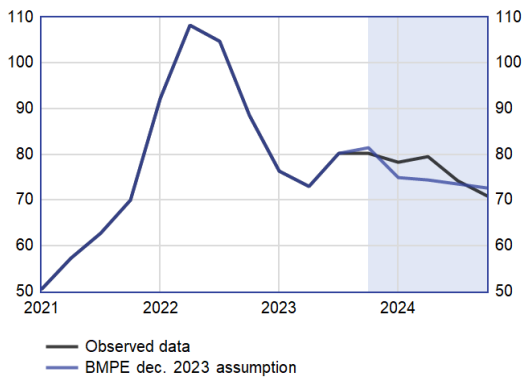
**(a) Foreign demand, 2021Q4 = 100**



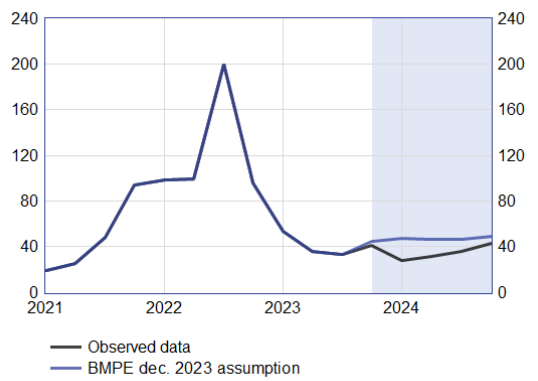
**(b) Long-term interest rate**



**(c) Oil (brent) price (in euros)**



**(d) Gas price (in euros)**



Sources: Eurosystem

primarily reflects the expert-judgement error on the public-consumption deflator (Figure 4) rather than shocks to the volume of public consumption, which are captured by the public finance shocks.

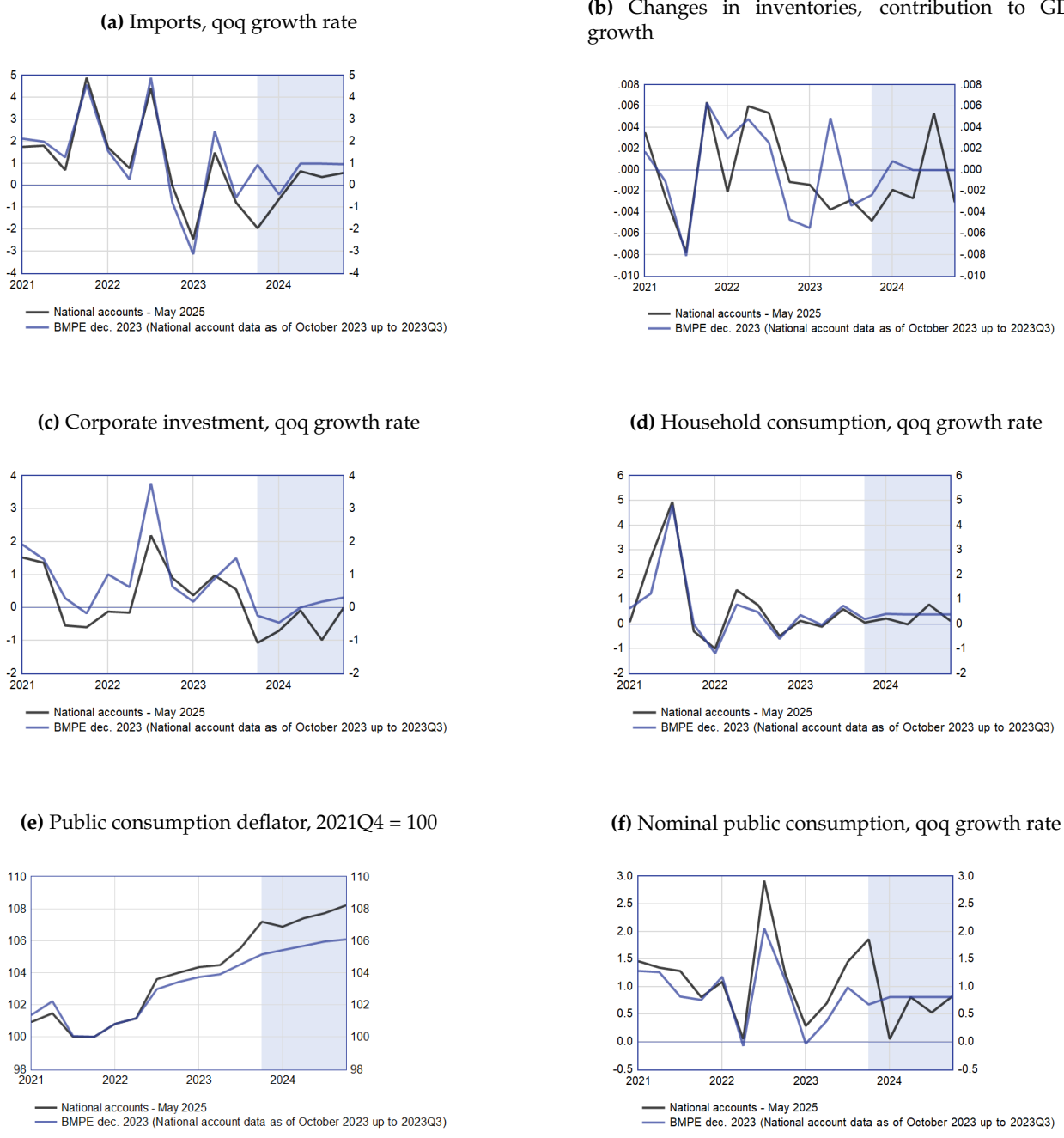
## 4 Concluding remarks

This paper presents the main properties – referred to as Basic Model Elasticities (BMEs) – of the Banque de France’s macroeconomic forecasting and policy analysis model for the French economy. These properties are derived from a set of 19 representative and orthogonal shocks. BMEs can be combined to construct scenarios and update projections, which is the core principle underlying the FR-BMEs model. In practice, however, the operational version of FR-BMEs relies on a broader set of shocks than those documented here.

Since March 2024, Banque de France has employed the FR-BMEs model for interim projection exercises (March and September), while the FR-BDF model remains the benchmark for BMPE exercises conducted in June and December. The transition to the FR-BMEs platform has generated productivity gains during these exercises, which typically involve limited revisions to previous projections. Nevertheless, this simplification entails a trade-off: the FR-BMEs platform does not allow for fully tractable and communicable public-finance projections, nor does it produce detailed forecasts for household disposable income, saving ratio or the profit margin of non-financial corporations.

Beyond its forecasting purpose, FR-BMEs also serves as a framework for policy analysis. In this paper, we conduct a post-mortem analysis of the 2024 real GDP growth forecast error from the December 2023 BMPE. Our findings indicate that the positive forecast error (+0.2 percentage point) is primarily attributable to historical data revisions in national accounts (+0.16 pp), with a smaller contribution from Eurosystem technical and international assumptions (+0.05 pp). By pure coincidence, revisions in public finance assumptions and expert judgement forecast errors offset each other (+0.28 pp and -0.28 pp, respectively).

**Figure 4:** Variables with expert judgement errors having had the largest impact on real GDP growth forecast error



Sources: Insee (National account data as of May 2025) and Banque de France forecast (December 2023 BMPE)

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