Fiscal Consolidation: Balancing Growth, Debt and Inequality*

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Abstract

This paper evaluates different fiscal consolidation policies using a Heterogeneous-Agent New-Keynesian (HANK) model. Three key results emerge. First, the effectiveness of fiscal consolidation improves markedly when implemented through a fiscal rule rather than resulting from a series of discretionary decisions: for the same level of expenditure cuts, the reduction in the debt-to-GDP ratio is larger, and the uncertainty surrounding debt forecasts is lower. Second, it is more efficient to use household transfers as an instrument than public consumption. Third, a significant reduction in the debt-to-GDP ratio can be achieved without penalizing GDP growth or exacerbating inequalities if the government drastically reduces social insurance-based transfers while increasing social assistance transfers. These results are based on an original stochastic debt-sustainability analysis using a HANK model, which provides: *(i)* the projected path of the future debt-to-GDP ratio for a given policy, conditional on a particular business cycle episode, and *(ii)* the full distribution of future debt-to-GDP ratios, thereby highlighting the policy's benefits in reducing the risk of a public debt increase under adverse economic conditions. Evaluations are based on the French economy, which has committed to lowering it in order to comply with the European Treaty.

Keywords: HANK model; Policy evaluation; Fiscal policy; Debt sustainability.

JEL codes: C54; C63; E32; E62; H63; H68.

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1 Introduction

The European treaties defining the Stability and Growth Pact state that each Member State must submit a budgetary trajectory to the European Commission demonstrating its ability to stabilize its public debt. As a result, many Eurozone (EZ) countries, starting from high debt levels partly linked to recent crises, will need to incorporate these new rules into their Finance Acts. France presents a particularly interesting case as its debt-to-GDP ratio has been increasing since 1974.[1] The first objective of this paper is to identify a fiscal strategy that complies with the treaty while avoiding reductions in GDP growth and increases in inequalities, two common pitfalls of fiscal consolidation programs. The second objective is to assess whether a consolidation effort implemented through a fiscal rule (or fiscal brake), rather than through discretionary decisions, can reduce the uncertainty surrounding debt-to-GDP ratio forecasts.[2]

Experience has shown that many fiscal consolidations have failed for two primary reasons. Firstly, the recessionary impact of these programs may be so substantial that there is no reduction in the debt-to-GDP ratio (Blanchard and Leigh (2013, 2014), IMF (2023)). Secondly, they tend to exacerbate inequalities (Ball et al. (2013), Brinca et al. (2021))), potentially leading to social unrest and electoral outcomes that undermine the continuity of these programs (Brender and Drazen (2008), Alesina et al. (2021)). These two reasons underscore the need to evaluate fiscal consolidation programs based on a model with robust fiscal/budgetary multipliers and that considers household heterogeneity. Therefore, we develop a Heterogeneous-Agent New-Keynesian (HANK) model to assess fiscal consolidation programs because *(i)* fiscal/budgetary multipliers are often inadequately measured in representative agent models (Kaplan et al. (2018), Auclert et al. (2023)) and *(ii)* the distributional effects of these programs can be predicted, as they impact households differently based on their income and wealth levels. Our HANK model extends that of Auclert et al. (2024) by incorporating: *(i)* public debt dynamics and a disaggregation of government spending into public consumption and household transfers, which differ in their fiscal multipliers; *(ii)* heterogeneous labor supply responses across three skill groups; and *(iii)* energy price shocks, to capture the recent energy crisis during which the French government resorted to debt-financed energy price shields to mitigate inflationary pressures (see Langot et al. (2024)). We analyze the consequences of fiscal consolidation programs over a four-year horizon, as the adverse effects mentioned above occur in the short term.

In a first step, we show that the debt reduction scenario presented by the French government in its Finance Act is not strong enough to meet the requirements of the European treaty. To do so, we determine the unique sequence of structural shocks that enables the model to exactly replicate the government's forecasts over the 2024-2027 period, extending to HANK models the method of conditional forecasts developed by Del Negro and Schorfheide (2013).[3,4] Using this shock identification strategy and the distribution of shocks estimated from historical data, our assessment

[1] The last time France recorded a budget surplus was in 1974. On average since 1981, French government expenditures have represented 55.2% of GDP, while revenues have been at 51.5%, resulting in an average deficit of 3.9%. As a result, from 1981 to 2024, the debt-to-GDP ratio has increased from 22.4% to 113% (see INSEE data).

[2] By requiring the publication of a multi-year fiscal adjustment path that steadily reduces public debt, the European Commission is implicitly advocating for the implementation of "fiscal rules" that would make a significant portion of fiscal policy predictable for the private sector.

[3] When a government presents its spending and revenue plans in a Finance Act, it also publishes forecasts of key economic aggregates (GDP, inflation, interest rates, public debt, etc.) to demonstrate the budgetary sustainability of its policies. These forecasts are based on a wide information set and combine non-structural models, statistical indicators, and forecasters' informal judgment. As such, they tend to outperform purely structural model-based forecasts, which rely on a more limited set of information and stronger assumptions.

[4] The conditional forecast method has previously been applied in VAR (e.g. Antolin-Diaz et al. (2021)), New Keynesian DSGE (e.g. Del Negro and Schorfheide (2013)), and HANK (Langot et al. (2024)) models.

indicates that the government relies on unrealistically favorable realizations of structural shocks to stabilize its debt, rather than on concrete policy adjustments. As a result, the risk of an increase in the debt-to-GDP ratio is high: our simulations show the median reaching 128.7% in 2027 (17.5 percentage points (pp) higher than in the government's Finance Act forecasts), with values exceeding 135.2% in the 25% most adverse scenarios. This initial set of results suggests that implementing a fiscal consolidation program is required to stabilize French public debt.

In a second step, we compare the effectiveness of different fiscal consolidation strategies —each calibrated to reduce public spending by €40 billion per year until 2027.[5] The first is a discretionary approach, in which changes in public spending are perceived by households and firms as a series of unexpected shocks. The second is the adoption of a fiscal rule (or fiscal brake) that reduces public expenditures until a specified public debt target is reached.[6] Besides, our results indicate that the choice of the fiscal instrument is critical to the success of a consolidation program. If the adjustment is based on reductions in public consumption, the debt-to-GDP ratio would fall to 108.2% (against 111.2% in the Finance Act), whether through discretionary implementation or a fiscal rule. If, instead, the adjustment is based on cuts in household transfers, the consolidation proves more effective, reducing the debt-to-GDP ratio to 107.2% under discretionary implementation and to 106.3% under a rule-based approach. The uniform cuts in household transfers even has a small positive effect on economic growth (whereas the contraction is more abrupt when public consumption is reduced) as the decline in demand is partially absorbed by the fall in households' savings and by the increase in labor supply of low- and middle-skilled workers. The introduction of a fiscal rule also reduces the risks associated with debt-to-GDP forecasts when transfers are used as the fiscal adjustment instrument. In the 25% most adverse economic scenarios, the debt-to-GDP ratio exceeds 131% under a discretionary policy that reduces transfers uniformly, whereas the rule-based approach limits this risk to 123.9%. Compared to the benchmark scenario, introducing a fiscal rule reduces the variance around the median debt-to-GDP ratio when transfers are the instrument. Indeed, under unfavorable economic conditions, reducing transfers has only a modest negative effect on economic activity, as households respond by lowering their savings and increasing their labor supply. This stabilizes the debt-to-GDP trajectory by pushing GDP in the opposite direction of debt.

However, the drawback of uniformly reducing all household transfers is that it significantly exacerbates inequality, as low-skilled workers (who hold few assets) rely heavily on these transfers to maintain their consumption. To address this issue, we propose deepening the reduction in insurance-based transfers (Bismarckian transfers), while simultaneously increasing assistance-based transfers (Beveridgian transfers).[7] Reallocating transfers in favor of assistance-based schemes and at the expense of insurance-based ones helps support economic activity and protect the most disadvantaged households. These households, characterized by low savings, consume the additional assistance transfers, thereby stimulating demand. Meanwhile, wealthier households, facing a reduction in insurance-based transfers, reduce their savings and increase labor supply to compensate for the lost benefits. This policy thus delivers both macroeconomic and distributional gains: it supports consumption and labor supply, contains inequalities and contributes to debt reduction. In this

[5] To stabilize the debt-to-GDP ratio by 2030, an annual reduction of €40 billion is required. This represents a yearly public spending cut of 1.42% of GDP. Those spendings amounted to 57% of GDP in 2023.

[6] To be incorporated into agents' expectations, such a rule must be voted by the parliament at the time of Fiscal Act implementation.

[7] We refer to insurance-based or Bismarckian transfers as those indexed to income, such as pensions or unemployment benefits. Assistance-based or Beveridgian transfers are those not indexed to income, such as health benefits, minimum income schemes, etc. We maintain the total transfer reduction at €40 billion per year, but now implement it through a €64 billion cut in insurance transfers combined with a €24 billion increase in assistance transfers.

sense, fiscal consolidation can be made socially acceptable by preserving GDP growth and curbing consumption inequality.[8] With this policy, the debt-to-GDP ratio reaches 108.4% in 2027 under discretionary implementation, and 107.5% if implemented through a rule. This represents a 1.6 pp smaller reduction in the debt ratio compared to the uniform transfer cut scenario, but this approach achieves fiscal consolidation while containing consumption inequality. Cutting transfers while reallocating them in favor of Beveridgian transfers is less effective at reducing both the median debt level and the risk of debt accumulation compared to a uniform cut (8 vs. 9.6 pp for the median; 9.4 vs. 11.3 pp in the bottom 25% of scenarios). However, by containing inequalities, this strategy promotes greater political stability, which in turn strengthens the credibility of a policy whose benefits materialize only in the medium term. Finally, even though a fiscal rule still outperforms discretion when public consumption is used as the adjustment tool, the advantage is smaller. This is because cuts to public consumption reduce demand, slow growth, and, as a result, increase the risk of rising debt.[9]

At the methodological level, our contribution is to generalize stochastic debt sustainability analysis (SDSA) by incorporating a structural model (a HANK model) and an evaluation that is *(i)* robust to changes in government policy rules and *(ii)* conditional on the estimated distribution of shocks, in line with the recommendations of Lucas (1976) and Blanchard et al. (2021). Using this methodology, we can assess alternative fiscal consolidation strategies either under the most plausible macroeconomic conditions or under specific scenarios, such as those consistent with the government's forecasts as outlined in its Finance Act. This approach also allows for the evaluation of fiscal consolidation programs that entail changes in the reduced-form multipliers of the model's solution, whether these arise from discretionary measures or the implementation of a fiscal rule.[10]

Literature. Our paper contributes to several strands of the literature. First, we add to the growing body of work on the quantitative analysis of HANK models by demonstrating their empirical relevance for macroeconomic policy evaluation, particularly in the context of fiscal consolidation programs. These programs have been widely studied empirically (e.g., Alesina et al. (2015), Ball et al. (2013), Blanchard and Leigh (2013), IMF (2023)). On a theoretical point, Kaplan et al. (2018) have shown how HANK amplifies the effects of fiscal policy and highlight that fiscal transfers have stronger multipliers than in representative-agent models, making consolidation via transfer cuts especially contractionary.[11] Auclert et al. (2025) review recent advances in HANK models and argue that reducing transfers or public spending can significantly depress demand in economies with a high share of hand-to-mouth households. McKay and Wolf (2023) show that simple fiscal rules — such as linking government spending to debt levels— can closely approximate optimal consolidation paths in HANK models underlining the importance of designing rules that stabilize debt. Brinca et al. (2021) show that fiscal consolidation episodes leads to strong recessive impacts and large income inequality. Bi et al. (2013) show that the effects of fiscal consolidation depend not only on

[8]Consumption is used as our measure of inequality, as it best reflects the actual purchasing power of households.

[9]Moreover, another drawback of this policy is that it exposes France to short-term debt risks: in 2024, in 25% of cases, the debt-to-GDP ratio would exceed 115.5% under a rule and 116.1% under a discretionary policy, exposing the French economy to heightened risks on financial markets and with its European partners.

[10]When the parameters of the government's decision rules are altered (e.g., through the introduction of a fiscal brake), the assumption of rational expectations implies a change in the model solution. In principle, if the policy is discretionary, the model should remain stable. However, this assumption may be invalid if the new policy shocks are outcomes that cannot plausibly be drawn from the shock distributions estimated from historical data.

[11]Using representative-agent DSGE models, Erceg and Lindé (2013) have shown that fiscal consolidation in a currency union leads to strong and persistent output losses, especially when prices are sticky. See also Gonzalez-Astudillo et al. (2024) that evaluate model a fiscal consolidation program aligned with Ecuador's IMF agreement or Busato et al. (2022) that explore whether raising the inflation target can serve as a consolidation tool.

the instrument chosen —either taxes or spending— but also on the duration of the policy and the uncertainty surrounding its implementation. However, this body of literature does not discriminate between the different uses of public expenditure. Instead to focus ourself on the liquidity of the government debt as Bayer et al. (2023) on HANK models, we contribute to this literature by building a HANK model with public consumption, Bismarckian and Beveridgian transfers and show that this distinction is crucial in the study the short-term impacts of fiscal consolidation programs.

Second, we contribute to the literature on policy evaluation using conditional forecasts, *à la* Del Negro and Schorfheide (2013), by identifying the structural shocks of a HANK model through the conditional forecast method, using data from government Finance Act projections and taking advantage of the sequence-space Jacobian solution method developed by Auclert et al. (2021).[12] Accordingly, our contribution is to develop a HANK model that captures the quarterly dynamics of public debt, enabling the design of a fiscal consolidation that preserves both short-term growth and inequality. This structural approach also provides a means to assess how the introduction of fiscal rules can mitigate the risks of substantial increases in public debt.

The remainder of the article is organized as follows. Section 2 presents the model. Section 3 details the calibration, estimation, and key model implications. Section 4 discusses the policy evaluations. Finally, Section 5 concludes.

2 The Model

2.1 Households

There are three types of household skills $s \in \{l, m, h\}$: low (l), medium (m), and high, (h). Within each skill group, households experience idiosyncratic productivity shocks that will take values $e' \in \mathtt{E}$ conditionally to a current value $e \in \mathtt{E}$. The transition matrix between productivity levels is $\mathcal{P}(e, e')$.

Household decision rules are independent of skill-type s. Hence, we drop the s subscript. These decisions are deduced from the following maximization problem[13]

$$\begin{aligned} V_t(e_t, a_{t-1}) &= \max_{c_t, a_t \geq 0} \left\{ u(\widetilde{c}_t) - v(n_t) + \beta_t \sum_{e'} \mathcal{P}(e, e') V_{t+1}(e_{t+1}, a_t) \right\} \\ s.t. \quad a_t &= \frac{1}{(1+g)(1+\pi_t)} a_{t-1} + y_t(a_{t-1}, e_t) - (1+\tau_c) c_t \end{aligned}$$

where the basket of goods c_t purchased by household has a value equal to $\widetilde{c}_t + (1 - s_H) p_E \underline{c}_E$, with $\widetilde{c}_t$ the basket that provides utility, $\underline{c}_E$ the subsistence level for the energy consumption, s_H a tariff shield, and $p_{E,t}$ the relative price of energy. The growth rate g gives the real trend and the inflation rate $\pi_t = \frac{P_t}{P_{t-1}} - 1$ is a composition of a nominal trend $\overline{\pi}$ and a cyclical inflation π^c_t, such that $1 + \pi_t = (1 + \pi^c_t)(1 + \overline{\pi})$. The discount factor β_t changes over time to account for demand shocks and is assumed to follow a stationary $AR(1)$ process. Net income $y(a, e)$ and taxable labor income net of social contributions $z(e)$ are defined as follows

$$\begin{aligned} y_t(a_{t-1}, e_t) &= r_t a_{t-1} + (1 - \tau_f) d_t \bar{d}(e_t) + (1 - \tau_p) \big(z_t(e_t)\big)^{1-\lambda} + T_{bev,t} \bar{T}_{bev}(e_t) \\ z_t(e_t) &= (1 - \tau_l) w_t e_t n_t + T_{bis,t} \bar{T}_{bis}(e_t) \end{aligned}$$

[12]Several methods have been developed to solve HANK models. Achdou et al. (2022) proposed a forward-backward algorithmic framework (see also Kaplan and Violante (2018)). In discrete time, Reiter (2009), 2010, Winberry (2018), and Bayer and Luetticke (2020) have proposed approaches to improve accuracy and computational speed. The Auclert et al. (2021) method provides a suite of tools enabling: *(i)* computation of dynamic responses to aggregate shocks; *(ii)* stability checks of the model dynamics (see also Auclert et al. (2023)); and *(iii)* parameter and shock estimation.

[13]See Appendix A for details on the stationarization of this problem.

where $1+r_t = \frac{1+i_{t-1}}{(1+g)(1+\pi_t)}$ and dividends d are distributed non-uniformly across households according to the function $\bar{d}'(e) > 0$. The tax rate on firms' profits is τ_f. Social contributions are proportional to labor incomes, with a contribution rate τ_l. A first transfer, $T_{bis,t}$, is indexed to labor income and taxable (pensions and unemployment benefits), indexation being defined by $\bar{T}'_{bis}(e) > 0$. It is thus the Bismarckian part of transfers. The second transfer, $T_{bev,t}$, is larger for poorer households, indexation being given by $\bar{T}'_{bev}(e) < 0$. It corresponds to the Beveridgian part of transfers. The transferts $T_{bis,t}$ and $T_{bev,t}$ follow stationary $AR(1)$ processes. Total progressive taxes are $\mathcal{T}_I(e) = z(e) - (1-\tau_p)(z(e))^{1-\lambda}$, where λ determines the degree of progressivity and τ_p the level of the tax.

We assume that $u(c) = \log(c)$, $v(n) = \varphi_{s,t}\frac{n^{1+\nu}}{1+\nu}$. The labor disutility parameters $\varphi_{s,t}$, which are skill specifics, change over time in order to account for labor supply shocks and are assumed to follow a stationary $AR(1)$ process. Purchased and consumed consumption baskets, respectively $x_t = \left(\int_0^1 x_{i,t}^{\frac{\varepsilon_d-1}{\varepsilon_d}}\, di\right)^{\frac{\varepsilon_d}{\varepsilon_d-1}}$ for $x \in \{c, \widetilde{c}\}$, are composed of imperfectly substitutable goods $x_i = c_i, \widetilde{c}_i$, with ε_d the elasticity of substitution. The baskets $c_{i,t}$ and $\widetilde{c}_{i,t}$ are given by

$$c_{i,t} = \left(\alpha_E^{\frac{1}{\eta_E}} c_{i,E,t}^{\frac{\eta_E-1}{\eta_E}} + (1-\alpha_E)^{\frac{1}{\eta_E}} c_{i,H,t}^{\frac{\eta_E-1}{\eta_E}}\right)^{\frac{\eta_E}{\eta_E-1}} \qquad \widetilde{c}_{i,t} = \left(\alpha_E^{\frac{1}{\eta_E}} (c_{i,E,t} - \underline{c}_E)^{\frac{\eta_E-1}{\eta_E}} + (1-\alpha_E)^{\frac{1}{\eta_E}} c_{i,H,t}^{\frac{\eta_E-1}{\eta_E}}\right)^{\frac{\eta_E}{\eta_E-1}}$$

where $c_{i,E,t}$ is the energy consumption, $c_{i,H,t}$ the domestically produced consumption good, η_E the elasticity of substitution between these goods, and α_E the share of energy in $c_{i,t}$. The value of the basket $c_{i,t}$ is $c_{i,t} = p_{H,t}c_{i,H,t} + (1-s_H)p_{E,t}c_{i,E,t}$, with $p_{H,t}$ and $p_{E,t}$ the relative prices of the home goods and the energy respectively, and thus $\widetilde{c}_{i,t} \equiv c_{i,t} - (1-s_H)p_{E,t}\underline{c}_E = p_{H,t}c_{i,H,t} + (1-s_H)p_{i,E,t}(c_{i,E,t} - \underline{c}_E)$ with $p_{H,t} = P_{H,t}/P_t$, $p_{E,t} = P_{E,t}/P_t$ and P_t the price of both c_t and $\widetilde{c}_t$.[14]

2.2 Unions

For each type $s \in \{l, m, h\}$, a union sets a unique wage by task k whatever the levels of productivity $e \in \mathtt{E}$ and wealth $a \in \mathtt{A}$. The union's program for the skill group s is[15]

$$U^s_{k,t}(W^s_{k,t-1}) \;=\; \max_{W^s_{k,t}} \left\{ \begin{array}{l} \int_e \int_{a_-} \left[u(c^s_{i,t}(e,a_-)) - v(n^s_{i,t}(e,a_-))\right] d\Gamma^s(e,a_-) \\ -\frac{\psi^s_W}{2}\left(\frac{W^s_{k,t}}{W^s_{k,t-1}} - 1\right)^2 + \beta U^s_{k,t+1}(W^s_{k,t}) \end{array} \right\} \quad s.t.\ N^s_{k,t} = \left(\frac{W^s_{k,t}}{W^s_t}\right)^{-\varepsilon^s} N^s_t$$

where the nominal wage of s-type workers is $W^s_t = \left(\int_k \left(W^s_{k,t}\right)^{1-\varepsilon^s} dk\right)^{\frac{1}{1-\varepsilon^s}}$. The equilibrium distribution satisfies $\sum_s \omega^s \int_e \int_{a_-} d\Gamma^s(e,a_-) = 1$, where ω^s is the fraction of s-type in the population. The adjustment cost parameter of the wage adjustment cost is ψ_W. The unions' decisions for the nominal wages lead to the New Keynesian Philipps Curves (NKPCs):

$$\pi^s_{W,t} \;=\; \kappa^s_W \left(N^s_t v'(N^s_t) - \frac{1}{\mu^s_w}\frac{W^s_t}{P_t} N^s_t \int_e \int_{a_-} e\ td^s_t(e)\ u'(c^s_t(e,a_-)) d\Gamma^s(e,a_-)\right) + \beta \pi^s_{W,t+1}$$

where $td^s_t(e) = \frac{(1-\lambda)(1-\tau_p)(1-\tau_l)}{1+\tau_c}(z^s(e))^{-\lambda}$ is a skill and productivity-specific tax wedge, $\mu^s_w = \frac{\varepsilon^s}{\varepsilon^s-1}$ the union markup, $\kappa^s_w \equiv \frac{\varepsilon^s}{\psi^s_W}$ the skill-specific wage rigidity.

[14] This formulation of the household's problem implies that each consumer, after purchasing the basket c, can freely transform it into a basket $\widetilde{c}$. This reformulation allows for *(i)* a simpler numerical solution, and *(ii)* the derivation of a Phillips curve based on price rigidities in the consumption basket c, as is standard in macroeconomic models.

[15] See Appendix B for details on the stationarization of all unions' problems and the Phillips curves derivation.

2.3 Firms

The supply of goods results from a four-stage production chain.[16]

Basic-good producers produce Y_N using only labor and minimize their production costs

$$\min_{n^l_{i,t}, n^m_{i,t}, n^h_{i,t}} \left\{ W^l_t N^l_t + W^m_t N^m_t + W^h_t N^h_t \right\}$$

$$s.t. \quad \begin{cases} Y_{N,t} & \leq \left(\alpha_l^{\frac{1}{\varepsilon_N}} \left(A^l_t N^l_t\right)^{\frac{\varepsilon_N - 1}{\varepsilon_N}} + \alpha_m^{\frac{1}{\varepsilon_N}} \left(A^m_t N^m_t\right)^{\frac{\varepsilon_N - 1}{\varepsilon_N}} + \alpha_h^{\frac{1}{\varepsilon_N}} \left(A^h_t N^h_t\right)^{\frac{\varepsilon_N - 1}{\varepsilon_N}} \right)^{\frac{\varepsilon_N}{\varepsilon_N - 1}} \\ N^s_t & = \sum_i \omega^s \pi^s_i e^s_{i,t} n^s_{i,t} \quad \forall s \in \{l, m, h\} \end{cases}$$

where $\sum_i \pi^s_i e^s_i = \varpi^s$ is the average productivity of each population and A^s a s-type productivity shock assumed to follow a stationary $AR(1)$ process, $\forall s \in \{l, m, h\}$. Optimal labor demands are

$$N^s_t = \frac{\alpha_s}{A^s_t} \left(\frac{W^s_t / (A^s_t \varpi^s)}{MC_{N,t}} \right)^{-\varepsilon_N} Y_{N,t} \quad \text{with} \quad MC_{N,t} = \left(\sum_s \alpha_s \left(\frac{W^s_t}{A^s_t \varpi^s} \right)^{1-\varepsilon_N} \right)^{\frac{1}{1-\varepsilon_N}} \quad \forall s \in \{l, m, h\}$$

As all s-type employees work the same number of hours through the unions' decisions, then $n^s_{i,t} = n^s_{i',t} \equiv n^s_t$, $\forall i, i'$. After normalizing $n^s_t = 1$,[17] we deduce that $N^s_t = \sum_i \omega^s \pi^s_i e^s_{i,t}$, with $\sum_s \omega_s = 1$. Assuming perfect competition, leading to $\Pi_{N,t} = (W_t - MC_{N,t}) Y_{N,t} = 0$, we have $w_t = mc_{N,t}$, with $w_t = \frac{W_t}{P_t}$ and $mc_{N,t} = \frac{MC_{N,t}}{P_t}$.

Intermediate-good producers produce Y_H with energy E and basic goods Y_N while minimizing their production costs

$$\min_{E_t, Y_{N,t}} \{ W_t Y_{N,t} + P_{FE_t} E_t \} \qquad s.t. \;\; Y_{H,t} \leq \left(\alpha_f^{\frac{1}{\sigma_f}} E_t^{\frac{\sigma_f - 1}{\sigma_f}} + (1 - \alpha_f)^{\frac{1}{\sigma_f}} Y_{N,t}^{\frac{\sigma_f - 1}{\sigma_f}} \right)^{\frac{\sigma_f}{\sigma_f - 1}}$$

The optimal demands of production factors are:

$$Y_{N,t} = (1 - \alpha_f) \left(\frac{W_t}{MC_{H,t}} \right)^{-\sigma_f} Y_{H,t}, \qquad E_t = \alpha_f \left(\frac{P_{FE,t}}{MC_{H,t}} \right)^{-\sigma_f} Y_{H,t}$$

with a marginal cost defined as follows

$$MC_{H,t} \;\; = \;\; \left(\alpha_f (P_{FE,t})^{1-\sigma_f} + (1 - \alpha_f) W_t^{1-\sigma_f} \right)^{\frac{1}{1-\sigma_f}}$$

Given that perfect competition leads to $\Pi_{H,t} = (P_{H,t} - MC_{H,t}) Y_{H,t} = 0$, we deduce $p_{H,t} = mc_{H,t}$ with $p_{H,t} = \frac{P_{H,t}}{P_{t}}$ and $mc_{H,t} = \frac{MC_{H,t}}{P_t}$.

Final-good producers combine goods in order to satisfy the households' preferences. They minimize their production costs

$$\min_{Y_{H,t}, Y_{FE,t}} \{ P_{H,t} Y_{H,t} + (1 - s_{H,t}) P_{FE,t} Y_{FE,t} \} \quad s.t. \quad Y_{F,t} \leq \left(\alpha_E^{\frac{1}{\eta_E}} (Y_{FE,t})^{\frac{\eta_E - 1}{\eta_E}} + (1 - \alpha_E)^{\frac{1}{\eta_E}} (Y_{H,t})^{\frac{\eta_E - 1}{\eta_E}} \right)^{\frac{\eta_E}{\eta_E - 1}}$$

[16] See Appendix C for details on the stationarization of all the firms' problems.
[17] See Appendix E for more details.

The optimal decisions satisfy

$$Y_{FE,t} = \alpha_E \left(\frac{(1-s_{H,t})P_{FE,t}}{MC_{F,t}}\right)^{-\eta_E} Y_{F,t}, \qquad Y_{H,t} = (1-\alpha_E)\left(\frac{P_{H,t}}{MC_{F,t}}\right)^{-\eta_E} Y_{F,t}$$

with a marginal cost defined as follows

$$MC_{F,t} \;=\; \left(\alpha_E((1-s_{H,t})P_{FE,t})^{1-\eta_E} + (1-\alpha_E)\,(P_{H,t})^{1-\eta_E}\right)^{\frac{1}{1-\eta_E}}$$

Perfect competition leads to $\Pi_{F,t} = (P_{F,t} - MC_{F,t})Y_{F,t} = 0$ and therefore $p_{F,t} = mc_{F,t}$ with $p_{F,t} = \frac{P_{F_t}}{P_t}$ and $mc_{F,t} = \frac{MC_{F,t}}{P_t}$.

Retailer i produces according to a linear production function, $Y_{i,t} = Y_{i,F,t}$, an imperfectly substitutable good. The households and the government have the same preferences and thus their baskets are defined by $Y_t = \left(\int_0^1 Y_{i,t}^{\frac{\varepsilon_{d,t}-1}{\varepsilon_{d,t}}}\,di\right)^{\frac{\varepsilon_{d,t}}{\varepsilon_{d,t}-1}}$, for $Y \in \{c, G\}$. We assume that the elasticity of substitution across goods changes over time, i.e. $\varepsilon_{d,t}$ depends on t. These variations in $\varepsilon_{d,t}$ lead to price-markup shocks (a disturbance to the desired markup of retailers' prices over their marginal costs) as the markup is given by $\mu_t = \frac{\varepsilon_{d,t}}{\varepsilon_{d,t}-1}$. We assume that μ_t follows a stationary $AR(1)$ process. The i-retailer sets its price (Monopolistic competition) to maximize its profits

$$\Pi(P_{i,t-1}) \;=\; \max_{P_{i,t}}\left\{\frac{P_{i,t}-P_{F,t}}{P_t}y_{i,t} - \frac{\psi_P}{2}\left(\frac{P_{i,t}}{P_{i,t-1}}-1\right)^2 Y_t + \frac{1}{1+r_{t+1}}\Pi(P_{i,t})\right\} \quad s.t.\;\; y_{i,t} = \left(\frac{P_{i,t}}{P_t}\right)^{-\varepsilon_d} Y_t$$

This leads to the following NKPC:

$$\pi_t \;=\; \kappa_P\left(mc_t - \frac{1}{\mu_t}\right) + \frac{1}{1+r_{t+1}}\frac{Y_{t+1}}{Y_t}\pi_{t+1}$$

with $mc_t = \frac{P_{F,t}}{P_t}$ and $\kappa_P = \frac{\varepsilon_d}{\psi_P}$. The firm's profit (its dividends) is defined by

$$\mathcal{D}_t = P_tY_t - P_{F,t}Y_{F,t} - \frac{\psi_P}{2}\left(\frac{P_{j,t}}{P_{j,t-1}}-1\right)^2 P_tY_t,$$

knowing that with a linear production, we have $Y_t = Y_{F,t}$.

2.4 Energy Market

Energy E_t^s is produced using raw energy $\overline{E}_t$ through the technology $E_t^s = A_E\overline{E}_t^{\nu}$, where $0 < \nu \leq 1$ and $A_E > 0$. Raw energy is purchased abroad at an exogenous price $\widetilde{P}_{Et}$, and the quantity of raw energy $\overline{E}_t$ adjusts to ensure energy market equilibrium. Assuming that $\nu = 1$, then energy price is $P_{Et} = \widetilde{P}_{Et}/A_E$, and the energy sector distributes dividends $d_{Et} = 0$.[18] Given that France does not produce any raw energy, we assume that the revenues from raw energy sales $\mathcal{R}_{Et} = P_{Et}E_t^s$ are earned by a foreign representative agent who uses them to purchase goods exported by French firms $\mathcal{R}_{Et} = X_t$. With this assumption, albeit highly simplistic, trade balance is always at equilibrium without any financial trade with the rest of the world. We assume that the relative price of energy $P_{E,t}$ follows a stationary $AR(1)$ process.

[18] Meyler (2009) and Gautier et al. (2023) demonstrate that changes in consumer energy prices are primarily driven by variations in oil prices in the short run: consumer prices for liquid fuels reflect a direct, complete, and rapid pass-through of crude oil prices, thus leading us to calibrate $\nu = 1$ so that changes in crude oil prices largely pass through to consumer energy prices.

2.5 Central Bank

The central bank, here the ECB, follows a monetary rule:

$$i_t^* = \rho_r i_{t-1}^* + (1-\rho_r)\left(i_{ss}^* + \phi_\pi \pi_t^{EU}\right) + \widetilde{\varepsilon}_t$$

with European inflation defined as

$$\pi_t^{EU} = \mu_{FR}\pi_t + (1-\mu_{FR})\pi_t^{REU} \quad \text{where} \quad \pi_t^{REU} = \rho_\pi \pi_t + \pi_t^{REU*}$$

where π_t^{REU} is the inflation in the rest of the Euro area, μ_{FR} the share of the French economy in the Euro area, and π_t^{REU*} the uncorrelated component of EU inflation with French inflation (an *iid* process by assumption). Therefore, the effective Taylor rule for the French economy is

$$i_t^* \quad = \quad \rho_r i_{t-1}^* + (1-\rho_r)\left(i_{ss}^* + \phi_\pi(\mu_{FR} + (1-\mu_{FR})\rho_\pi)(\pi_t - \overline{\pi}\right) + \varepsilon_t$$

with $\varepsilon_t = \widetilde{\varepsilon}_t + \phi_\pi(1-\rho_r)(1-\mu_{FR})\pi_t^{REU*}$ that follows an $AR(1)$.

2.6 Interest Rate and Risk Premium

The interest rate decided by the central bank i_t^* may differ from the effective interest rate on the French government debt b_t. Let us define the effective nominal interest rate

$$i_t = i_t^* + \widetilde{\vartheta}_t$$

where $\widetilde{\vartheta}_t$ is a wedge that can be positive or negative, according to the risk premium on government debt and the maturity composition this debt. In order to account for the reactivity of the financial markets to the French debt-to-GDP ratio, we assume that the spreads between public debt interest rates and the short-term interest rate $(\widetilde{\vartheta}_t)$ is given by

$$\widetilde{\vartheta}_t = \eta\frac{b_t}{Y_t} + \vartheta_t \quad \text{where} \quad \vartheta_t = \rho^\vartheta \vartheta_{t-1} + \varepsilon_t^\vartheta \quad \text{with} \quad \varepsilon_t^\vartheta \sim \mathcal{N}(0, \sigma_{\varepsilon^\vartheta})$$

The parameter η gives the sensitivity of the spread to the debt-to-GDP ratio, $\frac{b_t}{Y_t}$. The Fisher rule leads to $1 + r_t = \frac{1+i_{t-1}}{(1+g)(1+\pi_t)} = \frac{1+i_{t-1}^* + \widetilde{\vartheta}_{t-1}}{(1+g)(1+\pi_t)}$.

2.7 Government

Government revenues and expenditures are denoted respectively R_t and D_t. Public debt (B_t) finances the differences:

$$\begin{aligned}
R_t &= \sum_s \int_e \int_{a_-} \mathcal{T}_I^s(e) d\Gamma^s(e, a_-) + \tau_l \sum_s \int_e \int_{a_-} w_t^s n_t^s e d\Gamma^s(e, a_-) + \tau_c C_t + \tau_f \mathcal{D}_t \\
D_t &= G_t + \widetilde{T}_t + s_{H,t} p_{FE,t}(Y_{FE,t} + (1+\tau_c)\underline{c}_{FE}) \\
b_t &= (1+r_t)b_{t-1} - R_t + D_t
\end{aligned} \tag{1}$$

where b is the real public debt and $\widetilde{T}_t$ aggregate real transfers. To ensure the stability of the public debt dynamics, the lump-sum transfer incorporates a fiscal brake

$$\widetilde{T}_t = T_t - \theta\left(\frac{b_{t-1}}{b} - 1\right) + e_{\tau,t} \quad \text{with} \quad T_t = \sum_s \int_e \int_{a_-} \left[T_{bev,t}\overline{T}_{bev}(e) + T_{bis,t}\overline{T}_{bis}(e)\right] d\Gamma^s(e, a_-)$$

such that $\widetilde{T}_t$ is reduced when debt is larger than its steady-state level and e_τ is a measurement error. We assume that e_τ follows a stationary $AR(1)$ process. T_t is the observed transfers paid by the government to households which are composed of Beveridgian transfers $T_{bev,t} = \sum_s \int_e \int_{a_-} T_{bev,t}\overline{T}_{bev}(e) d\Gamma^s(e, a_-)$ and Bismarckian transfers $T_{bis,t} = \sum_s \int_e \int_{a_-} T_{bis,t}\overline{T}_{bis}(e) d\Gamma^s(e, a_-)$.

Introducing a fiscal rule as a fiscal consolidation tool. The government can announce that it will consolidate its debt according to a rule. We will consider the following rule that can be applied to each of its policy instrument

$$\mathcal{B}_t = (1-\rho^{\mathcal{B}})\mathcal{B} + \rho^{\mathcal{B}}\mathcal{B}_{t-1} - \upsilon^{\mathcal{B}}(b_{t-1} - b) + \varepsilon_t^{\mathcal{B}} \quad \text{with } \mathcal{B} \in \{G, T_{bis}, T_{bev}\} \tag{2}$$

The component $\upsilon^{\mathcal{B}}(b_{t-1} - b)$ represents a fiscal brake: if $\upsilon^{\mathcal{B}} > 0$, expenditures are reduced in proportion to the gap between the current debt level and the target b. If $\upsilon^{\mathcal{B}} = 0$, then expenditures follow the usual $AR(1)$ process. When the government intends to modify all transfers (Beveridgian and Bismarckian) in the same way, the same innovation and the same fiscal adjustment apply to the $T_{bis,t}$ and $T_{bev,t}$ components of the transfers.

Implementing a fiscal consolidation. A minimum requirement for any budget consolidation program is that it lowers the primary deficit enough to stabilize the public debt. Therefore, at horizon n, the program must ensure that $b_{t+n} = b_{t+n-1}$. Along an adjustment path without shocks, Equation (1) implies that the debt-stabilizing objective is satisfied if and only if:

$$(\overline{r} - \phi)\, b_{t+n} = S_{t+n} \quad \text{where } \phi = \tfrac{\theta}{b} + \textstyle\sum_{\mathcal{B}\in\{G,T_{bis},T_{bev}\}} \upsilon^{\mathcal{B}}$$

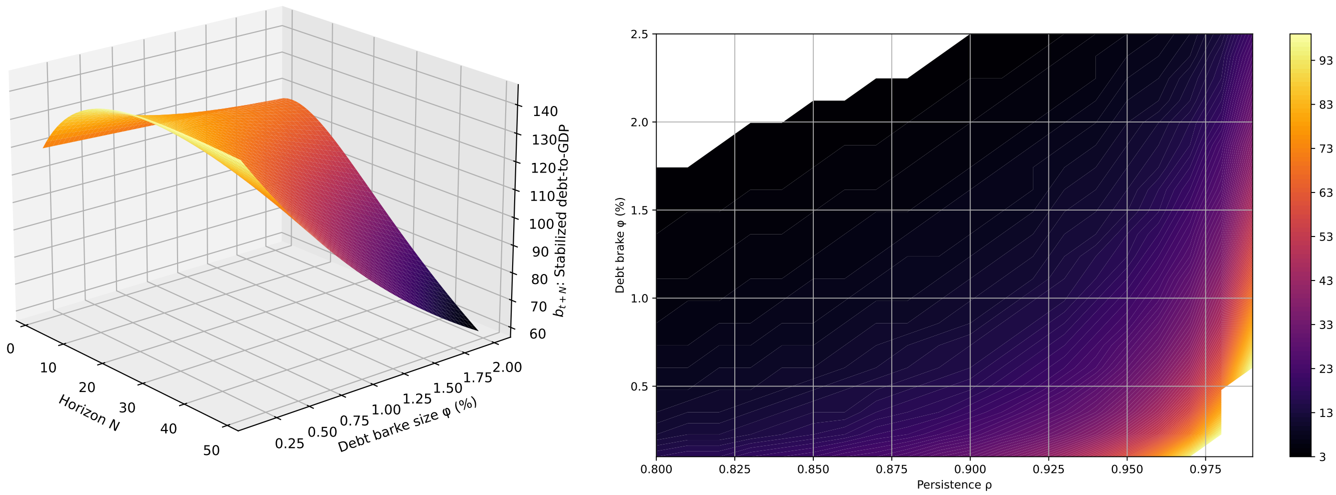
with $\overline{r} = i - \overline{\pi} - g$ the gap between real interest and growth rates, ϕ the sum of all debt brakes and $S_{t+n} = R_{t+n} - (\theta + \sum_{\mathcal{B}} \mathcal{B}_{t+n})$ the primary surplus net of the debt brakes contained in the expenditure rules (Equations (2)). Several policy strategies can be considered to stabilize the debt. One option is to define a path of discretionary fiscal adjustments that directly shape the trajectory of the net primary balance (i.e., targeting S_{t+n}). Alternatively, a fiscal rule can be enshrined in law to automatically constrain public spending whenever the debt level exceeds a predefined target (i.e., adjusting through ϕ).[19] The strategy of controlling the net primary balance through discretionary measures must take into account the government's difficulty to adjust. To model these difficulties, we assume (in this subsection only) that the net primary surplus follows an $AR(1)$ process: $S_{t+1} = \rho S_t + (1-\rho)\overline{S}$. This framework then allows us to express the debt stabilization objective as a function of the initial conditions $\{b_{t-1}, S_t\}$, the policy instruments $\{\phi, \rho\}$, and the adjustment horizon n:

$$\underbrace{\frac{\rho^n S_t + (1-\rho^n)\overline{S}}{\overline{r} - \phi}}_{b_{t+n}} = \underbrace{(1+\overline{r}-\phi)^{n+1} b_{t-1} - \left(\varsigma_1 S_t + \varsigma_2 \overline{S}\right)}_{\text{path to reach } b_{t+n} \text{ starting from } \{b_{t-1}, S_t\}} \quad \text{where} \quad \begin{cases} \varsigma_1 = \displaystyle\sum_{k=0}^{n} \rho^k (1+\overline{r}-\phi)^{n-k} \\ \varsigma_2 = \displaystyle\sum_{k=0}^{n} (1-\rho^k)(1+\overline{r}-\phi)^{n-k} \end{cases}$$

This equation shows *(i)* that a strong fiscal rule lowers the level of stable debt (b_{t+n}) by accelerating the departure from the initial debt position (b_{t-1}); and *(ii)* that high persistence in the primary balance slows this adjustment, thereby tending to raise the level at which debt stabilizes —under the assumption that $S_t > \overline{S}$.

Panel (a) of Figure 1 shows that a sufficiently strong fiscal brake (i.e., when ϕ is large) can reduce public debt at a level below its initial value. However, this result is difficult to achieve in the short run, as the debt dynamics remain dominated during the first ten years by the accumulation of deficits, which continues despite fiscal consolidation efforts, thereby outweighing the impact of

[19] As usual, if $\overline{r} < \phi$, the debt can be stable even with a net primary deficit ($S_{t+n} < 0$). A sufficient condition to ensure the stability of public debt is $\overline{r} - \frac{\theta}{b} - \phi < 0$, meaning that, even if $\overline{r} > 0$, a sufficiently strong fiscal brake, such that $\phi > \overline{r}$, is enough to guarantee the non-explosiveness of public debt.



(a) Stabilized debt b_{t+n} as a function of ϕ and n

(b) Heatmap of Horizon n as a function of ϕ and ρ

Figure 1: Public debt and Fiscal Consolidation. Calibrations: $b_{t-1} = 113\%$, $S_t = -3.8\%$, $\overline{S} = 0$ and $\overline{r} = 0$; in panel (a), $\rho = 0.9$

the fiscal brake. Panel (b) of Figure 1 shows that the debt is stabilized more quickly when the persistence of primary deficits is low (i.e., when ρ is small) and the fiscal brake is strong (i.e., when ϕ is large). With this illustrative calibration and a French GDP equal to €2917 billion in 2024, debt stabilization is achieved within 5 years at 124% when $\phi = 0.025$, requiring a reduction of the deficit by €40 billion each year over that period.[20]

In the quantitative analysis that follows, we go beyond this simple partial-equilibrium assessment of the government's budget constraint —which nonetheless allows for an ex ante calibration of the required fiscal effort— by accounting for the impact of fiscal consolidations on GDP, inflation, interest rates, and tax revenues.[21] Analyzing debt sustainability within a dynamic model also makes it possible to distinguish the effects of consolidation depending on how it is implemented —through a sequence of discretionary shocks or via a fiscal rule— since the model captures changes in private agents' behavior in response to the government's decision-making framework.

2.8 Equilibrium

Market-clearing conditions used to determine the unknowns $\{N, w, p_{FE}\}$ are

$$\begin{aligned}
\text{asset market:} \qquad & b_t = \mathcal{A}_t \equiv \sum_s \int_e \int_{a_-} a_t^s(e, a_-) d\Gamma^s(a_-, e) \\
\text{labor market:} \qquad & N_t = \mathcal{N}_t \equiv \sum_s \int_e \int_{a_-} n_t^s(e, a_-) d\Gamma^s(a_-, e) \\
\text{energy market:} \qquad & \overline{E}_t = \mathcal{E}_t \equiv Y_{E_t} + E_t
\end{aligned}$$

[20] If $\phi = 0.01$ (respectively, $\phi = 0.001$), then the deficit must be reduced by €22 (€8) billion each year over the 8 (22) years allowing to stabilize the debt at 129% (143%).

[21] In the quantitative model, we restrict our focus to government programs in which only expenditures can be adjusted (see Equation 2) but we take into account that spreads increase when public debt raises.

and the market clearing condition on the goods market can be used to check Walras law:

$$Y_t\left(1-\frac{\psi_P}{2}\pi^2\right)=X_t+C_t+G_t$$

3 Calibration, Estimation and Model's Implications

Using Auclert et al. (2021)'s method, the dynamic paths of the equilibrium defined in Section 2.8 are obtained thanks to the first-order approximation method developed by Reiter (2009), (2010) and are summarized by the following $MA(\infty)$ representation (see Appendix D.1 for details)

$$d\mathbf{Y}=\mathcal{M}(\Theta,\Phi)\mathcal{E} \tag{3}$$

where $\mathcal{E}$ contains all the time series of the model's shocks, and $\mathcal{M}(\Theta,\Phi)$ represents all the model's multipliers, which are combinations of the model structural parameters $\{\Theta,\Phi\}$. Among the model parameters, we distinguish between those that determine the steady state, Φ, and those that govern the dynamics of the exogenous shocks, Θ. This representation of the model solution allows us to estimate it, to decompose the variances of endogenous variables and to analyze the historical decomposition of time series.

3.1 Calibrations Based on Steady State Restrictions and External Information

Results of the calibration procedure of $\Phi_1\subset\Phi$ leads to the values reported in Table 1: the parameters take classical values, except those that are model-specific so that its steady-state matches observed ratios (see also Appendix E). Another subset of parameter is calibrated using external information. The least known calibration concerns the nominal rigidity of prices in France. In Jerger and Rohe (2014), the estimate on French data of ψ_P is equal to 10.3880 over the sample 1Q1980 to 2Q1994, implying $\kappa=0.5776$, and to 3.2691 over the sample 3Q-1994 to 3Q-2008, implying $\kappa=1.8354$.[22] Therefore, our calibration of $\kappa=0.95$ is an intermediate value.

The second subset $\Phi_2\subset\Phi$ concerns the calibration of model's inequalities. These parameters solve

$$\min_{\Phi_2}[\Psi_s(\Phi_2)-\Psi_d]W[\Psi_s(\Phi_2)-\Psi_d]' \quad \text{with } W=Id$$

where Ψ_z, $\forall z\in\{s,d\}$, is the set of simulated and targeted moments. Table 2 reports the results.

The Marginal Propensities to Consume (MPC) per productivity state are reported in panel (a) of Figure 2. As expected, low-income agents consume a larger fraction of any increase in their income. Panel (b) of Figure 2 shows that those agents devote a larger share of their expenditures to energy, as in the data. Panel (c) of Figure 2 shows that they also have more difficulty reducing their energy consumption when the price increases. This result comes from the largest share of incompressible consumption in their energy consumption. Finally, panel (d) of Figure 2 shows that the energy MPCs decline with income. Finally, this calibration results in 33.45% of households being financially constrained.

3.2 Estimated Parameters using Historical Quarterly Data

In order to determine the forecasted distribution of the debt-to-GDP ratio at different horizons for each fiscal consolidation program, it is necessary to characterize the distribution of exogenous

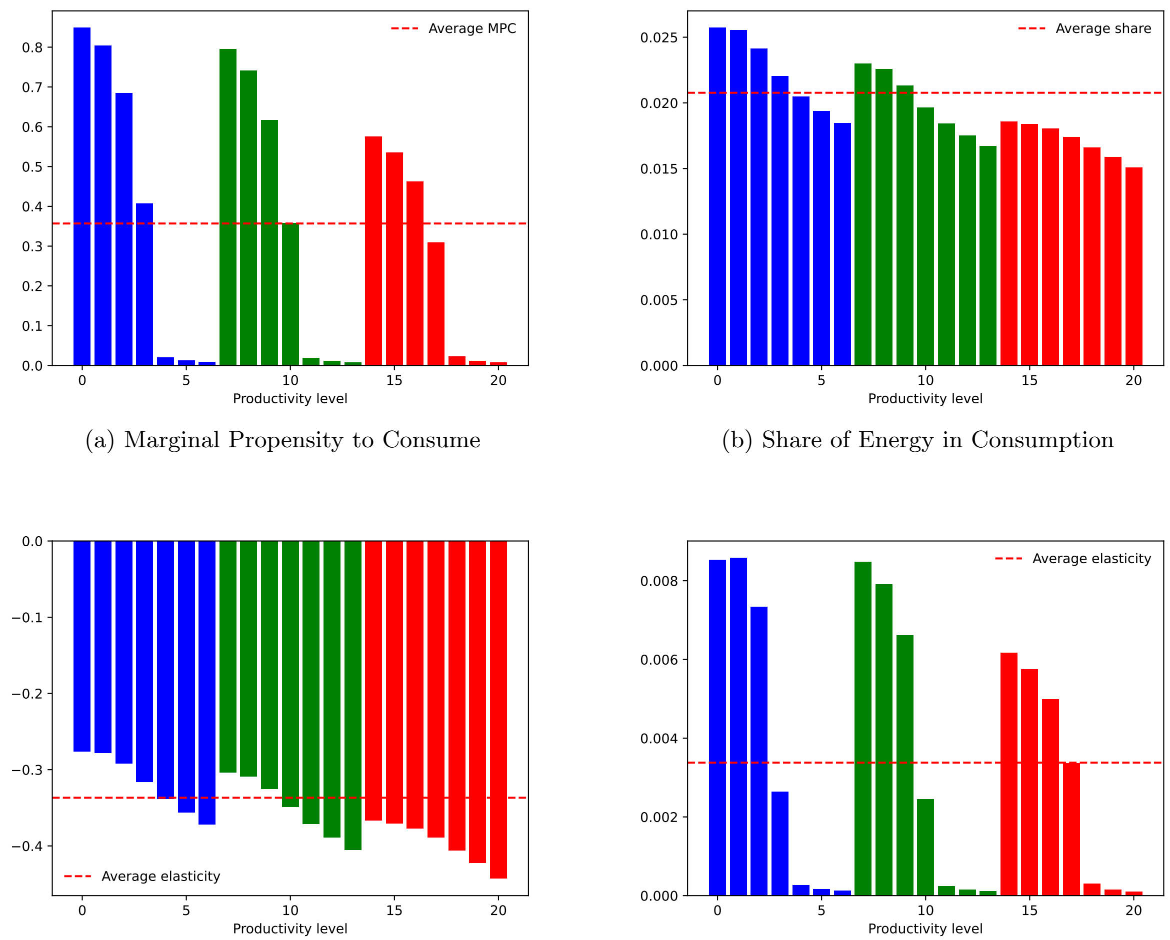
[22]The link of our calibration with a Calvo model is given by $\psi_P=\frac{\theta(\varepsilon_d-1)}{(1-\theta)(1-\beta\theta)}$ and $\kappa=\frac{\varepsilon_d}{\psi_P}$, where ψ_P is the adjustment cost parameter *à la* Rotemberg, $\varepsilon_d=6$, leading to $\mu=\frac{\varepsilon_d}{\varepsilon_d-1}=1.2$ and $\beta=0.9922$.

Preferences	**Values**	**Targets**
Discount factor β	0.9942	Real interest rate $r = 0.2\%$ per quarter
Frisch elasticity of labor supply φ	1	Chetty et al. (2012)
Elasticity of intertemporal substitution σ	1	Log-utility for consumption
Incompressible energy consumption $\underline{c}$	0.0054	40% of households' energy consumption
Wage markup μ_w	1.1	Auclert et al. (2021)
Low-skill labor desutility ϕ_l	0.4001	Low-skill wage
Middle-skill labor desutility ϕ_l	0.2991	Middle-skill wage
High-skill labor desutility ϕ_l	0.1630	High-skill wage
Elasticity of substitution between labor inputs ϵ_N	0.9	Goos et al. (2014)
Elasticity of substitution between production inputs η_E	0.5	Negative impact on GDP of energy-price shock
Share parameter (energy, intermediate good) α_E	0.025	Sharing rule: a half of energy to households
Production	**Values**	**Targets**
Real growth rate g	0.00303	Past data: see Appendix E.1
Elasticity of substitution between production inputs σ_f	η_E	Simplifying assumption
Share parameter (energy, labor) α_f	0.0256	Sharing rule: a half of energy to firms
Firm markup μ	1.2	Auclert et al. (2021)
Productivity parameters A_s	1	Normalization
Energy price	3.64	Share of energy in GDP of 8.7%
Government	**Values**	**Targets**
Public debt B	4.494	Debt-to-GDP ratio 100% with annual GDP
Public spending G	0.218	Public spending-to-GDP ratio = 19.4%
Transfers	0.160+0.201	Transfers-to-GDP ratio (Bev. + Bism.) = 32.1%
Steady-state interest rate spread ϑ	0.00424	Average quarterly past French debt cost 0.00858
Sensitivity of spread to debt η	0.0077	Past data: see Appendix E.1
Nominal rigidity	**Values**	**Targets**
Price rigidity κ	0.95	Jerger and Rohe (2014)
Wage rigidity κ_w	0.1	Auclert et al. (2024)
Monetary policy	**Values**	**Targets**
Steady-state ECB interest rate i^*	0.00434	Past data: see Appendix E.1
Steady-state inflation π	0.00349	Past data: see Appendix E.1
Taylor rule coefficient $\phi_\pi(\mu_{FR} + (1-\mu_{FR})\rho_\pi))$	1.2	With $\phi_\pi = 1.5$, $\mu_{FR} = 20\%$, and $\rho_\pi = 0.75$
Persistence of monetary policy ρ_r	0.85	Carvalho et al. (2021)

Table 1: **Parameters Φ_1 based on external information**

Parameters	**Value**	**Moment Ψ_z**	**Data**	**Model**
Productivity-persistence low-skill	$\rho_l = 0.967$	Gross income D10/D1	11.67	11.65
Productivity-persistence middle-skill	$\rho_m = 0.966$	Gross income D5/D1	2.94	2.84
Productivity-persistence high-skill	$\rho_h = 0.94$	Average productivity persistence	0.966	0.965
Productivity-variance low-skill	$\sigma_l = 0.48$	Net consumption D10/D1	3.07	3.11
Productivity-variance middle-skill	$\sigma_m = 0.62$	Net Consumption D5/D1	1.49	1.63
Productivity-variance high-skill	$\sigma_h = 1.34$	Net income D10/D1	4.16	3.67
Dividends rule $\bar{d}(e) = e^{a_{div}}$	$a_{div} = 1.865$	Dividends D10/D1	66.25	66.24
Beveridgian transfer rule $\bar{\tau}(e) = e^{a_{beve}}$	$a_{beve} = -0.547$	Beveridgian Transfer D10/D1	0.36	0.36
Bismarckian transfer rule $\bar{T}(e) = e^{a_{bism}}$	$a_{bism} = 0.722$	Bismarckian Transfer D10/D1	5.43	5.43
Level of the income tax $(1-\tau_z)z^{1-\lambda}$	$\lambda = 0.176$	Net income D5/D1	1.57	1.49
Progressivity of the income tax $(1-\tau_z)z^{1-\lambda}$	$\tau_z = 0.35$	Income-tax revenues/GDP	0.115	0.115
Level of VAT	$\tau_c = 0.236$	VAT revenues/GDP	0.17	0.17
Level of social security contribution	$\tau_l = 0.261$	Social-security contribution revenues/GDP	0.195	0.195
Level of the corporate tax	$\tau_f = 0.27$	Corporate-tax revenues/GDP	0.045	0.045

Table 2: **Parameters Φ_2 based on steady-state restrictions**



(a) Marginal Propensity to Consume

(b) Share of Energy in Consumption

(c) Price Elasticity, Energy

(d) Income Elasticity, Energy

Figure 2: Heterogeneous households' behaviors

shocks. To ensure consistency with the model, we estimate the stochastic processes governing these shocks using observed data. Given values for the parameters Φ, Equation (3) is used to estimate the persistence and standard deviation parameters ρ^Z and σ^Z, respectively, for all shocks $Z \in \mathcal{Z} \equiv \{\beta, \mu, P_E, \varepsilon, \vartheta, \{\varphi_s\}_{s=l,m,h}, \{A_s\}_{s=l,m,h}, G, T, e_\tau\}$, using a Bayesian approach and a dataset.

To obtain a just-identified system, the number of time series used in the estimation is equal to the number of shocks in the model. Accordingly, to identify the 14 shocks, we use the dataset

$$d\mathcal{Y}_t = \left\{ Y_t, \pi_t, p_{E,t}, i_t^*, i_t, \{N_{s,t}\}_{s=l,m,h}, \{\pi_{s,t}^w\}_{s=l,m,h}, G_t, T_t, \frac{b_t}{Y_t} \right\}_{t=t_0}^T.$$

The estimation for Θ is based on the autocovariances of these time series and provides sufficient information to characterize the stochastic environment faced by economic agents.[23]

Shock	Z	Persistence ρ^Z Mean	Standard dev. σ^Z Mean	Variance $\frac{(\sigma^Z)^2}{1-(\rho^Z)^2} \times 100$
Preference	β	0.788914 (0.025618)	0.003649 (0.000609)	0.003526
Price markup	μ	0.825371 (0.028805)	0.012137 (0.001159)	0.046212
Energy price	P_E	0.883850 (0.022467)	0.383981 (0.024360)	67.383557
Monetary policy	ε	0.497910 (0.038383)	0.005359 (0.000439)	0.003818
Spread	ϑ	0.830231 (0.033184)	0.001136 (0.000117)	0.000415
Disutility l	φ_l	0.767689 (0.046773)	0.019754 (0.002352)	0.095024
Disutility m	φ_m	0.750024 (0.044256)	0.018142 (0.002191)	0.075236
Disutility h	φ_h	0.669080 (0.058969)	0.034567 (0.003853)	0.216333
Productivity l	A^l	0.879364 (0.015513)	0.034214 (0.003019)	0.516321
Productivity m	A^m	0.813233 (0.025164)	0.021879 (0.001907)	0.141351
Productivity h	A^h	0.838475 (0.027252)	0.091553 (0.008153)	2.822589
Government consumption	G	0.729980 (0.059621)	0.000975 (0.000090)	0.000203
Transfers	T	0.782119 (0.053167)	0.001935 (0.000174)	0.000964
Measurement error	e_τ	0.762355 (0.046843)	0.011196 (0.002879)	0.029929

Table 3: Estimated parameters of the $AR(1)$ processes (Standard errors in parenthesis)

The autocorrelations of the $AR(1)$ processes and the standard deviations of their innovations are reported in Table 3 (see details in Appendix F).[24] The main takeaway from these estimates is the low overall variance of fiscal shocks $\{G, T\}$ and weakly correlated with the business cycle, despite being large on average.

[23] See Appendix D.2 for more details on the estimation method.

[24] Appendix E presents the data. The sample is over $t_0 = 2Q2003$ to $T = 4Q2019$. All data are stationarized by extracting a linear trend, except the debt-to-GDP ratio, the energy price, the employment rates and the interest rates where only its average over the sample is removed.

Finally, regarding the dynamics of the risk premium, its sensitivity to the level of French public debt (parameter η) is estimated using quarterly data $\{i_t, i_t^*, b_t\}$ and the auxiliary equation $\widetilde{\vartheta}_t = \eta b_t + \vartheta_t$. The estimated value, reported in Table 1, implies that a 1 percentage point (pp) increase in the debt-to-GDP ratio leads to a 0.028 pp increase in the annual spread.

Historical shocks decomposition. Based on these shock process estimations, the variance decomposition[25] indicates that productivity shocks $\{A^l, A^m, A^h\}$ are the main drivers of output fluctuations, accounting for approximately 62% of the total variance. Household demand shocks (β) and firm markup shocks (μ) follow, contributing around 15% and 10%, respectively. These are followed by labor disutility shocks (around 5%), monetary policy shocks (3.7%), and energy shocks (1.7%). In contrast, spread shocks, government consumption shocks, and transfer shocks together explain only about 1% of output variance. This last result is due to the low variance of these shocks (see Table 3). More than 20% of inflation fluctuations are explained by oil-price fluctuations, and around 10% by markup fluctuations, but here again, the share of productivity shocks is large (around 55%). The high contribution of energy to inflation fluctuations is due to price rigidity, which means that domestic prices only react with delay to shocks, particularly those that are very persistent, whereas energy prices are determined by very volatile shocks. Debt dynamic is driven by the main determinants of output and inflation fluctuations. Its variations are explained by shocks to productivity (60%), markup (9%), consumer demand (4%), monetary policy (3%) energy prices (2%). Finally, the three main macroeconomic shocks (productivity, demand, markup and oil price) also explain most of the fluctuations in labor markets. They account for 76% of variations in unskilled jobs, 75.6% in intermediate jobs, and 68.4% in skilled jobs.

3.3 Identifying Changes in Fiscal Policy Rules based on Forecasts

When the French government proposed in 2023 its Finance Act for 2024, it may change the $AR(1)$ processes for G and T, thereby implying a change in the structural parameters that characterize its behavior, but also the new shocks representing the energy-consumption subsidies (the tariff shield) between 1Q2022 and 4Q2023. To test the invariance of the fiscal rules on G and T, the time series provided in the Finance Act are used to estimate the realizations of the model structural shocks that would make the government's forecasts consistent with the model.[26] If these realizations lie within the confidence intervals of the distribution estimated from historical data, then the invariance of the model's structural parameters cannot be rejected. Conversely, if they fall outside the confidence interval —i.e. if the Lucas (1976) critique quantitatively matters— a re-estimation of the government's decision rule parameters becomes necessary, with the new estimates replacing those previously obtained from historical data.[27] Hence, we compare the simulations based on the models where $\{\rho^Z, \sigma^Z\}$, $\forall Z$, are or are not re-estimated. Results show that the invariance of the laws of shocks cannot be rejected (see the innovations of household and firm shocks displayed in Figure 19 in Appendix H), *except* for government consumption and transfer shocks.

Since only the government changes its behaviors, the re-estimation of $\{\rho^Z, \sigma^Z\}$, for $Z \in \{G, T\}$, is based on data $\{G_t, T_t\}_{t=4Q2019}^{4Q2027}$ accounting for its commitments described in the Finance Act. Therefore, in the evaluations of this Finance Act, based on conditional forecasts, we use the new values for $\{\widetilde{\rho}^Z, \widetilde{\sigma}^Z\}$, for $Z \in \{G, T\}$, reported in Table 4 consistent with agents' expectations.

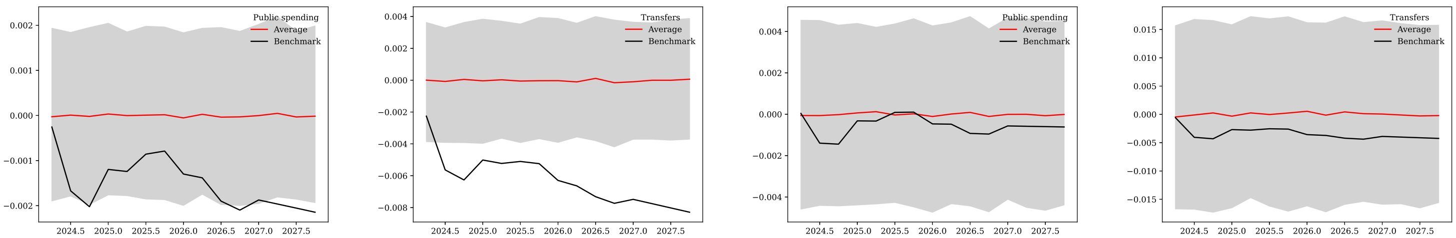
[25]See Appendix G for the variance and historical decomposition of aggregates with respect to shocks.

[26]The method used to estimate these shock realizations is based on the work of Del Negro and Schorfheide (2013), extended to HANK models (See Langot et al. (2023)).

[27]See Appendix D.3 for more details on this method.

Z	G	T
$\widetilde{\rho}^Z$	0.95936	0.90148
$\widetilde{\sigma}^Z$	0.00227	0.00835

Table 4: Estimated parameters over 4Q2019 to 4Q2027



(a) Govt. consumption (A) (b) Govt. transfers (A) (c) Govt. consumption (B) (d) Govt. transfers (B)

Figure 3: Innovations of government decision rules. The grey areas show the confidence intervals of shocks, the red lines are the average for these fraws. Black lines show the shock realizations consistent with governement forecasts (A) before and (B) after re-estimation of the $AR(1)$ shocks processes.

Figure 3 shows the confidence intervals for the innovations of the government decision rules (grey areas), the mean of these shocks (red line) and the sequences of the innovations (black lines) identified by the models to allow it to match the government forecasts. Regarding private shocks, the estimated innovations fall within the confidence interval. However, these estimates reveal that the Finance Act is highly optimistic regarding markups, spread and the medium-skill worker labor-market paths whereas the underlying sequence of productivity shocks of high-skill workers declines continuously.[28],[29]

3.4 Induced Inequality Dynamics

In addition to reproducing the expected evolution of macroeconomic aggregates, our model also makes it possible to estimate the evolution of inequalities compatible with this equilibrium trajectory. The description of inequality dynamics is an important element in selecting a fiscal consolidation program, as the one that best contains them will likely have the highest probability of being fully implemented due to the greater political stability it can help foster.

Changes in consumption inequalities are reported in Figure 4. Increases in the real interest rate and in high wages raise inequality, whereas strong GDP growth supports consumption among the poorest by boosting employment. In response to the government Finance Act, which plans to return transfers to households to their pre-energy-crisis levels in the coming years[30], the model predicts a rise in inequality: in 2023, a well-off worker consumes 4 times more than a low-income worker, while by 2027, this ratio is expected to increase to 4.2 times (panel (d) of Figure 6). This reduction in transfers penalizes low-income households, who are the primary beneficiaries and have no savings

[28]See panels (h), (i), (r), (u), and (v) in Figure 19 of Appendix H.

[29]In Appendix J, we compare the trajectories of two shock realizations: the first is obtained with the model that does not account for the re-estimation of public expenditure processes, while the second takes this into consideration. This allows, indirectly, to measure the impact of the bias related to the Lucas (1976) critique.

[30]Without any information on the implementation of this reduction, we assume that the Bismarkian and the Beveridgian components of transfers are reduced homogeneously.

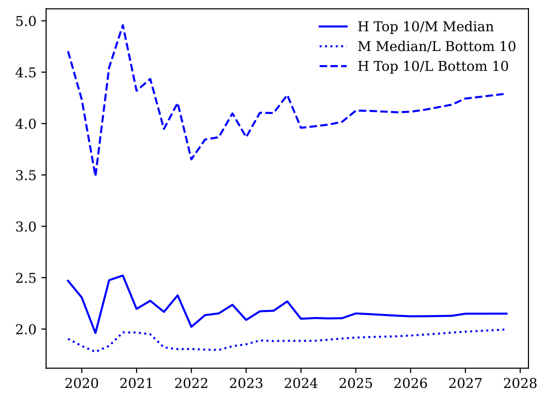


Figure 4: Consumption inequalities between skills. Dashed lines: Ratio of average consumption of high-skill workers in the top 10% of their wage distribution (H Top 10) to that of low-skill workers in the bottom 10% (L Bottom 10). Dotted lines: Ratio of median consumption among middle-skill workers (M Median) to that of L Bottom 10. Solid lines: Ratio of H Top 10 consumption to that of M Median.

to offset these income losses. The strong growth forecasted by the government in its Finance Act, which is expected to boost consumption, is not sufficient to contain the rise in inequality. In the following sections, we will compare the implications of various fiscal consolidation programs on inequality with those reported in these figures.

4 Policy Evaluation: Assessing Fiscal Consolidation Programs

In its Finance Act for 2024, the French government projects a slight increase in the debt-to-GDP ratio, reaching 111.2% by 2027. We first show that this stabilization of the debt-to-GDP ratio — achieved without the announcement of a fiscal consolidation program— is primarily driven by strong GDP growth, which in turn relies on exceptionally favorable realizations of structural shocks in the private sector.[31] This result suggests that a substantial fiscal consolidation program is required to achieve a greater and less risky reduction in public debt. Secondly, we evaluate the implementation of fiscal consolidation: we demonstrate that *(i)* reductions in transfers are more effective than cuts in public consumption and *(ii)* it is preferable to use a fiscal rule rather than a discretionary policy. Third, we show how to design a fiscal consolidation policy that addresses the traditional challenges associated with such measures —namely, avoiding growth losses and preventing increases in inequality. Finally, our structural analysis allows us to decompose the reduction in public debt into the direct effects of government expenditure cuts and the indirect effects arising from changes in government revenues, GDP growth, inflation, and interest rates.

4.1 Measuring the Risk of Not Implementing Fiscal Consolidation

To assess the risk surrounding the government forecasts when passing its Finance Act, we retain the trajectories of fiscal shocks presented in the Act for the 2Q2024-4Q2027 period —implicitly as-

[31] Appendix I explains why our method based on conditional forecasts extended to HANK models is a necessary tool for evaluating a Finance Act, particularly in comparison with fiscal consolidation programs that may alter the structure of the economy.

suming that the government has full control over these expenditures during the forecast horizon—while randomly drawing all other shocks to reflect uncertainty in the economic environment. This procedure yields a distribution of the debt-to-GDP ratio at each point in time over the forecast horizon (see Figure 5). While under the very favorable economic assumptions used by the govern-

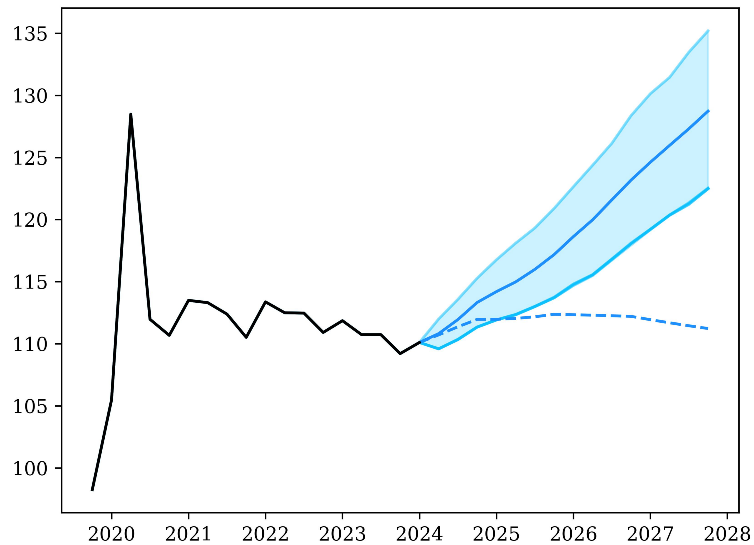


Figure 5: Debt-to-GDP forecasts without fiscal consolidation. Solid line: median of the simulations. Dashed line: forecasts with business cycle shocks consistent with the Finance Act. Blue area: 50% of the distribution.

ment in its Finance Act, the debt-to-GDP ratio would stabilize at 111.2%, our forecasts indicate that the median of the projected distribution reaches 128.7%, 17.5 pp higher than the government's projection. Moreover, the distribution shows that under the 25% most adverse economic scenarios, the debt-to-GDP ratio would exceed 132.5%, 21.3 pp above the government's forecast. In fact, the government's forecast for the debt trajectory is significantly lower than what would be observed under the 25% most optimistic scenarios (The government's forecast falls within the top 4% of the most optimistic scenarios). These results therefore *(i)* call for policy evaluation when facing a more realistic macroeconomic environment, and *(ii)* support the case for implementing fiscal consolidation, which involves less risk than relying on the hope of sufficiently favorable economic conditions to reduce public debt.

4.2 On the Effectiveness of Fiscal Consolidation

Starting in 2024, and given the 2023 public debt as well as the macroeconomic forecasts for the period from 1Q2024 to 4Q2027 included in the Finance Act (a full four-year horizon), this section compares different fiscal consolidation programs that reduce primary deficit by €40 billion per year. Such a path is expected to stabilize the debt-to-GDP ratio by 2029.[32] In the first program, public consumption expenditure G is reduced. In the second, public transfers T are reduced, keeping

[32]This calibration is based on the approximations presented in Section 2.7: debt stabilization is achieved within six years, requiring a yearly deficit reduction of €40 billion over that period. As such, this spending reduction allows government to stabilize debt within the seven-year adjustment period as required by the European Commission.

unchanged the composition between the Bismarckian (T_{bis}) and Beveridgian (T_{bev}) transfers. Each of these programs will be implemented in a discretionary way or by implementing a fiscal rule ($\upsilon^{\mathcal{B}} = 0$ or $\upsilon^{\mathcal{B}} > 0$, respectively in Equation (2)). When policy is discretionary, all estimated shocks over the period from 1Q2024 to 4Q2027 are scaled by a coefficient that reduces government spending by €40 billion per year on average. When a fiscal rule is implemented, the parameter $\upsilon^{\mathcal{B}} > 0$ is calibrated so that the sequence of restrictions it generates is of the same order of magnitude as the sequence of discretionary shocks. To evaluate these programs, we compare them to the Finance Act forecasts, which serve as our benchmark and also enable us to identify the shock realizations that allow the model to replicate the government's projections up to 4Q2027 (First column of Table 5).

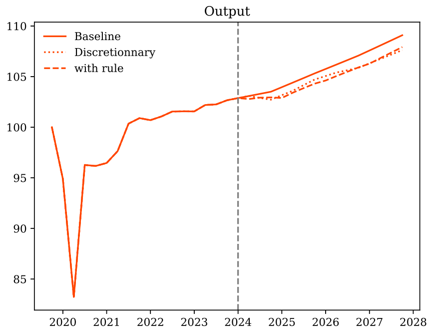
	Without Fiscal Consolidation	With Fiscal Consolidation			
		G		T	
		Rule	Discretion	Rule	Discretion
2024	112.3	112.1	112.5	111.1	111.9
Δ.		-0.2	+0.2	-1.2	-0.4
2027	111.2	108.2	108.2	106.3	107.2
Δ		-3.0	-3.0	-4.9	-4.0

Table 5: Impact of Fiscal Consolidation on Debt-to-GDP Ratio (reduction of the expenditures by €40 billion/year until 2027). Δ indicates the difference between outcome under each scenario and the baseline scenario without fiscal consolidation. G and T refer to fiscal consolidation strategies based on cuts in public consumption and transfers, respectively.

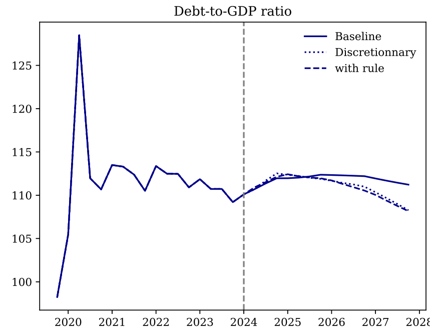
As of late 2023, the debt-to-GDP ratio was 109.2%. Table 5 shows that a stronger reduction in public spending —whether through cuts to G or T, each calibrated as an annual reduction of €40 billion— would lower public debt by at least 3 pp, and by up to 4.9 pp under the most effective strategy, compared to what is planned in the Finance Act. In contrast, the Finance Act projects a 2 pp increase in the debt ratio. Relative to 2024, the very modest debt reduction projected in the Finance Act, and the more substantial reduction achieved under the various consolidation programs, stand in stark contrast to the partial equilibrium assessments (see Section 2.7), where debt stabilizes at 124% of GDP in 2029 following an annual €40 billion reduction in the primary deficit. This discrepancy can only be explained by the highly favorable assumptions made about the economic environment between 1Q2024 and 4Q2027, which strongly support debt reduction.

Results reported in Table 5 also show that a fiscal consolidation rule, committing the government to automatically reduce its spending as long as its debt exceeds a target value, outperforms the discretionary strategy if transfers are used as fiscal tools. With a rule reducing by €40 billion each year, the debt-to-GDP ratio is reduced by 0.9 pp more than with a discretionary policy. This indicates that a discretionary policy does not allow economic actors to cushion the effects of fiscal consolidation by adjusting their savings and labor supply decisions, which makes it less effective compared to a rule. At the opposite, for the same amount of public savings but concentrated on public consumption over the next 5 years, a rule announced with the same multi-year horizon reduces the debt-to-GDP ratio by the same amount than a discretionary policy.

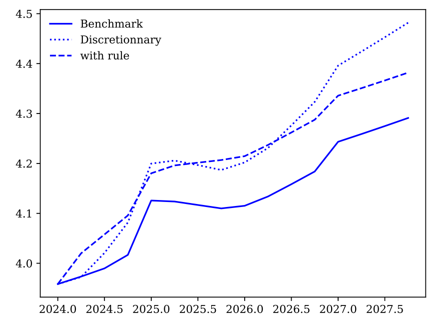
Table 5 also shows that reductions in household transfers (such as pensions, unemployment benefits, healthcare, and minimum income support) are more effective than cuts in public consumption in lowering the debt-to-GDP ratio. Between 2024 and 2027, the debt-to-GDP ratio would fall by 4.9 pp with a reduction in transfers, compared to just 3.1 pp with a reduction in public consumption, assuming these policies are implemented through a fiscal rule. Transfer cuts are preferable because public consumption cuts tend to compress demand more sharply in the short term (see panel (a) of



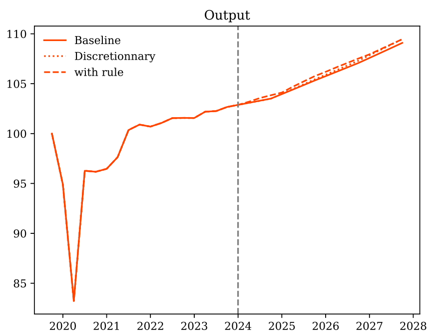
(a) G: GDP



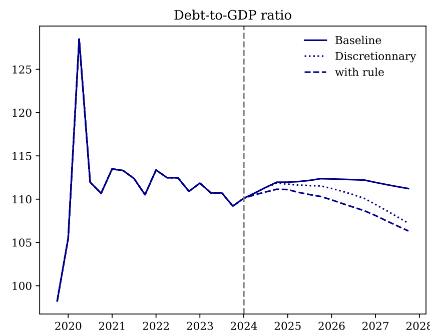
(b) G: Debt-to-GDP ratio)



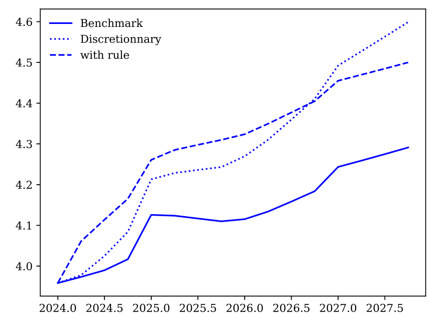
(c) G: Inequalities



(d) T: GDP



(e) T: Debt-to-GDP ratio



(f) T: Inequalities

Figure 6: Counterfactual: €40 billion reduction in government spending, using public consumption (G) as fiscal instrument, panels (a)-(c), or transfers (T), panels (d)-(f)

Figure 6), which slows economic growth and thereby increases the debt-to-GDP ratio in the short run (see panel (b) of Figure 6). Conversely, following a reduction in transfers, households can reduce their savings, thereby mitigating the recessionary impact of the contraction. In addition, some households can increase their labor supply to compensate for the loss of income resulting from the decrease in transfers. These responses help offset the decline in demand caused by lower transfer income (see panel (d) of Figure 6). Moreover, when transfers are used as the instrument for fiscal consolidation, the debt-to-GDP ratio does not rise in the short term (see panel (e) of Figure 6).

Beyond aggregate outcomes, fiscal consolidation must also be evaluated in light of its distributional implications. Indeed, a sharp rise in inequality can lead to political instability, ultimately undermining the credibility of the consolidation program. Accordingly, panels (c) and (f) of Figure 6 illustrate how inequalities evolve over the period, depending on the fiscal consolidation program adopted. When public consumption is used as the instrument of fiscal consolidation, the resulting decrease in aggregate demand lowers output growth and thereby reduces employment for all workers, regardless of skill level. Since the most disadvantaged households rely more heavily on labor income, this also leads to an increase in inequality —the consumption inequality ratio rises to 4.48 in 2027, compared to 4.29 in the benchmark scenario (see panel (c) of Figure 6). When transfers are used as the instrument of fiscal consolidation, low- and middle-skill workers increase their labor supply, partially offsetting the income loss caused by the reduction in transfers. As a result, the consumption inequality ratio rises to 4.50 (4.60) in 2027 with a fiscal rule (with discretionary policy), compared to 4.29 in the benchmark scenario (see panel (f) of Figure 6). Low-skill households are particularly dependent on Beveridgian transfers, which account for a significant share of their income. Consequently, the decline in transfers impacts them substantially. Although they respond by increasing their labor supply, it is insufficient to fully compensate for the income loss, and their consumption declines unlike other households.

Even if fiscal consolidation programs appear justified by their effectiveness in reducing the debt-to-GDP ratio, the results of this section highlight that the increase in inequality they generate poses a significant obstacle to their social acceptability, particularly given the risk that governments implementing them may be voted out of office (see, e.g., Brender and Drazen (2008); Alesina et al. (2021)). These findings therefore underscore the importance of evaluating consolidation programs within a more robust framework that accounts for a broader range of future business cycle scenarios, and of complementing them with appropriate redistribution policies. Building on the two main findings of this section —*(i)* transfers appear to be more effective in reducing public debt, and *(ii)* the implementation of a fiscal rule introducing a debt brake enhances the effectiveness of consolidation policies, particularly when the adjustment is carried out through transfers— the next section aims to identify, in a large range of future business cycle scenarios, a reallocation of transfers that avoids an increase in inequality when a fiscal consolidation is implemented.

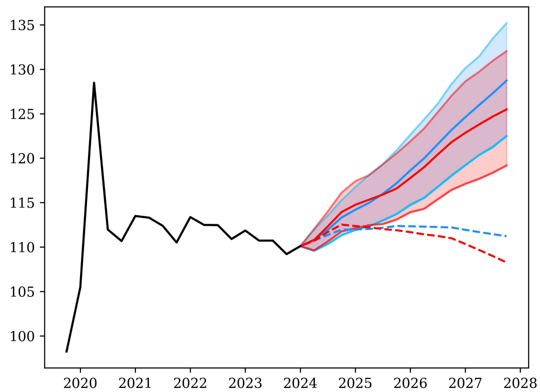
4.3 Reducing the Risk of Debt Increase Through Fiscal Consolidation

Unlike Table 5, Table 6 does not report the trajectory of a specific economic scenario (i.e., the particular sequence that underlies the Finance Act), but rather the statistical properties of the distribution of the debt-to-GDP ratio forecast for the future, based on our estimated distribution of aggregate shocks, consistently with Blanchard et al. (2021) recommendations.

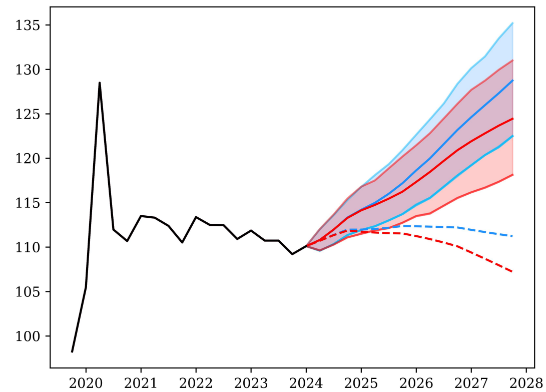
	Without Fiscal Consolidation		With Fiscal Consolidation							
			G				T			
			Rule		Discretion		Rule		Discretion	
	med.	Top_{25}	med.	Top_{25}	med.	Top_{25}	med.	Top_{25}	med.	Top_{25}
2024	113.3	115.3	113.2	115.5	113.9	116.1	112.2	114.2	113.3	115.4
Δ			-0.1	0.2	0.6	0.8	-1.1	-1.1	-0.0	0.1
2025	117.2	120.9	116.3	120.0	116.6	120.5	114.0	117.3	116.2	120.2
Δ			-0.9	-0.9	-0.6	-0.4	-3.2	-3.5	-1	-0.7
2026	123.2	128.4	120.5	125.5	121.8	127.0	117.1	121.5	120.9	126.1
Δ			-2.7	-2.9	-1.4	-1.4	-6.1	-6.9	-2.3	-2.3
2027	128.7	135.2	122.7	128.4	125.5	132.0	119.1	123.9	124.4	130.9
Δ			-6	-6.8	-3.2	-3.2	-9.6	-11.3	-4.3	-4.3

Table 6: Impact of Fiscal Consolidations on Public Debt. Δ indicates the difference between the median (or Top_{25}) outcome under each scenario and the baseline scenario without fiscal consolidation. G and T refer to fiscal consolidation strategies based on cuts in public consumption and transfers, respectively.

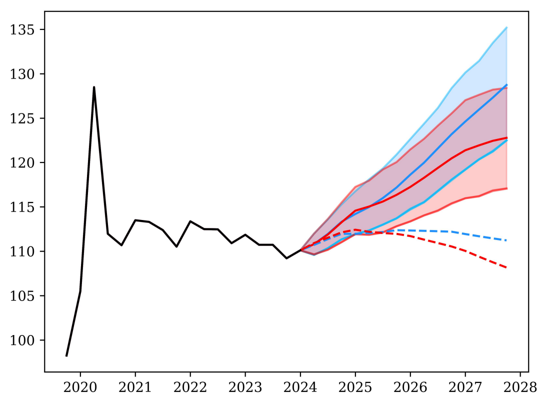
As under the specific business cycle conditions assumed in the Finance Act, a fiscal consolidation calibrated to reduce public expenditures by €40 billion per year is more efficient when transfers to households are used as the adjustment instrument. In 2027, the median of the debt-to-GDP ratio is reduced by 3.2 pp when the discretionary consolidation relies on cuts to public consumption, whereas it can be reduced by 4.3 pp when transfers are used instead. Table 6 also shows that if fiscal consolidation is implemented through a rule-based approach, it becomes more effective: the median of the debt-to-GDP ratio falls by 6 pp when public consumption is reduced, and by as much as 9.6 pp when transfers are used.



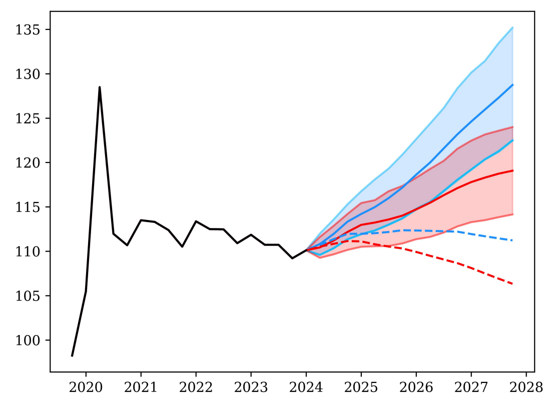
(a) G: discretionary policy



(b) T: discretionary policy



(c) G: rule



(d) T: rule

Figure 7: Public debt. Blue: without fiscal consolidation. Red: with fiscal consolidation. Line: median of the debt-to-GDP ratio simulations. Dotted line: debt-to-GDP ratio within the economic scenario selected by the government.

Beyond significantly lowering the median debt-to-GDP ratio —as in the scenario where shock realizations align with the Finance Act forecasts— a fiscal rule also mitigates the risk of substantial increases in the debt-to-GDP ratio (see the columns Top_{25} in Table 6 and Figure 7). With a fiscal consolidation based on cuts to public consumption and implemented in a discretionary manner, the debt-to-GDP ratio could exceed 132% under unfavorable economic conditions —that is, within the least favorable fourth of business cycles observed between 2003 and 2019. This outcome would be 6.5 pp higher than the median forecast, providing a measure of the risk around the debt-to-GDP forecasts. If the same policy is implemented through a rule, the risk is reduced: the gap between the median and the least favorable fourth of historical business cycle conditions would be only 5.7 pp (128.4 minus 122.7). When fiscal consolidation is based on transfer cuts and implemented in a discretionary fashion, the gap between the median and the least favorable fourth remains the same as under a consumption-based adjustment (6.5 pp). However, when the transfer-based policy is implemented through a rule, the risk is further reduced, with the gap narrowing to 4.8 pp.

Beyond showing that transfer reductions are more effective than cuts to public consumption in a less specific economic environment than in the previous section, this section also demonstrates that a consolidation strategy based on transfers can reduce the risk of a sharp increase in the debt-to-GDP ratio in the future. More importantly, the results highlight that the implementation strategy of the consolidation —whether through discretionary measures or via a fiscal brake— is crucial: a fiscal rule doubles the median debt reduction (by a factor of 2.2) and multiplies by 2.6 the reduction achieved under the 25% most adverse economic conditions. Indeed, a debt brake targeting transfers allows GDP and debt to move in opposite directions, thanks to substantial changes in household behavior. This makes the impact of an anticipated reduction in transfers both more powerful and less destabilizing for the debt-to-GDP ratio than a reduction in public consumption, which is less easily offset by behavioral responses and causes GDP and debt to evolve in the same direction.

4.4 Reducing Public Debt Without Damaging Growth or Worsening Inequality

Previous results show that fiscal consolidation is necessary to stabilize French public debt in a robust macroeconomic environment (Section 4.1). Transfer cuts are the most effective instrument, and their effectiveness is further enhanced by the introduction of a debt brake (Sections 4.2 and 4.3). However, such cuts risk increasing inequality (Section 4.2). To ensure the credibility of a fiscal consolidation program (only socially acceptable program can be chosen by the population), this section explores how to design a transfer reduction strategy that *(i)* preserves GDP growth, *(ii)* avoids increasing inequality while *(iii)* still reducing public debt. This is be done thanks to a change in the combination of Bismarckian and Beveridgian transfers that manages to decrease public debt while maintaining output growth and without worsening inequalities (our threefold objective).

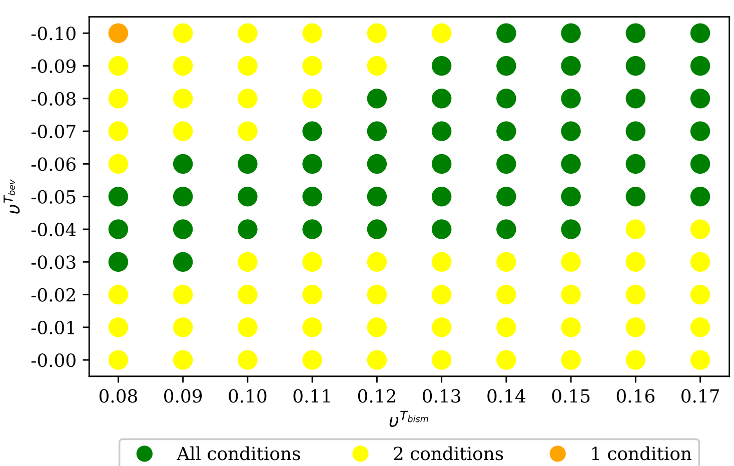


Figure 8: Grid of different combinations of Beveridgian and Bismarckian transfers

Figure 8 shows that several combinations of Bismarckian and Beveridgian transfers, through combination of policies such that $\upsilon^{T_{bev}} < 0$ and $\upsilon^{T_{bism}} > 0$, meet our three objectives (in green on Figure 8). Specifically, the reduction in Bismarckian transfers, governed by a debt brake, helps lower the debt level, but must be offset by a sufficiently strong increase in Beveridgian transfers to prevent a worsening of consumption inequality. We now present the results for the bottom-leftmost point in the figure that satisfies all three conditions (i.e., $\upsilon^{T_{bev}} = -0.03$ and $\upsilon^{T_{bism}} = 0.08$). This configuration achieves our threefold objective with the smallest necessary adjustments: Bismarckian transfers are reduced by €64 billion per year, and Beveridgian transfers are increased by €24 billion per year on average.

	Without Fiscal Consolidation		With Fiscal Consolidation T_{bis} & T_{bev}			
			Rule		Discretion	
	med.	Top_{25}	med.	Top_{25}	med.	Top_{25}
2024	113.3	115.3	111.9	113.9	113.2	115.3
Δ			-1.4	-1.4	-0.1	0.0
2025	117.2	120.9	114.1	117.4	116.3	120.3
Δ			-3.1	-3.5	-0.9	-0.6
2026	123.2	128.4	117.9	122.3	121.4	126.6
Δ			-5.3	-6.1	-1.8	-1.8
2027	128.7	135.2	120.7	125.8	125.6	132.2
Δ			-8.0	-9.4	-3.1	-3.0

Table 7: Impact of Fiscal Consolidations on Public Debt —Reduction in Bismarckian Transfers and Increase in Beveridgian Transfers— Δ corresponds to the difference in the median (med.) or in the top 25% of the distribution (Top_{25}) between each scenario and the one without fiscal consolidation.

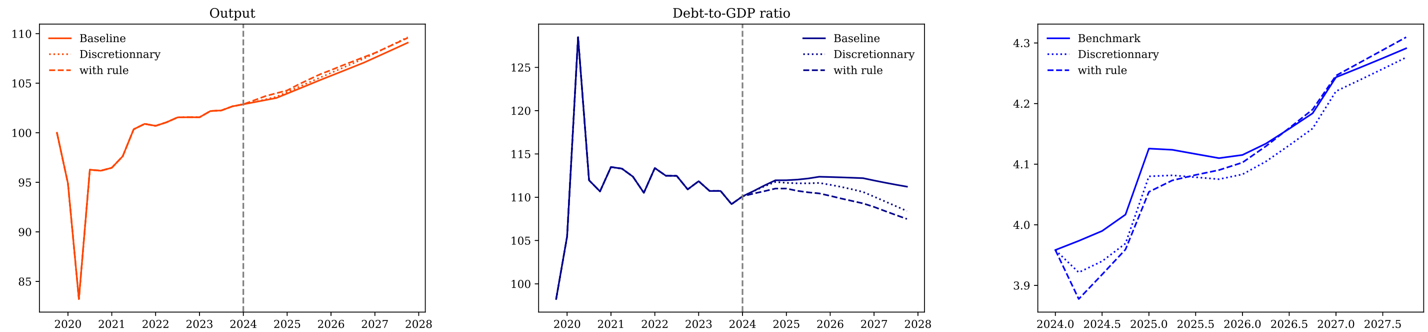
As in the previous cases, Table 7 shows that rule-based consolidation outperforms discretionary policy, with debt reduction being 4.9 pp greater in 2027 for the median, and 6.5 pp greater for the minimum debt-to-GDP ratio within the 25% most adverse economic conditions. Comparison with Table 6 highlights that this policy is less effective at reducing the debt-to-GDP ratio than a uniform reduction in transfers: in 2027, the median (the Top_{25}) of the forecast is higher by 1.6 pp (1.9 pp) compared to the uniform transfer cuts.

Figure 9 shows that the incentives for higher-income workers to work more —due to a reduction in Bismarckian transfers not offset by increases in Beveridgian transfers for this group— combined with the support for consumption provided to the most disadvantaged —through an increase in Beveridgian transfers that more than compensate for the reduction in Bismarckian transfers— are sufficient to sustain economic activity (see panel (a) of Figure 9). However, these effects are not sufficient to reduce the debt-to-GDP ratio in the same proportion than in the case of uniform transfer cuts (see panels (b) and (d) of Figure 9). Indeed, this reallocation of transfers toward their Beveridgian component shifts income toward households that contribute the least to tax revenues, thereby reducing government revenue. Moreover, by providing greater support to supply —through work incentives for a broad segment of the population— than to demand —through consumption support for low-income households only— the policy leads to lower inflation and, consequently, higher real interest rates relative to the benchmark, thereby increasing the debt burden.

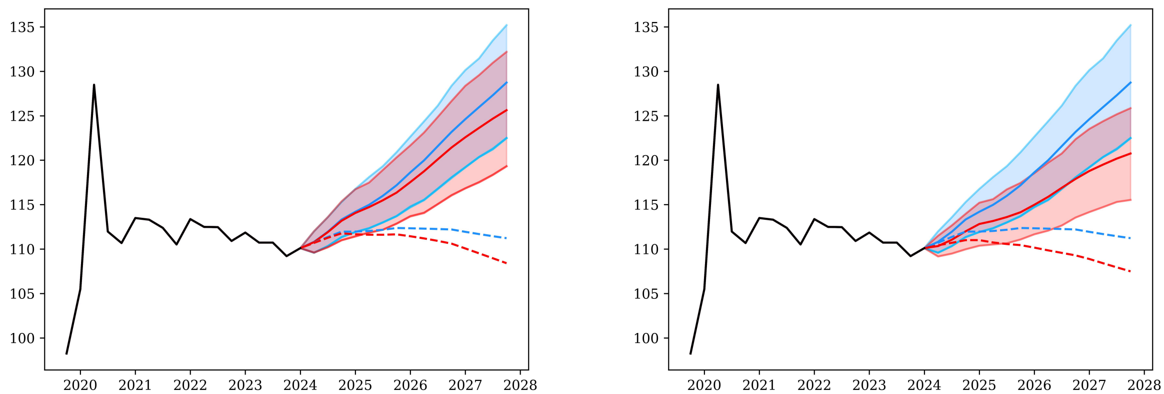
Finally, the increase in Beveridgian transfers, benefiting the most disadvantaged households, more than offsets the sharp reduction in Bismarckian transfers, thereby supporting consumption among low-income workers. As a result, inequality follows a trajectory similar to that observed under the Finance Act scenario: in 2027, a well-off worker consumes 4.31 times more than a low-income worker, compared to 4.29 in the benchmark (see panel (c) of Figure 9). This policy therefore reconciles all three objectives: a substantial reduction in the debt-to-GDP ratio, sustained economic growth, and stable inequalities. It thus appears possible to reduce public debt without worsening inequality or harming growth. What matters is the type of transfers being cut.

4.5 General versus partial-equilibrium effects

Our method allows us to decompose the general equilibrium (GE) adjustment in debt dynamics into several partial equilibrium (PE) effects. Figure 10 presents this decomposition, with results



(a) T_{bis} & T_{bev}: GDP (b) T_{bis} & T_{bev}: Debt-to-GDP ratio (c) T_{bis} & T_{bev}: Inequalities

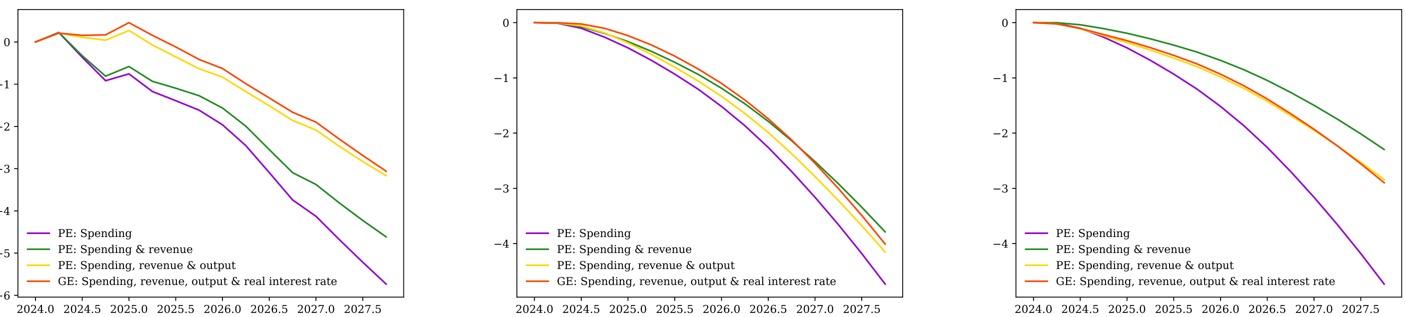


(d) T_{bis} & T_{bev}: discretionary policy (e) T_{bis} & T_{bev}: rule

Figure 9: Counterfactual with €64 billion reduction in Bismarckian transfers accompanied by a €24 billion increase in Beveridgian transfers

expressed as percentage-point (pp) differences relative to the forecasts in the Finance Act. First, the impact of the reduction in government spending, whether in government consumption G or transfers T, on the debt-to-GDP ratio is calculated by assuming that all other variables follow the paths from the benchmark scenario (purple lines). This corresponds to the direct effect of the policy. Second, we incorporate the change in government revenues induced by the policy (green line), since a reduction in public spending may affect fiscal revenues. Third, we compute the debt-to-GDP ratio also accounting for changes in GDP dynamics, in addition to changes in both spending and revenues. In this case, the real interest rate is the only variable that remains fixed at its benchmark value (yellow line). Finally, the general equilibrium effect (orange line) incorporates all endogenous adjustments.

Regardless of the scenario considered, the direct effect of the policy —i.e., when only the reduction in public expenditures is accounted for— is the largest. It results in a decrease in the debt-to-GDP ratio of approximately 5 to 6 pp compared to the benchmark scenario. In the case of the policy that reduces Bismarckian transfers while increasing Beveridgian transfers (Scenario 3), this 5 pp gap indicates that the PE effect is roughly twice as large as the GE effect (see panel (c) of Figure 10).



(a) G with rule — scenario 1

(b) T with rule — scenario 2

(c) T_{bis} & T_{bev} with rule — scenario 3

Figure 10: Partial- versus General-Equilibrium Effects on the Debt-to-GDP Ratio (absolute difference with respect to the Finance Act forecasts).

When changes in government revenues are also taken into account, the impact on debt diminishes, with the reduction in the debt-to-GDP ratio limited to between -2.25 pp and -5 pp. In Scenario 1, revenues fall due to the contraction in economic activity. In Scenarios 2 and 3, activity is largely preserved, but the reduction in Bismarckian transfers lowers income tax revenues, while the increase in Beveridgian transfers (Scenario 3) raises the overall cost of the policy without increasing revenue, due to the progressivity of the tax system.

Once GDP dynamics are incorporated, the decline in the debt-to-GDP ratio is further reduced in Scenario 1, as the reduction in government consumption has a pronounced contractionary effect. For the policy involving uniform cuts to transfers (Scenario 2), the impact of GDP on debt marginally increases, as GDP is only slightly affected. In Scenario 3, where GDP growth exceeds largely that of the benchmark, taking GDP dynamics into account leads to an even greater reduction in the debt-to-GDP ratio.

Finally, accounting for adjustments in the real interest rate completes the general equilibrium analysis. In Scenario 1, which results in a sharp short-term recession driven by a fall in demand, the significant decline in inflation causes a substantial increase in the real interest rate (since the ECB's policy rate adjustment only partially reflects an inflation drop specific to France), thereby increasing the cost of debt. In Scenarios 2 and 3, economic activity is either maintained or supported by a supply-driven expansion due to fiscal consolidation. Economic activity, boosted by higher labor supply, reduces inflation, which in turn raises the real interest rate and, consequently, interest payments. However, this final effect is relatively small, making the impact of real interest rate adjustments negligible in the overall debt-to-GDP ratio dynamics.

5 Conclusion

This paper develops a methodology to rigorously assess the debt sustainability implications of a Finance Act and to evaluate alternative fiscal consolidation programs. Using conditional forecasts from a Heterogeneous Agent New Keynesian (HANK) model, we identify all future shocks consistent with the French government's Finance Act. By comparing these shock realizations to their historical distributions, we uncover a strong degree of optimism underlying the government's projections, casting doubt on its ability to reduce public debt without a substancial fiscal consolidation program.

We then introduce and compare alternative consolidation strategies to the government's Finance

Act. Our results show that consolidation through cuts in public consumption has recessionary effects, in contrast to consolidation via reductions in public transfers. Moreover, the effectiveness of fiscal consolidation improves markedly when implemented through the introduction of a fiscal rule: for the same level of expenditure cuts, the reduction in the debt-to-GDP ratio is larger, and the uncertainty surrounding debt forecasts is lower.

The composition of transfer cuts also proves to be crucial in determining distributional outcomes. We show that debt can be reduced and growth preserved without increasing inequality, provided that reductions in insurance-based (Bismarckian) transfers are partially offset by increases in means-tested (Beveridgian) transfers.

Finally, our analysis highlights the importance of evaluating debt sustainability in general equilibrium. Fiscal policy decisions should not rely solely on partial equilibrium effects. In all scenarios considered, partial equilibrium estimations significantly overstate the debt-reducing effects compared to their general equilibrium counterparts.

References

Accardo, A., M. André, S. Billot, J.-M. Germain, and M. Sicsic (2021). Réduction des inégalités: la redistribution est deux fois plus ample en intégrant les services publics. *Insee Référence, INSEE*.

Achdou, Y., J. Han, J.-M. Lasry, P.-L. Lions, and B. Moll (2022, January). "Income and wealth distribution in macroeconomics: A continuous-time approach". *Review of Economic Studies 89*, 45–86.

Alesina, A., C. Favero, and F. Giavazzi (2015). The output effect of fiscal consolidation plans. *Journal of International Economics 96*, S19–S42.

Alesina, M. A., G. Ciminelli, D. Furceri, and G. Saponaro (2021). *Austerity and Elections.* International Monetary Fund.

André, M., J.-M. Germain, and M. Sicsic (2023). La redistribution élargie, incluant l'ensemble des transferts monétaires et les services publics, améliore le niveau de vie de 57% des personnes. *Insee Analyses 88, INSEE*.

Antolin-Diaz, J., I. Petrella, and J. F. Rubio-Ramirez (2021). "Structural scenario analysis with SVARs". *Journal of Monetary Economics 117*, 798–815.

Auclert, A., , M. Rognlie, and L. Straub (2025). Fiscal and Monetary Policy with Heterogeneous Agents. *Annual Review of Economics*. forthcoming.

Auclert, A., B. Bardóczy, and M. Rognlie (2023). MPCs, MPEs, and multipliers: A trilemma for new keynesian models. *Review of Economics and Statistics 105*(3), 700–712.

Auclert, A., B. Bardóczy, and M. Rognlie (2024). The Intertemporal Keynesian Cross. *Journal of Political Economy 132*(12), 4068–4121.

Auclert, A., B. Bardoczy, M. Rognlie, and L. Straub (2021). "Using the sequence-space Jacobian to solve and estimate heterogeneous-agent models". *Econometrica 89*(5), 2375–2408.

Auclert, A., M. Rognlie, and L. Straub (2023). "Determinacy and Existence in the Sequence Space". Mimeo, *Stanford University*.

Ball, L. M., D. Furceri, M. D. Leigh, and M. P. Loungani (2013). *The distributional effects of fiscal consolidation.* International Monetary Fund.

Bayer, C., B. Born, and R. Luetticke (2023). "The liquidity channel of fiscal policy". *Journal of Monetary Economics 134*, 86–117.

Bayer, C. and R. Luetticke (2020). "Solving discrete time heterogeneous agent models with aggregate risk and many idiosyncratic states by perturbation". *Quantitative Economics 11*(4), 1253–1288.

Bi, H., E. Leeper, and C. Leith (2013). "Uncertain Fiscal Consolidations". *The Economic Journal 123*, F13–F63.

Blanchard, O., A. Leandro, and J. Zettelmeyer (2021). Redesigning eu fiscal rules: From rules to standards. *Economic Policy 36*(106), 195–236.

Blanchard, O. J. and D. Leigh (2013). Growth forecast errors and fiscal multipliers. *American Economic Review 103*(3), 117–120.

Blanchard, O. J. and D. Leigh (2014). Learning about fiscal multipliers from growth forecast errors. *IMF Economic Review 62*(2), 179–212.

Brender, A. and A. Drazen (2008). How do budget deficits and economic growth affect reelection prospects? evidence from a large panel of countries. *American Economic Review 98*(5), 2203–2220.

Brinca, P., M. H. Ferreira, F. Franco, H. A. Holter, and L. Malafry (2021). Fiscal consolidation programs and income inequality. *International Economic Review 62*(1), 405–460.

Busato, F., M. Albanese, and M. Varlese (2022). Inflation-Based Fiscal Consolidation: a DSGE Approach. MPRA Paper 113838, University Library of Munich.

Carvalho, C., F. Nechio, and T. Tristao (2021). "Taylor Rule Estimation by OLS". *Journal of Monetary Economics 124*, 140–154.

Chetty, R., A. Guren, D. Manoli, and A. Weber (2012). "Does Indivisible Labor Explain the Difference between Micro and Macro Elasticities? A Meta-Analysis of Extensive Margin Elasticities". *NBER Macroeconomics Annual 27*, 1–56.

Del Negro, M. and F. Schorfheide (2013). DSGE Model-Based Forecasting. In *Handbook of economic forecasting*, Volume 2, pp. 57–140. Elsevier.

Erceg, C. J. and J. Lindé (2013). Fiscal consolidation in a currency union: Spending cuts vs. tax hikes. *Journal of Economic Dynamics and Control 37*(2), 422–445.

Gautier, E., M. Marx, and P. Vertier (2023). How do gasoline prices respond to a cost shock? *Journal of Political Economy Macroeconomics 1*(4), 707–741.

Gonzalez-Astudillo, M., J. Guerra-Salas, and A. Lipton (2024). Fiscal Consolidations in Commodity-Exporting Countries: A DSGE Perspective. Central Bank of Chile Working Paper 1015, Central Bank of Chile.

Goos, M., A. Manning, and A. Salomons (2014). Explaining job polarization: Routine-biased technological change and offshoring. *American economic review 104*(8), 2509–2526.

IGU (2015). "Wholesale Gas Price Survey". Technical report, *International Gas Union.*

IMF (2023). Chapter 3: Coming down to earth: How to tackle soaring public debt.

Jerger, J. and O. Rohe (2014). "Testing for parameter stability in DSGE models. The cases of France, Germany, Italy, and Spain". *International Economics and Economic Policy 11*, 329–351.

Kaplan, G., B. Moll, and G. L. Violante (2018). "Monetary policy according to HANK". *American Economic Review 108*(3), 697–743.

Kaplan, G. and G. L. Violante (2018). "Microeconomic heterogeneity and macroeconomic shocks". *Journal of Economic Perspectives 32*(3), 167–194.

Langot, F., S. Malmberg, F. Tripier, and J.-O. Hairault (2023). "The Macroeconomic and Redistributive Effects of Shielding Consumers from Rising Energy Prices: the French Experiment". Working paper 2305, Cepremap.

Langot, F., S. Malmberg, F. Tripier, and J.-O. Hairault (2024). "The Macroeconomic and Redistributive Effects of Shielding Consumers from Rising Energy Prices: a Real-Time Evaluation of the French Experiment". Technical report, CEPREMAP.

Lucas, R. (1976). "Econometric Policy Evaluation: A Critique". *Carnegie Rochester Conference Series on Public Policy 1*, 104–130.

McKay, A. and C. Wolf (2023). Optimal Policy Rules in HANK. mimeo, MIT.

Meyler, A. (2009). "The pass through of oil prices into euro area consumer liquid fuel prices in an environment of high and volatile oil prices". *Energy Economics 31*, 867–881.

Reiter, M. (2009). "Solving heterogeneous-agent models by projection and perturbation". *Journal of Economic Dynamics and Control 33*(3), 649–665.

Reiter, M. (2010, October). "Approximate and almost-exact aggregation in dynamic stochastic heterogeneous-agent models". Economics series 258, *Institute for Advanced Studies.*

Winberry, T. (2018). "A method for solving and estimating heterogeneous agent macro models". *Quantitative Economics 9*(3), 1123–1151.

Appendix

A Household's decisions

Household's decisions are deduced from the following maximization problem

$$\begin{aligned} V_t(e_t, a^T_{t-1}) &= \max_{c^T_t, a^T_t \geq 0} \left\{ \log(\tilde{c}^T_t) - \varphi_{s,t} \frac{n_t^{1+\nu}}{1+\nu} + \beta_t \sum_{e'} \mathcal{P}(e,e') V_{t+1}(e_{t+1}, a^T_t) \right\} \\ s.t. \quad P^N_t a^T_t &= P^N_{t-1} a^T_{t-1} + P^N_t y^T_t(a^T_{t-1}, e_t) - (1+\tau_c) P^N_t c^T_t \end{aligned}$$

with x^T_t is the level of the real variable $x \in \{c, a, y\}$ at time t and P^N_t the level of nominal price. Real variables grow at the constant rate g whereas nominal variables grow at the constant rate $\overline{\pi}$. We denote $x_t = x^T_t/(1+g)^t$ and $P_t = P^N_t/(1+\overline{\pi})^t$. Therefore, the inflation net of its deterministic component is defined by $\pi^c_t = \frac{P_t}{P_{t-1}} - 1$. Using these notations, the household's problem can be rewritten as follows:

$$\begin{aligned} V_t(e_t, a_{t-1}) &= \max_{c_t, a_t \geq 0} \left\{ \log((1+g)^t) + \log(\tilde{c}_t) - \varphi_{s,t} \frac{n_t^{1+\nu}}{1+\nu} + \beta_t \sum_{e'} \mathcal{P}(e,e') V_{t+1}(e_{t+1}, a^T_t) \right\} \\ s.t. \quad P_t a_t &= \frac{1}{(1+g)(1+\overline{\pi})} P_{t-1} a_{t-1} + P_t y_t(a_{t-1}, e_t) - (1+\tau_c) P_t c_t \end{aligned}$$

where the stationarized net income $y(a, e)$ and the stationarized taxable labor income net of social contributions $z(e)$ are deduced from

$$\begin{aligned} P^N_t y^T_t(a^T_{t-1}, e_t) &= i_{t-1} P^N_{t-1} a^T_{t-1} + (1-\tau_f) P^N_t d^T_t \bar{d}(e_t) + (1-\tau_p) P^N_t \Xi^T_t \left(z^T_t(e_t)\right)^{1-\lambda} + P^N_t T^T_{bev,t} \bar{T}_{bev}(e_t) \\ z^T_t(e_t) &= (1-\tau_l) w^T_t e_t n_t + T^T_{bis,t} \bar{T}_{bis}(e_t) \end{aligned}$$

Assuming that $\Xi^T_t = [(1+g)^t]^{-(1-\lambda)}$, the budgetary constrain expressed with stationarized variables becomes

$$\begin{aligned} P_t y_t(a_{t-1}, e_t) &= \frac{i_{t-1}}{(1+g)(1+\overline{\pi})} P_{t-1} a_{t-1} + (1-\tau_f) P_t d_t \bar{d}(e_t) + (1-\tau_p) P_t \big(z_t(e_t)\big)^{1-\lambda} + P_t T_{bev,t} \bar{T}_{bev}(e_t) \\ z_t(e_t) &= (1-\tau_l) w_t e_t n_t + T_{bis,t} \bar{T}_{bis}(e_t) \end{aligned}$$

where the total progressive taxes are $\mathcal{T}_I(e) = z(e) - (1-\tau_p)\big((z(e))\big)^{1-\lambda}$. Therefore, the budgetary constrain can be rewritten as follows

$$\begin{aligned} P_t a_t &= \frac{1+i_{t-1}}{(1+g)(1+\overline{\pi})} P_{t-1} a_{t-1} + (1-\tau_p) \left[(1-\tau_l) w_t e_t n_t + T_{bis,t} \bar{T}_{bis}(e_t)\right]^{1-\lambda} \\ &\quad + (1-\tau_f) P_t d_t \bar{d}(e_t) + P_t T_{bev,t} \bar{T}_{bev}(e_t) - (1+\tau_c) P_t c_t \\ a_t &= \frac{1}{(1+g)(1+\overline{\pi})} \frac{1+i_{t-1}}{1+\pi^c_t} a_{t-1} + (1-\tau_p) \left[(1-\tau_l) w_t e_t n_t + T_{bis,t} \bar{T}_{bis}(e_t)\right]^{1-\lambda} \\ &\quad + (1-\tau_f) d_t \bar{d}(e_t) + T_{bev,t} \bar{T}_{bev}(e_t) - (1+\tau_c) c_t, \end{aligned}$$

where $\frac{1}{(1+g)(1+\overline{\pi})} \frac{1+i_{t-1}}{1+\pi^c_t} = \frac{1+i_{t-1}}{(1+g)(1+\pi_t)} \approx 1 + i_{t-1} - \pi_t - g$, with $(1+\overline{\pi})(1+\pi^c_t) \equiv 1 + \pi_t$, gives the returns of savings as the gap between the real interest rate and the GDP growth rate g, i.e. $r_t = i_{t-1} - \pi_t - g$.

B Union and Phillips Curve

A union sets a unique nominal wage by task k, $\forall s \in \{l, m, h\}$. Wages exhibit both a real trend and a nominal trend. They are denoted $W_{k,t}^{s,TN}$. The union's program for the skill group s is

$$
\begin{aligned}
U_{k,t}^s(W_{k,t-1}^{s,TN}) \quad &= \quad \max_{W_{k,t}^{s,TN}} \left\{ \begin{array}{l} \int_e \int_{a_-} \left[\log\left(c_{i,t}^{s,T}(e,a_-)\right) - \varphi_{s,t} \frac{\left(n_{i,t}^s(e,a_-)\right)^{1+\nu}}{1+\nu} \right] d\Gamma^s(e,a_-) \\ -\frac{\psi_W^{s,TN}}{2} \left(\frac{W_{k,t}^{s,TN}}{W_{k,t-1}^{s,TN}} - (1+g)(1+\overline{\pi}) \right)^2 + \beta U_{k,t+1}^s(W_{k,t}^{s,TN}) \end{array} \right\} \\
s.t. \quad N_{k,t}^s &= \left(\frac{W_{k,t}^{s,TN}}{W_t^{s,TN}} \right)^{-\varepsilon^s} N_t^s \quad \text{where } W_t^{s,TN} = \left(\int_k \left(W_{k,t}^{s,TN} \right)^{1-\varepsilon^s} dk \right)^{\frac{1}{1-\varepsilon^s}},
\end{aligned}
$$

Since the two growth component (real and nominal) are log-additive, the union's problem can be rewritten in terms of stationarized variables as follows:

$$
\begin{aligned}
U_{k,t}^s(W_{k,t-1}^s) \quad &= \quad \max_{W_{k,t}^s} \left\{ \begin{array}{l} \int_e \int_{a_-} \left[\log\left(c_{i,t}^s(e,a_-)\right) - \varphi_{s,t} \frac{\left(n_{i,t}^s(e,a_-)\right)^{1+\nu}}{1+\nu} \right] d\Gamma^s(e,a_-) \\ -\frac{\psi_W^s}{2} \left(\frac{W_{k,t}^s}{W_{k,t-1}^s} - 1 \right)^2 + \beta U_{k,t+1}^s(W_{k,t}^s) \end{array} \right\} \\
s.t. \; N_{k,t}^s \quad &= \quad \left(\frac{W_{k,t}^s}{W_t^s} \right)^{-\varepsilon^s} N_t^s
\end{aligned}
$$

with $\psi_W^{s,TN} = \frac{\psi_W^s}{[(1+g)(1+\overline{\pi})]^2}$. With a wage inflation defined by $\pi_{W,t}^s = \frac{W_t^{s,TN}}{W_{t-1}^{s,TN}} - 1 = (1+\overline{\pi}) \left(\frac{W_t^s}{W_{t-1}^s} - 1 \right)$.

Furthermore, the union k imposes that every worker works the same amount of hours, so that: $n_k^s = N_k^s$. An agent of type s:

- provides $n_{k,t}^s$ hours of work for the task k and a total number of hours $n^s = \int n_{k,t}^s dk$;
- gets income $z_t^s = \int_k (1-\tau_p)((1-\tau_l)W_{k,t}^s e_t n_{k,t}^s + A)^{1-\lambda} dk$;
- has before tax income $\widetilde{z}_t^s = \int_k (1-\tau_l) W_{k,t}^s e_t n_{k,t}^s dk + A$;
- pays the progressive tax $\widetilde{z}_t^s - z_t^s$;
- where $A = T_{bev,t} \bar{T}_{bev}(e)$.

Using $n_k^s = N_k^s$ and the union's constraint, the household's income is

$$
z_t^s = \int_k (1-\tau_p) \left((1-\tau_l) W_{k,t}^s e_t n_{k,t}^s + A \right)^{1-\lambda} dk = \int_k (1-\tau_p) \left((1-\tau_l) W_{k,t}^s e_t \left(\frac{W_{k,t}^s}{W_t^s} \right)^{-\varepsilon_s} N_t^s + A \right)^{1-\lambda} dk
$$

The first order condition (FOC) with respect to W_k^s of the labor union's problem:

$$
0 = \underbrace{\frac{\partial}{\partial W_k^s} \left(\int_e \int_{a_-} u(c^s(e,a_-)) - v(n_k^s(e,a_-)) d\Gamma^s(e,a_-) \right)}_{\text{part 1}} - \Psi_W^s \frac{1}{W_{k,t-1}^s} \left(\frac{W_{k,t}^s}{W_{k,t-1}^s} - 1 \right) + \beta \underbrace{\frac{\partial U_{k,t+1}^s}{\partial W_k^s}(W_k^s)}_{\text{part 2}}
$$

Part 1.

$$\frac{\partial}{\partial W_k^s}\left(\int_e\int_{a_-} u(c^s(e,a_-)) - v(n_k^s(e,a_-))d\Gamma(e,a_-)\right) = \int_e\int_{a_-}\left(u'(c^s)\frac{\partial c^s}{\partial W_k^s} - v'(n_k^s)\frac{\partial n_k^s}{\partial W_k^s}\right)d\Gamma^s(e,a_-)$$
$$= \int_e\int_{a_-}\left(u'(c^s)\frac{\partial c^s}{\partial W_k^s} + v'(n_k^s)\varepsilon_s\frac{n_k^s}{W_k^s}\right)d\Gamma^s(e,a_-)$$

Indeed,

$$\frac{\partial n_k^s}{\partial W_k^s} = \frac{\partial}{\partial W_k^s}\left(\left(\frac{W_{k,t}^s}{W_t^s}\right)^{-\varepsilon_s} N_t^s\right) = -\varepsilon_s\frac{N^s}{W_k^s}\left(\frac{W_{kt}^s}{W_t^s}\right)^{-\varepsilon_s} = -\varepsilon_s\frac{N_k^s}{W_k^s}$$

and we have

$$\begin{aligned}
\frac{\partial c^s}{\partial W_k^s} &= \frac{1}{(1+\tau_c)P_t}\frac{\partial z^s}{\partial W_k^s} \\
&= \frac{1}{1+\tau_c}\frac{\partial}{\partial W_k^s}\int_k (1-\tau_p)\left((1-\tau_l)W_{k,t}^s e_t n_{k,t}^s + A\right)^{1-\lambda} dk \\
&= \frac{1}{(1+\tau_c)P_t}\int_k (1-\tau_p)(1-\lambda)(1-\tau_l)\left(e_t n_{k,t}^s + W_{k,t}^s e_t\frac{\partial n_k^s}{\partial W_k^s}\right)((1-\tau_l)W_{kt}^s e_t n_{kt}^s + A)^{-\lambda} dk \\
&= \frac{1}{(1+\tau_c)P_t}\int_k (1-\tau_p)(1-\lambda)(1-\tau_l)\left(e_t n_{k,t}^s - \varepsilon_s W_{k,t}^s e_t\frac{N_k^s}{W_k^s}\right)\left((1-\tau_l)W_{k,t}^s e_t n_{k,t}^s + A\right)^{-\lambda} dk \\
&= \frac{1}{(1+\tau_c)P_t}\int_k (1-\tau_p)(1-\lambda)(1-\tau_l)(1-\varepsilon_s)e_t n_{k,t}^s\left((1-\tau_l)W_{k,t}^s e_t n_{k,t}^s + A\right)^{-\lambda} dk \\
&= (1-\varepsilon_s)\int_k e_t n_{k,t}^s\frac{1}{P_t}\underbrace{\frac{(1-\lambda)(1-\tau_p)(1-\tau_l)}{1+\tau_c}(z_t^s(e))^{-\lambda}}_{\equiv td_t^s(e)} dk
\end{aligned}$$

Part 2. Envelope theorem: $\frac{\partial U_{k,t+1}^s}{\partial W_k^s}(W_k^s) = \Psi_W^s\left(\frac{W_{k,t+1}^s}{W_{k,t}^s}-1\right)\frac{W_{k,t+1}^s}{(W_{k,t}^s)^2} = \Psi_W^s\frac{1}{W_{k,t}^s}\left(\frac{W_{k,t+1}^s}{W_{k,t}^s}-1\right)\frac{W_{k,t+1}^s}{W_{k,t}^s}$. At the symmetric equilibrium, we have $W_k^s = W_{k'}^s = W^s$ and $n_k^s = n_{k'}^s = N^s\ \forall k,k'$ and thus $\frac{\partial c^s}{\partial W_k^s} = \frac{1}{P_t}(1-\varepsilon_s)td_t^s(e)e_t N_t^s$. Using $\pi_{W,t}^s = \frac{W_t^s}{W_{t-1}^s}-1$, the FOC rewrites:

$$\begin{aligned}
0 &= \frac{1}{P_t}(1-\varepsilon_s)N_t^s\int_e\int_{a_-} e_t td_t^s(e)u'(c^s)d\Gamma^s(e,a_-) \\
&\quad + v'(N^s)\frac{N^s}{W^s}\varepsilon_s - \Psi_W^s\frac{1}{W_{t-1}^s}\pi_{W,t}^s + \beta\Psi_W^s\pi_{W,t+1}^s(1+\pi_{W,t+1}^s)\frac{1}{W_t^s} \\
\Leftrightarrow 0 &= (1-\varepsilon_s)\frac{W_t^s}{P_t}N_t^s\int_e\int_{a_-} e_t\cdot td_t^s(e)\cdot u'(c^s(e,a_-))d\Gamma(e,a_-) + v'(N_t^s)N_t^s\varepsilon_s \\
&\quad - \Psi_W^s(1+\pi_{W,t}^s)\pi_{W,t}^s + \beta\Psi_W^s\pi_{W,t+1}^s(1+\pi_{W,t+1}^s)
\end{aligned}$$

The resulting New-Keynesian Phillips curve for sector s is:

$$\begin{aligned}
\pi_{W,t}^s &= \frac{\varepsilon_s}{\Psi_W^s}\left[\frac{1-\varepsilon_s}{\varepsilon_s}\frac{W_t^s}{P_t}N_t^s\int_e\int_{a_-} e_t td_t^s(e)u_t'(c^s(e,a_-))d\Gamma(e,a_-) + v'(N_t^s)N_t^s\right] + \beta\pi_{W,t+1}^s \\
&= \kappa_W^s\left(N_t^s v'(N_t^s) - \frac{1}{\mu_w^s}\frac{W_t^s}{P_t}N_t^s\int_e\int_{a_-} e_t td_t^s(e)u_t'(c^s(e,a_-))d\Gamma(e,a_-)\right) + \beta\pi_{W,t+1}^s
\end{aligned}$$

with tax distortion $td_t^s = \frac{(1-\lambda)(1-\tau_p)(1-\tau_l)}{1+\tau_c}(z_t^s(e))^{-\lambda}$, $\mu_w^s = \frac{\varepsilon_s}{\varepsilon_s-1}$, $\kappa_W = \frac{\varepsilon_s}{\Psi_W^s}$, $\pi_W(1+\pi_W)\approx\pi_W$.

C Firms Decisions

Basic-good producers produce Y_N^T using only labor and minimize their production costs

$$\min_{n^l_{i,t},n^m_{i,t},n^h_{i,t}} \left\{W_t^{l,TN}N_t^l + W_t^{m,TN}N_t^m + W_t^{h,TN}N_t^h\right\}$$

$$s.t.\quad \begin{cases} Y_{N,t}^T & \leq & (1+g)^t\left(\alpha_l^{\frac{1}{\varepsilon_N}}\left(A_t^lN_t^l\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_m^{\frac{1}{\varepsilon_N}}\left(A_t^mN_t^m\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_h^{\frac{1}{\varepsilon_N}}\left(A_t^hN_t^h\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}}\right)^{\frac{\varepsilon_N}{\varepsilon_N-1}} \\ N_t^s & = & \sum_i \omega^s\pi_i^s e_{i,t}^s n_{i,t}^s \quad \forall s\in\{l,m,h\} \end{cases}$$

The corresponding stationarized problem is

$$\min_{n^l_{i,t},n^m_{i,t},n^h_{i,t}} \left\{W_t^lN_t^l + W_t^mN_t^m + W_t^hN_t^h\right\}$$

$$s.t.\quad \begin{cases} Y_{N,t} & \leq & \left(\alpha_l^{\frac{1}{\varepsilon_N}}\left(A_t^lN_t^l\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_m^{\frac{1}{\varepsilon_N}}\left(A_t^mN_t^m\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_h^{\frac{1}{\varepsilon_N}}\left(A_t^hN_t^h\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}}\right)^{\frac{\varepsilon_N}{\varepsilon_N-1}} \\ N_t^s & = & \sum_i \omega^s\pi_i^s e_{i,t}^s n_{i,t}^s \quad \forall s\in\{l,m,h\} \end{cases}$$

Intermediate-good producers produce Y_H^T with energy E^T and basic goods Y_N^T while minimizing their production costs

$$\min_{E_t^T,Y_{N,t}^T}\{W_t^{TN}Y_{N,t}^T + P_{E_t}^NE_t^T\} \qquad s.t.\;\; Y_{H,t}^T \leq \left(\alpha_f^{\frac{1}{\sigma_f}}\left(E_t^T\right)^{\frac{\sigma_f-1}{\sigma_f}} + (1-\alpha_f)^{\frac{1}{\sigma_f}}\left(Y_{N,t}^T\right)^{\frac{\sigma_f-1}{\sigma_f}}\right)^{\frac{\sigma_f}{\sigma_f-1}}$$

The corresponding stationarized problem is

$$\min_{E_t,Y_{N,t}}\{W_tY_{N,t} + P_{E_t}E_t\} \qquad s.t.\;\; Y_{H,t} \leq \left(\alpha_f^{\frac{1}{\sigma_f}}\left(E_t\right)^{\frac{\sigma_f-1}{\sigma_f}} + (1-\alpha_f)^{\frac{1}{\sigma_f}}\left(Y_{N,t}\right)^{\frac{\sigma_f-1}{\sigma_f}}\right)^{\frac{\sigma_f}{\sigma_f-1}}$$

Final-good producers produce Y_F^T by combining goods $Y_{H,t}^T$ and $Y_{E,t}^T$ in order to satisfy the households' preferences. They minimize their production costs

$$\min_{Y_{H,t}^T,Y_{E,t}^T}\{P_{H,t}^NY_{H,t}^T + (1-s_{H,t})P_{E,t}^NY_{E,t}^T\} \quad s.t. \quad Y_{F,t}^T \leq \left(\alpha_E^{\frac{1}{\eta_E}}\left(Y_{E,t}^T\right)^{\frac{\eta_E-1}{\eta_E}} + (1-\alpha_E)^{\frac{1}{\eta_E}}\left(Y_{H,t}^T\right)^{\frac{\eta_E-1}{\eta_E}}\right)^{\frac{\eta_E}{\eta_E-1}}$$

The corresponding stationarized problem is

$$\min_{Y_{H,t},Y_{E,t}}\{P_{H,t}Y_{H,t} + (1-s_{H,t})P_{E,t}Y_{E,t}\} \quad s.t. \quad Y_{F,t} \leq \left(\alpha_E^{\frac{1}{\eta_E}}\left(Y_{E,t}\right)^{\frac{\eta_E-1}{\eta_E}} + (1-\alpha_E)^{\frac{1}{\eta_E}}\left(Y_{H,t}\right)^{\frac{\eta_E-1}{\eta_E}}\right)^{\frac{\eta_E}{\eta_E-1}}$$

Retailers. The i-retailer's sets its price (Monopolistic competition) to maximize its profits

$$\Pi^{TN}(P_{i,t-1}^N) \quad = \quad \max_{P_{i,t}^N}\left\{\left(P_{i,t}^N - P_{F,t}^N\right)y_{i,t}^T - \frac{\psi_P^N}{2}\left(\frac{P_{i,t}^N}{P_{i,t-1}^N} - (1+\overline{\pi})\right)^2 P_t^NY_t^T + \frac{1}{1+i_t}\Pi^{TN}(P_{i,t}^N)\right\}$$

$$s.t.\quad y_{i,t}^T = \left(\frac{P_{i,t}^N}{P_t^N}\right)^{-\varepsilon_d} Y_t^T$$

where the profit $\Pi^{TN}(P^N_{i,t-1})$ integrates the real and the nominal trends. If we first stationarize with respect to the nominal trend, the retailer's objective becomes:

$$\begin{aligned} \Pi^T(P_{i,t-1}) &= \max_{P_{i,t}} \left\{ (P_{i,t} - P_{F,t})\, y^T_{i,t} - \frac{\psi^N_P (1+\overline{\pi})^2}{2} \left(\frac{P_{i,t}}{P_{i,t-1}} - 1 \right)^2 P_t Y^T_t + \frac{1+\overline{\pi}}{1+i_t} \Pi^T(P_{i,t}) \right\} \\ & \quad s.t. \;\; y^T_{i,t} = \left(\frac{P_{i,t}}{P_t} \right)^{-\varepsilon_d} Y^T_t \end{aligned}$$

where the profit $\Pi^T(P_{i,t-1})$ integrates only the real trend. This value can be expressed in real terms as follows:

$$\begin{aligned} \Pi^{TR}(P_{i,t-1}) &= \max_{P_{i,t}} \left\{ \frac{P_{i,t} - P_{F,t}}{P_t} y^T_{i,t} - \frac{\psi_P}{2} \left(\frac{P_{i,t}}{P_{i,t-1}} - 1 \right)^2 Y^T_t + \frac{(1+\overline{\pi})(1+\pi^c_{t+1})}{1+i_t} \Pi^{TR}(P_{i,t}) \right\} \\ & \quad s.t. \;\; y^T_{i,t} = \left(\frac{P_{i,t}}{P_t} \right)^{-\varepsilon_d} Y^T_t \end{aligned}$$

with $\psi^N_P (1+\overline{\pi})^2 = \psi_P$, $\Pi^{TR}(P_{i,t-1}) = \Pi^T(P_{i,t-1})/P_t$ and $\pi^c_{t+1} = \frac{P_{t+1}}{P_t} - 1$, implying that $\pi_{t+1} = (1+\overline{\pi})(1+\pi^c_{t+1}) - 1 = \frac{P^N_{t+1}}{P^N_t} - 1$. After stationarizing all real variables by $(1+g)^t$, the problem becomes

$$\Pi(P_{i,t-1}) = \max_{P_{i,t}} \left\{ \frac{P_{i,t} - P_{F,t}}{P_t} y_{i,t} - \frac{\psi_P}{2} \left(\frac{P_{i,t}}{P_{i,t-1}} - 1 \right)^2 Y_t + \frac{1}{1+r_t} \Pi(P_{i,t}) \right\} \quad s.t. \;\; y_{i,t} = \left(\frac{P_{i,t}}{P_t} \right)^{-\varepsilon_d} Y_t$$

D Method for Quantitative Policy Evaluation

D.1 Approximation of the equilibrium dynamic

The equilibrium defined in Section 2.8 can be sumarized by the following system:

$$\mathbf{H}_t(\mathbf{Y},\mathbf{Z}) \equiv \begin{pmatrix} \Psi(S_{t+1}, S_t, S_{t-1}) \\ \mathcal{A}_t - b_t \\ \mathcal{N}_t - N_t \\ \mathcal{E}_t - \overline{E}_t \end{pmatrix} = 0 \tag{4}$$

where $\Psi(S_{t+1}, S_t, S_{t-1}) = 0$ regroups all the equations describing the firm, union, government, and central bank behaviors, with S_t the vector of aggregate variables controlled by these agents, $\mathbf{Y}$ gathering the time series of unknown aggregate variables and $\mathbf{Z}$ of exogenous aggregate shocks.[33]

In step 1, we calibrate parameters that determine the steady state of the economy using Equation (4) for $x_{t+1} = x_t = x$, $\forall x \in \{S, \mathcal{A}, b, \mathcal{N}, N\}$. In step 2, we estimate the parameters that govern the dynamics of the aggregate shocks, $Z \in \mathcal{Z} \equiv \{\beta, \mu, P_E, \varepsilon, \vartheta, \{\varphi_s\}_{s=l,m,h}, \{A_s\}_{s=l,m,h}, G, T, e_\tau\}\}$, using Bayesian techniques and a linear approximation of Equation (4) given by

$$\begin{aligned} 0 &= \sum_{s=0}^{\infty}[H_Y]_{t,s} dY_s + \sum_{s=0}^{\infty}[H_Z]_{t,s} dZ_s \quad \text{where} \quad [H_Y]_{t,s} \equiv \frac{\partial \mathbf{H}_t}{\partial Y_s} \quad \text{and} \quad [H_Z]_{t,s} \equiv \frac{\partial \mathbf{H}_t}{\partial Z_s} \\ \Rightarrow \quad d\mathbf{Y} &= \mathbf{G} d\mathbf{Z} \quad \text{with} \quad \mathbf{G} = -H_Y^{-1} H_Z, \quad d\mathbf{Y} = \mathbf{Y} - \overline{\mathbf{Y}}, \quad \text{and} \quad d\mathbf{Z} = \mathbf{Z} - \overline{\mathbf{Z}} \end{aligned}$$

where $\overline{\mathbf{Y}}$ and $\overline{\mathbf{Z}}$ are the steady state values of $\mathbf{Y}$ and $\mathbf{Z}$. $\mathbf{G}$ is the complete Jacobian of the dynamic system. $\mathbf{G}$ depends on calibrated parameters determined in step 1. If all the exogenous shocks of the model have the following MA(∞) representation, $dZ_t = \sum_{s=0}^{\infty} \mathbf{m}_s^Z \varepsilon_{t-s}^Z$, then the solution of the HA model can be represented by a MA(∞) that involves $\mathbf{G}$ and $\mathbf{m}$:

$$dY_t = \sum_{s=0}^{\infty} \sum_{Z \in \mathcal{Z}} \left[\mathbf{G}^{Y,Z} \mathbf{m}^Z\right]_s \varepsilon_{t-s}^Z = \sum_{s=0}^{\infty} \sum_{Z \in \mathcal{Z}} m_s^{Y,Z} \varepsilon_{t-s}^Z \quad \Rightarrow \quad d\mathbf{Y} = \mathcal{M}(\Theta, \Phi)\mathcal{E} \tag{5}$$

where $\mathcal{E}$ contains the time series of all shocks, and $\mathcal{M}(\Theta, \Phi)$ represents all the model multipliers, which are combinations of the model structural parameters $\{\Theta, \Phi\}$. Among the model parameters, we distinguish between those that affect the steady state, Φ, and those that govern the dynamics of the exogenous shocks, Θ. This representation of the model solution allows us to estimate it, to decompose the variances of endogenous variables and to analyze the historical decomposition of time series.

D.2 Estimation of the Parameters Θ

In order to determine the forecast distribution of the debt-to-GDP ratio at different horizons, it is necessary to determine the distribution of exogenous shocks. To ensure consistency with the model, we estimate the processes for these shocks using observed data. Replacing ∞ by a "large" finite integer in Equation (5) and given values for parameters Φ, one can estimate the parameters $(\rho^Z)^s = \left[\mathbf{m}^Z\right]_s$ and σ^Z if Z_t follows $AR(1)$ processes, using a Bayesian method and a data set. In order to have a "just-identified" system, the number of time series used in the estimation is equal

[33] The dynamic paths of this economy are solved using the method developed by Auclert et al. (2021). Solutions are obtained thanks to the first-order approximation method developed by Reiter (2009), (2010).

to the number of shocks introduced in the model. Therefore, to identify the 14 shocks, we use the data set

$$d\mathcal{Y}_t = \left\{ Y_t, \pi_t, p_{E,t}, i_t^*, i_t, \{N_{s,t}\}_{s=l,m,h}, \{\pi_{s,t}^w\}_{s=l,m,h}, G_t, T_t, \frac{b_t}{Y_t} \right\}$$

The vector of parameters

$$\Theta = \left\{ \rho^Z, \sigma^Z | \text{for } Z \in \mathcal{Z} \equiv \{\beta, \mu, P_E, \varepsilon, \vartheta, \{\varphi_s\}_{s=l,m,h}, \{A_s\}_{s=l,m,h}, G, T, e_\tau\} \right\}$$

is estimated using a Bayesian method, under the restriction of a common innovation for both types of transfers

$$\widehat{\Theta} = \text{argmax } \mathcal{L}\left(\Theta | \{d\mathcal{Y}_t\}_{t=t_0}^T, \Phi\right)$$

where $d\mathcal{Y}_t$ replaces the model solutions dY_t in Equation (5) that provides the link between Θ and the data, knowing the values for Φ. Given the dataset $d\mathcal{Y}_t$, the procedure for estimating Θ consists first to assume the prior distribution of parameters $p(\Theta)$, and second to compute using Equation (5) the data's autocovariances $\text{cov}(d\mathcal{Y}_{i,t}, d\mathcal{Y}_{j,t'})$, $\forall i, j, t, t'$, which are stacked into the matrix $\mathcal{V}$, in order to obtain the likelihood function

$$\mathcal{L}(\Theta) = -\frac{1}{2}\log(\det(\mathcal{V})) - \frac{1}{2} d\mathcal{Y}' \mathcal{V}^{-1} d\mathcal{Y},$$

where the decomposition for $\mathcal{V}$ is obtained using the Cholesky method for efficiency motives.

In a Bayesian estimation, the posterior distribution $p(\Theta|d\mathcal{Y})$ is proportional to $\exp(\mathcal{L}(\Theta))p(\Theta)$. The estimate of $\widehat{\Theta}$ provides sufficient information to describe the stochastic environment of the agents.

D.3 Conditional Forecasts

In the spirit of Del Negro and Schorfheide (2013), we assume that the vector of endogenous variables $d\mathcal{Y}_t$ takes the forecasted values $\{d\mathcal{Y}_t^f\}_{t=T+1}^{T+H}$ reported in the Finance Act. To achieve this objective, we use Equation (5) to compute the vector of unanticipated shocks $\mathcal{E}^f$ allowing the model solution to match the target $\{d\mathcal{Y}_t^f\}_{t=T+1}^{T+H}$. In order to satisfy the rank condition necessary for identification, the 14 time series in $d\mathcal{Y}_t^f$ and the model (Equation (5)) allow us to identify the time series of the 14 shocks $\mathcal{E}^f = \{\varepsilon_s^Z | \text{for } Z \in \mathcal{Z}\}_{s=T+1}^{T+H}$. Among the shocks $\mathcal{E}^f$, it is necessary to distinguish between two groups of shocks.

(i) The shocks $\{\varepsilon_s^Z | \text{for } Z \in \{P_{FE}, G, T\}\}_{s=T+1}^{T+H}$ that affect the exogenous and observable variables $\{P_{FE}, G, T\}$, driven by the process $dZ_t = \rho^Z dZ_{t-1} + \sigma^Z \varepsilon_t^Z$. They are identified using only forecasts for $\{p_{E,s}, G_s, T_s\}_{s=T+1}^{T+H}$, without any filtering by the model.

(ii) The shocks $\{\varepsilon_s^Z | \text{for } Z \in \mathcal{Z} \setminus \{P_{FE}, G, T\}\}_{s=T+1}^{T+H}$ that affect the exogenous and unobservable variables $\{\beta, \mu, \varepsilon, \vartheta, \{\varphi_s\}_{s=l,m,h}, \{A_s\}_{s=l,m,h}, e_\tau\}$, driven by the process $dZ_t = \rho^Z dZ_{t-1} + \sigma^Z \varepsilon_t^Z$. They are identified using the model restrictions (Equation (5)) and shocks $\{\varepsilon_s^{p_E}, \varepsilon_s^G, \varepsilon_s^T\}_{s=T+1}^{T+H}$.

The estimated shocks $\mathcal{E}^f$ identify the economic context that allows the model to match the Finance Act forecasts. Even if the government does not announce the introduction of a new fiscal rule, it can alter the distribution of shocks associated with its discretionary interventions compared to those estimated over the sample $t \in [0, T]$. Therefore, to take seriously this potential problem, first underlined by Lucas (1976). We must distinguish two cases.

1. **Stability of the government decision rules.** Let's assume that the government decision rule is such that dZ_t, for $Z \in \{G, T\}$, is an $AR(1)$ process: $dZ_{T+h} = \rho^Z dZ_{T+h-1} + \sigma^Z \varepsilon^Z_{T+h}$ for $h \in [1, H]$ and $Z \in \{G, T\}$. Therefore, the sequence of $\{\varepsilon^Z_{T+h}\}^H_{h=1}$ satisfying its announcement $\{d\widetilde{Z}_{T+h}\}^H_{h=1}$, for $Z \in \{G, T\}$, is given by $\widehat{\varepsilon}^Z_{T+h} = \frac{1}{\widehat{\sigma}^Z}(d\widetilde{Z}_{T+h} - \widehat{\rho}^Z d\widetilde{Z}_{T+h-1})$ where $\{\widehat{\rho}^Z, \widehat{\sigma}^Z\}$ are the estimates of $\{\rho^Z, \sigma^Z\}$ over the sample $t \in [0, T]$. This forecast of the innovations is admissible if and only if $\widehat{\varepsilon}^Z_{T+h} \in CI$ of $\mathcal{N}(0, 1)$ $\forall h \in [1, H]$, consistently with the assumption made over the sample $t \in [0, T]$. If this is the case, then the stability of the parameters $\{\rho^Z, \sigma^Z\}$ is not rejected by the new announcements of the government and the Lucas (1976) critique is not quantitatively relevant. The model solution is then given by Equation (5).

2. **Instability of the government decision rules.** If the government decision rules are unstable ($\exists \widehat{\varepsilon}^Z_{T+h} \notin CI$ of $\mathcal{N}(0, 1)$), then they can be rewritten as follows:

$$dZ_t = \begin{cases} \widehat{\rho}^Z dZ_{t-1} + \widehat{\sigma}^Z \varepsilon^Z_t & \text{if } t \leq T \quad \text{Old policy rule} \\ \widetilde{\rho}^Z dZ_{t-1} + \widetilde{\sigma}^Z \varepsilon^Z_t & \text{if } t > T \quad \text{New policy rule} \end{cases}$$

Therefore, when the government announces $\{d\widetilde{Z}_{T+h}\}^H_{h=1}$, the sequence of $\{\varepsilon^Z_{T+h}\}^H_{h=1}$ must be identified using $\varepsilon^Z_{T+h} = \frac{1}{\widetilde{\sigma}^Z}(d\widetilde{Z}_{T+h} - \widetilde{\rho}^Z d\widetilde{Z}_{T+h-1})$. The parameters $\widetilde{\Theta}_g = \{\widetilde{\rho}^Z, \widetilde{\sigma}^Z | \text{for } Z \in \{G, T\}\}$ can be re-estimated using the government forecasts $\{d\widetilde{Z}_{T+h}\}^H_{h=1}$ and we will have necessarily $\varepsilon^Z_{T+h} \in CI$ of $\mathcal{N}(0, 1)$, $\forall Z, h$. Therefore, the identification of shocks over the sample $[T + 1; T + H]$ is now made through

$$d\mathbf{Y} = \mathcal{M}(\Theta_{-g}, \widetilde{\Theta}_g, \Phi)\mathcal{E} \tag{6}$$

which replaces Equation (5). In this case, the Lucas (1976) critique is quantitatively relevant and the identification process of the shocks must be "corrected" in order to be unbiased.

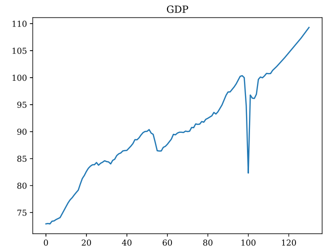
E Data, Steady State and Calibrations

E.1 Raw data

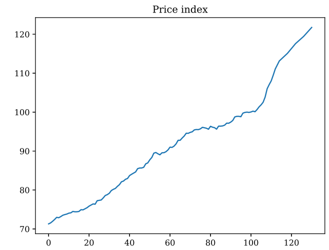
Data	Web access	Providers
Population	DBnomics code	Eurostat
GDP	DBnomics code	Eurostat
CPI	DBnomics code	INSEE
Energy price	DBnomics code	INSEE
Government consumption	DBnomics code	Eurostat
Government transfers	DBnomics code	Eurostat
Public debt	DBnomics code	Eurostat
Employment rate	DBnomics code	INSEE
Employment in Agriculture	DBnomics code	Eurostat
Employment in Wholesale and Retail Trade	DBnomics code	Eurostat
Employment in Construction	DBnomics code	Eurostat
Employment in Real estate	DBnomics code	Eurostat
Employment in Science and Administration	DBnomics code	Eurostat
Employment in Industry	DBnomics code	Eurostat
Employment in Finance	DBnomics code	Eurostat
Employment in Information and Communication	DBnomics code	Eurostat
Total Compensation in Agriculture	DBnomics code	Eurostat
Total Compensation in Wholesale and Retail Trade	DBnomics code	Eurostat
Total Compensation in Construction	DBnomics code	Eurostat
Total Compensation in Real estate	DBnomics code	Eurostat
Total Compensation in Science and Administration	DBnomics code	Eurostat
Total Compensation in Industry	DBnomics code	Eurostat
Total Compensation in Finance	DBnomics code	Eurostat
Total Compensation in Information and Communication	DBnomics code	Eurostat
Total hours in Agriculture	DBnomics code	Eurostat
Total hours in Wholesale and Retail Trade	DBnomics code	Eurostat
Total hours in Construction	DBnomics code	Eurostat
Tota hours in Real estate	DBnomics code	Eurostat
Total hours in Science and Administration	DBnomics code	Eurostat
Tota hours in Industry	DBnomics code	Eurostat
Total hours in Finance	DBnomics code	Eurostat
Total hours in Information and Communication	DBnomics code	Eurostat
Euribor	DBnomics code	ECB
Interest charges	DBnomics code	AMECO

Table 8: Data sources

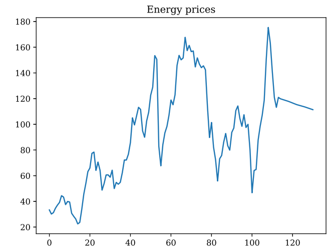
All the raw series of Table 8 are quarterly and range from 2Q1995 to 4Q2021, except Euribor that starts in 1999 and the employment rate, available only from 2Q2003. For the population and interest charges, which are annual series, we build quarterly series by interpolation. Some series are divided by the population to obtain per-capita variables: $\{Y, \frac{b}{Y}, G, T\}$. The consumer-price index series is monthly. It is quarterized using a moving average, from which we derive π. The energy price (P_{FE}) is the crude-oil price in euro. Finally, the data of hours and wages by worker types are constructed using data described in Appendix E.3. All times series are plotted in Figure 11.



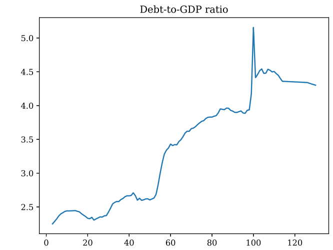
(a) GDP per capita



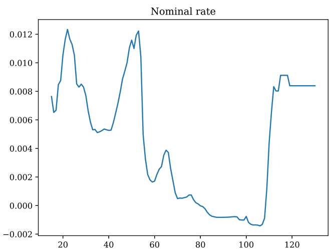
(b) Price index



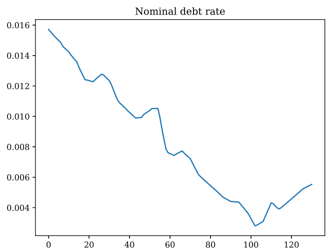
(c) Energy price



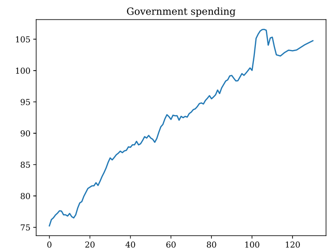
(d) Debt-to-GDP



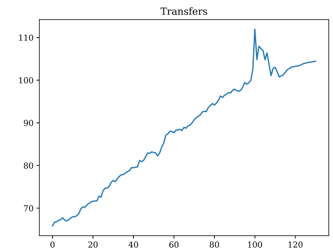
(e) Nominal interest rate



(f) Interest rate on public debt



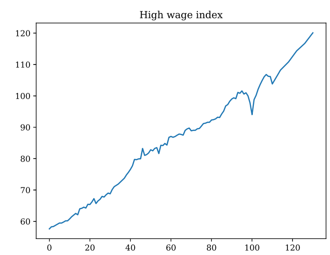
(g) Govt. consumption



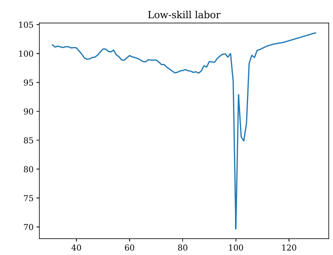
(h) Govt. transfers

(i) Low wages index

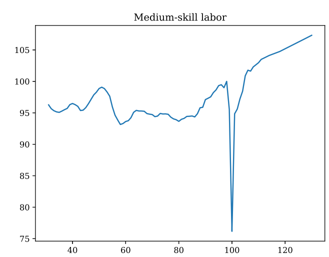
(j) Intermediate wages index



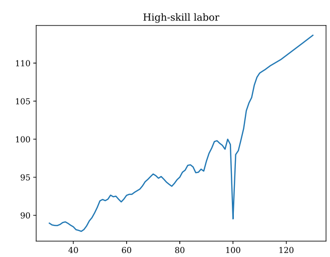
(k) High wages index



(l) Hours - Low wages



(m) Hours - Intermediate wages



(n) Hours - High wages

Figure 11: Raw data (100 in 4Q2019)

For the estimation, the time series of per-capita GDP , price index, Govt. consumption, Govt. transfers and wages are stationarized around a linear trend. The other times series are stationarized around their average over the sample.

E.2 Energy Market

From 2020 to 2023, total energy expenditure in France averaged approximately €223 billion, while GDP was around €2,600 billion. This implies that households, businesses, and public administrations allocated about 8.7% of their resources to energy purchases (see Data Gov. France). Following Meyler (2009) and Gautier et al. (2023), who show that short-term changes in consumer energy prices are primarily driven by fluctuations in crude oil prices, we calibrate $\nu = 1$, implying a near-complete pass-through from oil prices to consumer energy prices.[34] The share of total energy expenditures directly attributable to households is calibrated at 50%, and of that, 40% is considered incompressible household consumption (see Langot et al. (2023) for more details). Assuming further that $\sigma_f = \eta_E$, $Z = 1$ and $s_H = s_F = 0$. Then, using $mc = 1/\mu$, we can set $mc_F = mc$ and $p_F = mc_F$. Hence, we deduce

$$\begin{aligned} Y_{FE} &= \alpha_E \left(\frac{p_{FE}}{p_F}\right)^{-\eta_E} Y & \Leftrightarrow \quad & \frac{p_{FE}Y_{FE}}{Y} = \alpha_E \left(\frac{1}{p_F}\right)^{-\eta_E} p_{FE}^{1-\eta_E} \\ E &= \alpha_f(1-\alpha_E) \left(\frac{p_{FE}}{p_F}\right)^{-\eta_E} Y & \Leftrightarrow \quad & \frac{p_{FE}E}{Y} = \alpha_f(1-\alpha_E) \left(\frac{1}{p_F}\right)^{-\eta_E} p_{FE}^{1-\eta_E} \end{aligned}$$

which gives us:

$$\begin{aligned} \alpha_f &= \frac{\alpha_E}{1-\alpha_E} \frac{p_{FE}E/Y}{p_{FE}Y_{FE}/Y} \\ p_{FE} &= \left(\frac{(p_{FE}Y_{FE}/Y) + P_{FE}E/Y}{\alpha_E + \alpha_f(1-\alpha_E)} mc^{-\eta_E} \right)^{\frac{1}{1-\eta_E}} \end{aligned}$$

E.3 Labor Market.

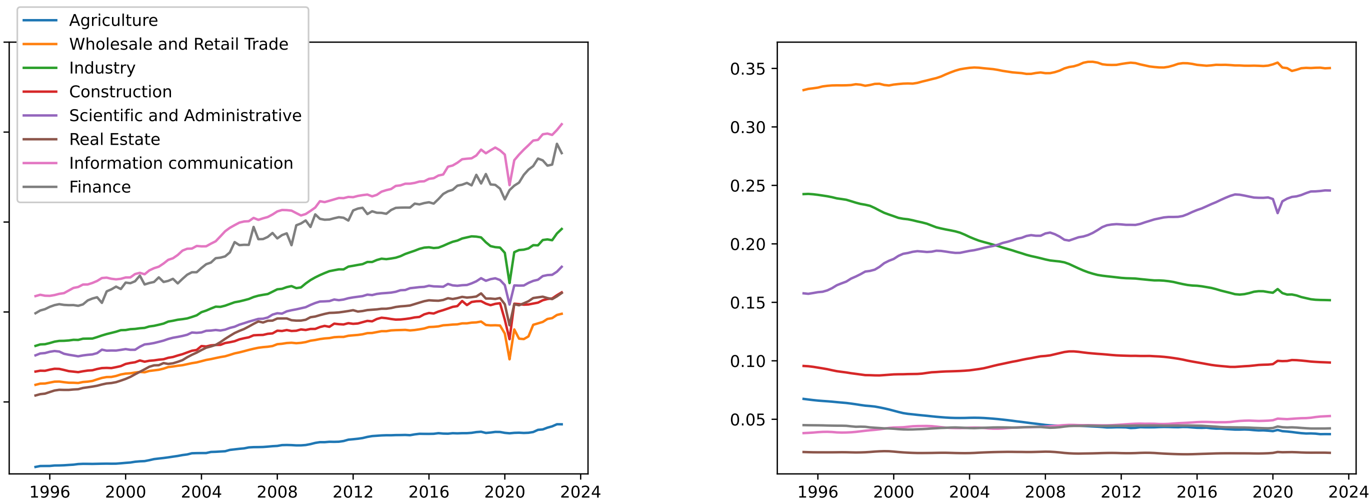
Figure 12 shows the employment shares and gross wage by sector of the French economy. For our model, we divide the labor market into three submarkets, $s \in \{l, m, h\}$:

- the submarket of high wages ($s = h$): Information Communication + Finance
- the submarket of intermediate wages ($s = m$): Industry + Construction + Scientific and Administrative + Real Estate
- the submarket of low wages ($s = l$): Wholesale and Retail Trade + Agriculture

We obtain the distributions shown in Figure 13. Between 1Q2003 and 4Q2019, the employment rate were $\widetilde{N}_L = 25.5\%$, $\widetilde{N}_M = 32.5\%$ and $\widetilde{N}_H = 5\%$. Therefore, the aggregate employment rate is $\sum_s \widetilde{N}_s = \widetilde{N} = 63\%$. This allows to deduce the relative employment sizes $\widetilde{N}_s/\widetilde{N}$ which are 40.5; 51.5 and 8%, respectivley.

To determine the employment rate by skill s, we need to use the participation rates and the employment rates for each skill s. We approximate these rates by assuming that low-wage workers have a diploma lower than the "baccalauréat", those with an intermediate wage have a diploma between the "baccalauréat" and two years of higher education, and high-wage workers have a bachelor or more. Data for the participation rates (see France Stratégie) and for unemployment (see INSEE) lead to

[34] We do not detail other energy sources, as IGU (2015) notes that wholesale gas prices are typically passed on to consumer gas prices with a short lag of three to six months. Moreover, electricity prices in the EU are largely determined by the cost of fossil fuels used in production. See Langot et al. (2023) for further details.



(a) Gross wages by employee

(b) Employment Shares

Figure 12: Raw labor-market statistics

- Participation rates (1985-2016): $P_l = 71\%$, $P_m = 76.25\%$ and $P_h = 87.0\%$
- Unemployment rates (2016): $U_l = 15\%$, $U_m = 10\%$ and $U_h = 6\%$.

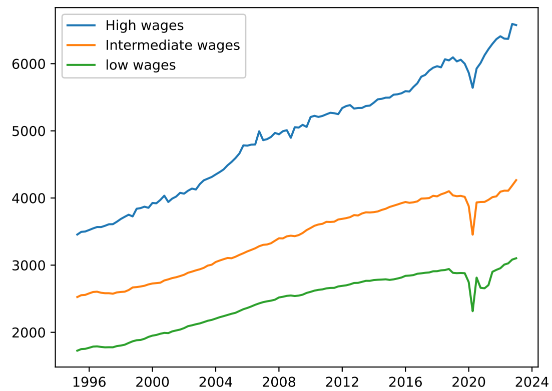
This leads to employment rates equal to $N_l = 56\%$, $N_m = 66.25\%$ and $N_h = 81\%$, consistent with a total employment rate equal to 63% and the shares N_s/N.

Beyond the employment rate (N), we also use the number of hours worked by workers (h) to build the aggregate hours $Nh = N \times h$.

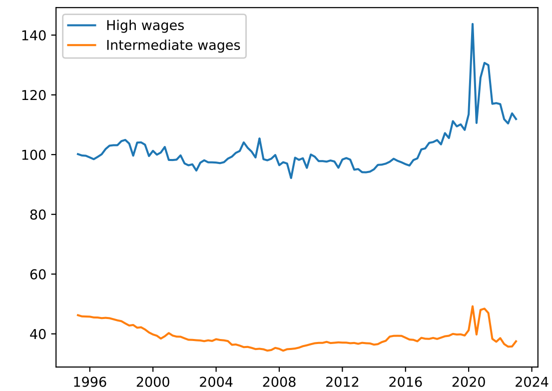
Sector s	L	M	H	Mean
Shares ($\widetilde{N}_s/\widetilde{N}$)	45.2%	48.6%	6.2%	-
Wages	1	1.4	2	1.3
Employment rates	56%	66.25%	81%	63%
Hours worked	1	0.98	1.02	0.99
$\widehat{N}_s$ (employment rates$\times$Share)	25.3	31.6	5.1	-

Table 9: Labor-market statistics

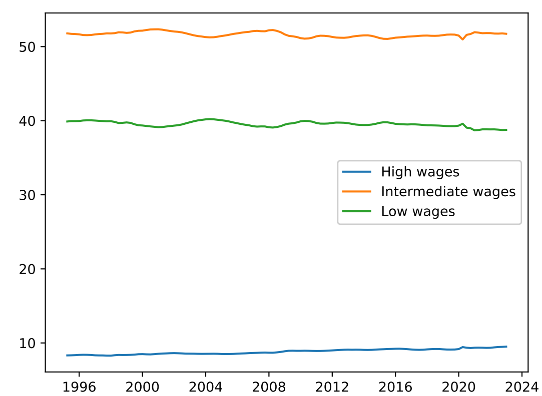
- Information provided by the data
  - the values of $\{\omega^s, n^s\}$ $\forall s$. Given that efficient labor is $N^s = \sum_i \omega^s \pi_i^s e_i^s n_i^s$, where ω^s is the size of each population, $\sum_i \pi_i^s e_i^s = \varpi^s$ is the average productivity of each population and $n^s(i) = n^s(i') \equiv n^s$, $\forall i, i'$ is the homogenous aggregate hours worked $\forall s$ (restriction implied by the unions) by each population, we deduce that $N^s = \varpi^s \omega^s n^s = \varpi^s \widehat{n}^s$.
  - the relative wages $\{1, l^m, l^h\}$
- Unknown parameters determined by steady-state restrictions: $\{\alpha_s, \varpi_s\}_{s=l,m,h}$



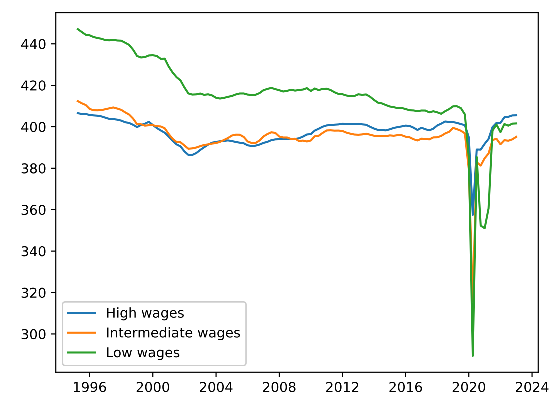
(a) Gross wages by employee



(b) Wage gaps



(c) Employment shares



(d) Hours worked by employee

Figure 13: Labor-market statistics

The production function is

$$
\begin{aligned}
Y_N &= \left(\alpha_l^{\frac{1}{\varepsilon_N}}\left(\varpi^l\omega^l n^l\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_m^{\frac{1}{\varepsilon_N}}\left(\varpi^m\omega^m n^m\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_h^{\frac{1}{\varepsilon_N}}\left(\varpi^h\omega^h n^h\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}}\right)^{\frac{\varepsilon_N}{\varepsilon_N-1}} \\
&= \left(\alpha_l^{\frac{1}{\varepsilon_N}}\left(\varpi^l\widehat{n}^l\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_m^{\frac{1}{\varepsilon_N}}\left(\varpi^m\widehat{n}^m\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_h^{\frac{1}{\varepsilon_N}}\left(\varpi^h\widehat{n}^h\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}}\right)^{\frac{\varepsilon_N}{\varepsilon_N-1}}
\end{aligned}
$$

where it is assumed that there are no TFP shocks at the steady state: $A^s = 1\ \forall s$. The firms controls the aggregate hours by skill $\widehat{n}^s$. The firm's FOC are, $\forall s \in \{l, m, h\}$:

$$
\begin{aligned}
\frac{\partial Y_N}{\partial \widehat{n}^s} &= \alpha_s^{\frac{1}{\varepsilon_N}}\varpi^s\left(\varpi^s\widehat{n}^s\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}-1}\left(\alpha_l^{\frac{1}{\varepsilon_N}}\left(\varpi^l\widehat{n}^l\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_m^{\frac{1}{\varepsilon_N}}\left(\varpi^m\widehat{n}^m\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}} + \alpha_h^{\frac{1}{\varepsilon_N}}\left(\varpi^h\widehat{n}^h\right)^{\frac{\varepsilon_N-1}{\varepsilon_N}}\right)^{\frac{\varepsilon_N}{\varepsilon_N-1}-1} = \frac{W^s}{W} \\
\Rightarrow\quad \widehat{n}^s &= \alpha_s(\varpi^s)^{\varepsilon_N-1}\left(\frac{W^s}{W}\right)^{-\varepsilon_N} Y_N
\end{aligned}
$$

where W is the total marginal cost:

$$
\begin{aligned}
W = MC_N &= \left(\sum_s \alpha_s\left(\frac{W^s}{\varpi^s}\right)^{1-\varepsilon_N}\right)^{\frac{1}{1-\varepsilon_N}} \\
&= W_l\left(\alpha_l\left(\frac{1}{\varpi^l}\right)^{1-\varepsilon_N} + \alpha_m\left(\frac{l^m}{\varpi^m}\right)^{1-\varepsilon_N} + \alpha_h\left(\frac{l^h}{\varpi^h}\right)^{1-\varepsilon_N}\right)^{\frac{1}{1-\varepsilon_N}} \\
&\equiv W_l\Gamma(\alpha_l, \alpha_m, \alpha_h, \varpi^l, \varpi^m, \varpi^h)
\end{aligned}
$$

This leads to

$$
\begin{aligned}
\widehat{n}^s &= \alpha_s(\varpi^s)^{\varepsilon_N-1}\left(\frac{W^s}{W_l\Gamma(\alpha_l, \alpha_m, \alpha_h, \varpi^l, \varpi^m, \varpi^h)}\right)^{-\varepsilon_N} Y_N \\
&= \alpha_s(\varpi^s)^{\varepsilon_N-1}\Gamma(\alpha_l, \alpha_m, \alpha_h, \varpi^l, \varpi^m, \varpi^h)^{\varepsilon_N}\left(\frac{W^s}{W_l}\right)^{-\varepsilon_N} Y_N
\end{aligned}
$$

Therefore, we deduce

$$
\begin{aligned}
\widehat{n}^l &= \alpha_l(\varpi^l)^{\varepsilon_N-1}\Gamma(\alpha_l, \alpha_m, \alpha_h, \varpi^l, \varpi^m, \varpi^h)^{-\varepsilon_N}Y_N &(7)\\
\widehat{n}^m &= \alpha_m(\varpi^m)^{\varepsilon_N-1}(l^m)^{-\varepsilon_N}\Gamma(\alpha_l, \alpha_m, \alpha_h, \varpi^l, \varpi^m, \varpi^h)^{-\varepsilon_N}Y_N &(8)\\
\widehat{n}^h &= \alpha_h(\varpi^h)^{\varepsilon_N-1}(l^h)^{-\varepsilon_N}\Gamma(\alpha_l, \alpha_m, \alpha_h, \varpi^l, \varpi^m, \varpi^h)^{-\varepsilon_N}Y_N &(9)
\end{aligned}
$$

where $\{\varpi^l, \varpi^m, \varpi^h, \alpha_l, \alpha_m, \alpha_h\}$ are the 6 unknowns. Remark that the homogeneity of the production function implies that

$$
\sum_s W_s n^s = WY_N \quad\Rightarrow\quad Y_N = \frac{1}{\Gamma}(n^l + l^m n^m + l^h n^h)
$$

This equation being a linear combination of equations (7), (8) and (9), we have 6 unknowns for only 3 independent equations (7), (8) and (9).

Additional restrictions:

1. $\sum_s \alpha_s = 1 \Rightarrow \alpha_h = 1 - \alpha_l - \alpha_m$
2. $\varpi_m = 1$ because we only observe 2 relative wages, $\{W_m/W_l, W_h/W_l\}$
3. $\sum_s \omega^s \varpi^s = 1 \Rightarrow \varpi^l = \frac{1-\omega^m\varpi^m-\omega^h\varpi^h}{\omega^l}$. With 2. this leads to $\varpi^h = \frac{1-\omega^l\varpi^l-\omega^m}{\omega^h}$

$\Rightarrow$ **The remaining 3 unknowns are $\{\varpi^l, \alpha_l, \alpha_m\}$.**

Using the definition of the function Γ, we deduce

$$\begin{aligned}
\Gamma(\alpha_l, \alpha_m, \alpha_h, \varpi^l, \varpi^m, \varpi^h) &= \left(\alpha_l \left(\frac{1}{\varpi^l}\right)^{1-\varepsilon_N} + \alpha_m \left(\frac{l^m}{\varpi^m}\right)^{1-\varepsilon_N} + \alpha_h \left(\frac{l^h}{\varpi^h}\right)^{1-\varepsilon_N}\right)^{\frac{1}{1-\varepsilon_N}} \\
\Leftrightarrow \quad \widetilde{\Gamma}(\alpha_l, \alpha_m, \varpi^l) &= \left(\alpha_l \left(\frac{1}{\varpi^l}\right)^{1-\varepsilon_N} + \alpha_m (l^m)^{1-\varepsilon_N} + (1-\alpha_l-\alpha_m)\left(\frac{\omega^h l^h}{1-\omega^l\varpi^l-\omega^m}\right)^{1-\varepsilon_N}\right)^{\frac{1}{1-\varepsilon_N}}
\end{aligned}$$

Solution can be obtained using:

$$\widehat{n}^l = \alpha_l (\varpi^l)^{\varepsilon_N - 1} \widetilde{\Gamma}(\alpha_l, \alpha_m, \varpi^l)^{(\varepsilon_N - 1)} (\widehat{n}^l + \widehat{l}^m \widehat{n}^m + \widehat{l}^h \widehat{n}^h) \tag{10}$$

$$\widehat{n}^m = \alpha_m (\widehat{l}^m)^{-\varepsilon_N} \widetilde{\Gamma}(\alpha_l, \alpha_m, \varpi^l)^{(\varepsilon_N - 1)} (\widehat{n}^l + \widehat{l}^m \widehat{n}^m + \widehat{l}^h \widehat{n}^h) \tag{11}$$

$$\widehat{n}^h = \alpha_h (\varpi^h)^{\varepsilon_N - 1} (\widehat{l}^h)^{-\varepsilon_N} \widetilde{\Gamma}(\alpha_l, \alpha_m, \varpi^l)^{(\varepsilon_N - 1)} (\widehat{n}^l + \widehat{l}^m \widehat{n}^m + \widehat{l}^h \widehat{n}^h) \tag{12}$$

where the variables with a "hat" are the observable data. Solutions must satisfy $\varpi^l > 0$, $0 < \alpha_l < 1$, $0 < \alpha_m < 1$ with $\alpha^l + \alpha^m < 1$. Moreover, the solution would be such that $\varpi^l < \varpi^m < \varpi^h$. Results (parameters and wage distributions) are reported in Figure 14.

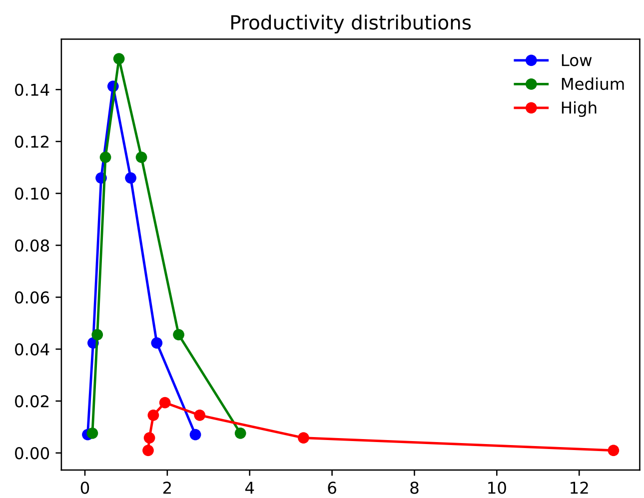


Figure 14: Productivity Distribution by Workers' Type s

Given the solutions for $\{\varpi^l, \varpi^m, \varpi^h\}$, where $\sum_s \omega^s \varpi^s = 1$, we define $\varpi^s = \Delta^s + \sum_i e_i^s \pi_i^s$, with $\sum_i e_i^s \pi_i^s = 1$, $\forall s$. Using the parameters $\{\rho^s, \sigma^s\}$, the grids of the idiosyncratic productivity shocks $[e_1^s, ..., e_N^s]$ and the Markov matrix $[\widetilde{\pi}_{ii'}^s]$ are constructed, and satisfy $\sum_i e_i^s \pi_i^s = 1$ where π_i^s is the stationary distribution associated with the Markov matrix $[\widetilde{\pi}_{ii'}^s]$.

Finally, equilibria on the labor markets allow us to deduce the values of the disutility of working φ_s, $\forall s \in \{l, m, h\}$ (see Table 10)).

s	l	m	h
	CES parameters of Y_N		
α_s	0.3173	0.5481	0.1445
ϖ_l	0.7917	1	2.5186
	Income Risks		
ρ_s	0.967	0.966	0.94
σ_s	0.48	0.62	1.34
	Disutility of working		
φ_s	0.4001	0.2991	0.1630

Table 10: Specific Parameters by Workers' Types s

E.4 Calibration of taxation and transfers

We use several moments of the decile distribution to calibrate transfer and income tax parameters. Those moments are computed from the data in Accardo et al. (2021) for 2018. We consider that Bismarckian transfers encompass pension and unemployment insurance transfers ("retraite" and "chômage et revenus de remplacement"). Beveridgian transfers include the other monetary transfers as well as health, social action and housing transfers in kind ("santé" and "action sociale et logement"). This way, we obtain the shares of transfers over GDP (17.9% for Bismarckian and 14.2% for Beveridgian) and their distribution by decile. For gross income, we consider primary income ("revenu primaire élargi") to which we remove social contributions ("cotisations sociales") and add Bismarckian transfers. For net income, we use disposable income ("revenu disponible") plus health, social action and housing transfers in kind. Consumption data (see INSEE) give us the distribution of consumption by decile. Finally, we obtain data for the distribution of dividends from André et al. (2023), using the dividend and mixed revenue category ("dividendes et revenus mixtes").

E.5 From government forecasts to quarterly data

	2023	2024	2025	2026	2027
Population (15-64)	41427249	41402466	41381174	41360167	41338765
GDP growth	0.9%	1.0%	1.4%	1.7%	1.8%
GDP share of G	26.0%	25.1%	24.8%	24.7%	24.2%
GDP share of T	25.3%	25.6%	25.1%	24.8%	24.5%
Debt-to-GDP	110.6%	112.3%	113.1%	112.9%	112.0%
Energy price	\$82	\$82	\$82	\$82	\$82
CPI (inflation rate)	4.9%	2.5%	1.7%	1.75%	1.75%
Employment	1.1%	0.4%	0.6%	1.1%	1.4%
Wage	4.1%	2.9%	2.3%	2.0%	1.9%
Short-term interest rate	3.4%	3.6%	3.2%	3.1%	3.1%
GDP share of interest charges	1.7%	1.9%	2.1%	2.3%	2.6%
Exchange rate EUR/USD	1.08	1.08	1.08	1.08	1.08

Table 11: Government forecasts. Source: Treasury Department data ("Programme de stabilité" (April, 2024))

Transfers (T) correspond to the categorie "Social benefits" while government consumption is total public spending minus transfers, minus investment and minus public debt cost. The level of the debt-to-gdp ratio is not exactly the same as the one presented in the model as in the model we divide debt by current quarterly GDP and then divide by four while in public accounting, debt is divided by GDP of the last four quarters. In the model, the energy price is first divided by the EUR/USD exchange rate and by the inflation level. For GDP, CPI, energy price and wage of the year τ, we compute the quarterly growth rates g^z_τ using the annual growth rates $g^z_{a,\tau}$ (their forecasts reported in the Table 11)[35], solving

$$(1 + g^z_{a,\tau}) \times \sum_{q=1Q}^{4Q} Z_{q,\tau} = Z_{1Q,\tau+1} \times \left[1 + (1 + g^z_\tau) + (1 + g^z_\tau)^2 + (1 + g^z_\tau)^3\right]$$

where $Z \in \{\text{GDP}, \text{CPI}\}$, energy price and wage. We built the quarterly data over the 1Q2024 to 4Q2027 period (see panels (a), (b) & (c) of Figure 15). We get quarterly series by interpolating the GDP share of G (government consumption) and the GDP share of T (government transfers). Then, using the quarterly data of GDP, we built quarterly data for G and T over the 1Q2024 to 4Q2027 period (see panels (a) & (b) of Figure 16). Concerning the debt-to-GDP ratio, the GDP share of interest charges and employment, we simply perform quarterly interpolation to construct quarterly data over the 1Q2024 to 4Q2027 period (see panel (c) of Figure 16), considering that the Finance Act gives the end-of-year value. For the short-term interest rate, we use the annual value for each quarter of the corresponding year.

Projected data for the labor markets. On the labor market, the government forecasts give aggregate projections for the employment rate (N) and the real wage (w). In order to construct hours worked (employment rate multiplied by number of hours worked per employee, $N \times h$) and real wages by salary level over the period 1Q2024 to 4Q2027, we use the government forecasts for N and w and the projections of the trends of N_s, h_s and w_s observed over the period 2Q-2003 to 4Q2023. To do this, we assume that:

(i) the distribution of jobs remains stable, ie. $N_{s,t} = \omega_s N_t$, for $t \in [1Q2024; 4Q2027]$. Hence, using the values of ω_s, we build $N_{s,t}$, consistent with N_t provided by the government forecasts.

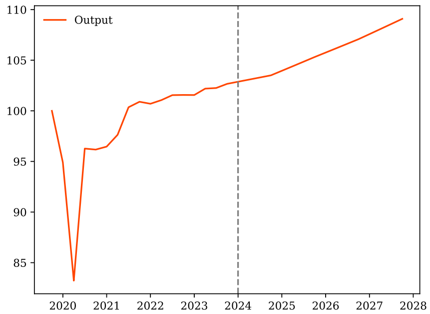
(ii) the ratio between the salary of a job of type l and the aggregate salary continues to evolve as it did between 2Q2003 and 4Q2023, $w_{l,t} = \mu_t w_t$ and μ_t observed between 2Q2003 and 4Q2023 then projected linearly between 1Q2024 to 4Q2027. This provides the data for $w_{l,t}$, given the government forecasts for w_t.

(iii) the wage gaps between m, h and l remain stable, i.e. $w_{s,t} = \gamma_s w_{l,t}$, for $s \in \{m, h\}$.

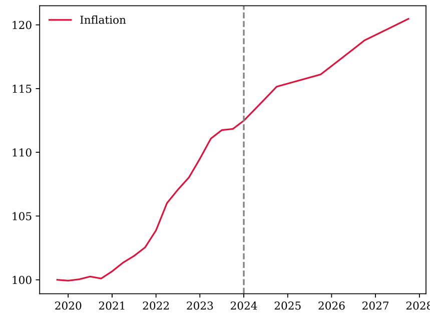
(iv) the number of hours worked by type of employee $s \in \{l, m, h\}$ evolves in the future (1Q2024 to 4Q2027) continuing the linear trend observed since 2Q2003.

Using this set of restrictions, we built total hours worked H_s and real wage w_s for each labor market $s \in \{l, m, h\}$ for the 1Q2024 to 4Q2027 sample. Data for the labor market are reported in Figure 17.

[35] For the energy price, we deduce the annual growth rate from forecasts of the data in level.

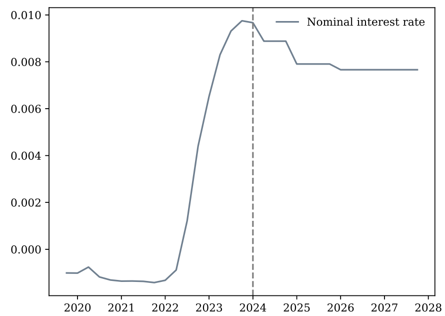


(a) GDP

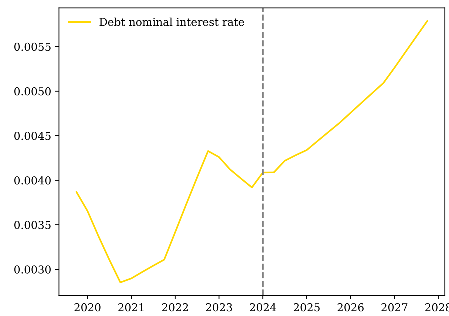


(b) Inflation

(c) Energy price

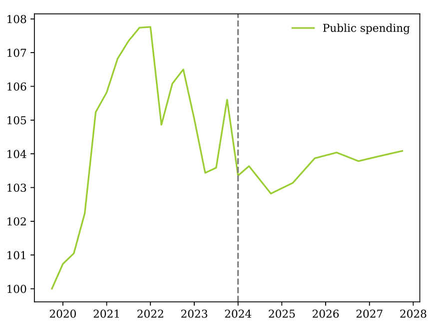


(d) Nominal interest rate

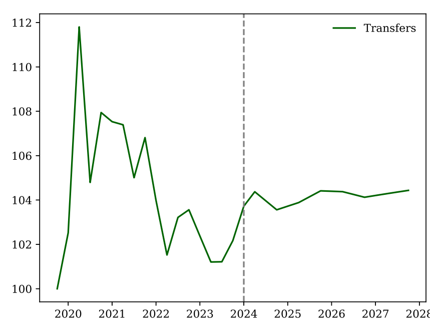


(e) Rate on public debt

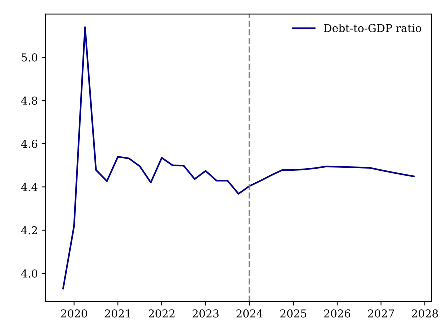
Figure 15: Data and Govt. Forecasts — Goods Market, Financial Market



(a) Govt. consumption

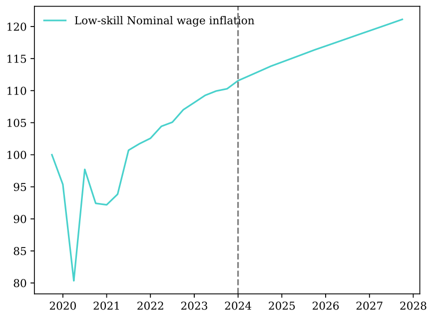


(b) Govt. transfers

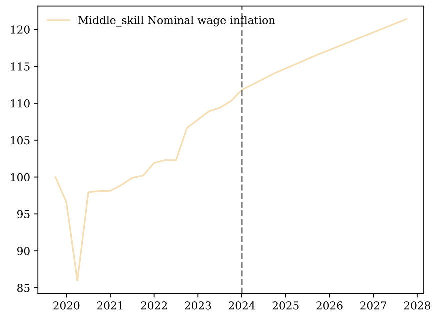


(c) Debt-to-GDP

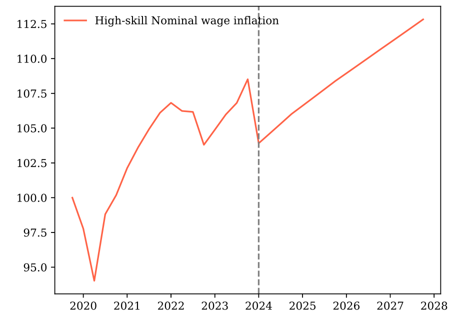
Figure 16: Data and Govt. Forecasts — Government Accounts



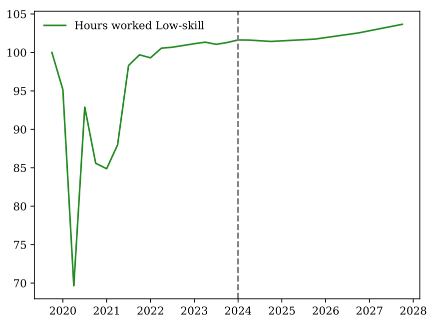
(a) Wage inflation l



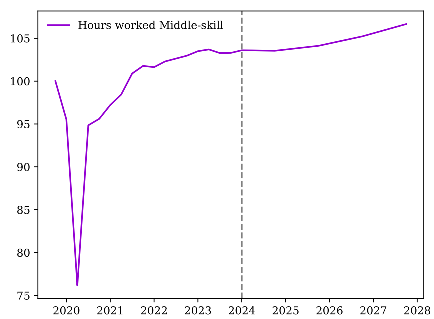
(b) Wage inflation m



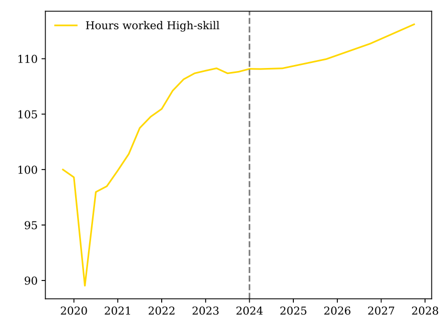
(c) Wage inflation h



(d) Hours worked l



(e) Hours worked m



(f) Hours worked h

Figure 17: Data and Govt. Forecasts — Labor Markets

F Estimation of the Exogenous Shock Processes

The persistence ρ and the standard deviation σ of the shock processes are estimated using a Bayesian procedure. Based on a Metropolis-Hastings algorithm, we draw one million draws. The first half of accepted draws were burned in to correct for possible mischoice of the starting point.

The prior distributions considered are reported in Table 12. For energy prices (p_{FE}), government spending (G) and transfers (T), our HANK model simply replicates the exogenous input series. Consequently, guesses for the values of these parameters can be obtained by estimating an $AR(1)$ on the time series $\{p_{FE}, G, T\}$. These estimates are used as information to define the priors of these shocks. The remaining priors for $\{\beta, \mu, \varepsilon, \vartheta, \{\varphi_s\}_{s=l,m,h},, \{A_s\}_{s=l,m,h}, e_\tau\}$ are assumed to follow beta distributions for the persistence and inverse-gamma distributions for the standard deviation, as usual in the literature. The results of the estimation are reported in Table 12.

Shock			**Prior**	**Mode**	**Mean**	**Std**	**95% CI**
Preference	β	ρ	$\beta(0.8, 0.05)$	0.782679	0.788914	0.025618	$[0.747558, 0.831786]$
		σ	$inv\Gamma(0.05, 1.0)$	0.003654	0.003649	0.000609	$[0.002727, 0.004731]$
Price markup	μ	ρ	$\beta(0.8, 0.05)$	0.830365	0.825371	0.028805	$[0.775270, 0.869698]$
		σ	$inv\Gamma(0.05, 1.0)$	0.012117	0.012137	0.001159	$[0.010382, 0.014178]$
Energy price	p_{FE}	ρ	$\mathcal{N}(0.89, 0.054)$	0.883494	0.883850	0.022467	$[0.844349, 0.917876]$
		σ	$\mathcal{N}(0.13, 0.067)$	0.381338	0.383981	0.024360	$[0.345383, 0.425461]$
Monetary policy	ε	ρ	$\beta(0.8, 0.05)$	0.494301	0.497910	0.038383	$[0.433938, 0.560735]$
		σ	$inv\Gamma(0.05, 1.0)$	0.005277	0.005359	0.000439	$[0.004683, 0.006131]$
Spread	ϑ	ρ	$\beta(0.8, 0.05)$	0.836132	0.830231	0.033184	$[0.770844, 0.879544]$
		σ	$inv\Gamma(0.05, 1.0)$	0.001114	0.001136	0.000117	$[0.000959, 0.001342]$
Disutility l	φ_l	ρ	$\beta(0.8, 0.05)$	0.767399	0.767689	0.046773	$[0.687332, 0.840859]$
		σ	$inv\Gamma(0.05, 1.0)$	0.019385	0.019754	0.002352	$[0.016140, 0.023850]$
Disutility m	φ_m	ρ	$\beta(0.8, 0.05)$	0.766534	0.750024	0.044256	$[0.673760, 0.818375]$
		σ	$inv\Gamma(0.05, 1.0)$	0.017585	0.018142	0.002191	$[0.014871, 0.022019]$
Disutility h	φ_h	ρ	$\beta(0.8, 0.05)$	0.675627	0.669080	0.058969	$[0.569410, 0.763542]$
		σ	$inv\Gamma(0.05, 1.0)$	0.033549	0.034567	0.003853	$[0.028592, 0.041240]$
Productivity l	A^l	ρ	$\beta(0.8, 0.05)$	0.884994	0.879364	0.015513	$[0.852222, 0.903325]$
		σ	$inv\Gamma(0.05, 1.0)$	0.034084	0.034214	0.003019	$[0.029600, 0.039531]$
Productivity m	A^m	ρ	$\beta(0.8, 0.05)$	0.818670	0.813233	0.025164	$[0.770651, 0.852453]$
		σ	$inv\Gamma(0.05, 1.0)$	0.021325	0.021879	0.001907	$[0.019001, 0.025179]$
Productivity h	A^h	ρ	$\beta(0.8, 0.05)$	0.845458	0.838475	0.027252	$[0.790351, 0.879977]$
		σ	$inv\Gamma(0.05, 1.0)$	0.091456	0.091553	0.008153	$[0.079345, 0.106194]$
Government spending	G	ρ	$\mathcal{N}(0.731, 0.085)$	0.735541	0.729980	0.059621	$[0.630886, 0.827662]$
		σ	$\mathcal{N}(0.0043, 0.0037)$	0.000940	0.000975	0.000090	$[0.000839, 0.001132]$
Transfers	T	ρ	$\mathcal{N}(0.778, 0.078)$	0.771574	0.782119	0.053167	$[0.693888, 0.868925]$
		σ	$\mathcal{N}(0.0051, 0.0060)$	0.001857	0.001935	0.000174	$[0.001672, 0.002239]$
Measurement error	e_τ	ρ	$\beta(0.8, 0.05)$	0.762938	0.762355	0.046843	$[0.680920, 0.835028]$
		σ	$inv\Gamma(0.05, 1.0)$	0.010718	0.011196	0.002879	$[0.007110, 0.016392]$

Table 12: Bayesian estimation results of the parameters of the $AR(1)$ processes

Because our model is not formulated in a linear state-space way, the Kalman filter cannot be used to evaluate its log-likelihood. Instead, and consistently with Auclert et al. (2021), its log-likelihood is computed using the covariance matrix linking the model variables. This covariance matrix relies on the model's Jacobian, obtained using the sequence-space method. Note that because we do not estimate structural parameters that affect the Jacobian of the system, the same Jacobian can be reused throughout the entire process of estimation, which saves some computing time.

G Historical Decomposition

This appendix presents the variance decomposition of the estimated model for the period of estimation 1Q2003-4Q2019. The variance decomposition of the main macroeconomic variables allows us to evaluate which are the main shocks for explaining the business cycle over the entire period. It gives the contribution of each shock in explaining the deviations of each endogenous variable from its long-term value (see Table 13).[36]

	output	inflation	debt	int. rate	debt rate	empl L	empl M	empl H	wage L	wage M	wage H
β	14.4%	4.9%	3.9%	9.9%	8.3%	19.9%	19.4%	12.9%	11.7%	11.8%	9.6%
μ	9.6%	9.3%	9.2%	5.1%	4.8%	9.5%	9.9%	12.5%	1.3%	1.4%	1.4%
P_E	1.7%	21.4%	2.2%	19.2%	20.3%	11.2%	12.0%	9.3%	13.0%	13.3%	11.2%
ε	3.7%	2.8%	3.2%	1.8%	1.5%	5.0%	5.1%	2.8%	8.2%	8.2%	5.7%
ϑ	0.8%	0.7%	0.6%	0.7%	1.6%	1.4%	1.4%	0.7%	1.7%	1.7%	1.4%
φ_l	1.1%	0.4%	0.1%	0.3%	0.4%	13.8%	0.1%	0.2%	7.2%	0.2%	0.1%
φ_m	3.9%	1.8%	0.4%	0.9%	1.2%	0.2%	13.8%	0.5%	0.7%	11.8%	0.5%
φ_h	0.2%	0.4%	0.2%	0.2%	0.2%	0.1%	0.1%	16.7%	0.2%	0.2%	24.5%
A^l	33.6%	25.3%	42.6%	32.0%	32.5%	21.4%	12.5%	9.5%	29.9%	23.4%	18.8%
A^m	12.5%	16.6%	8.9%	13.1%	13.5%	8.0%	13.1%	7.5%	9.6%	10.4%	6.8%
A^h	15.6%	12.7%	7.3%	12.2%	13.5%	6.3%	8.7%	24.8%	9.0%	9.0%	11.4%
G	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
T	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
e_τ	2.8%	3.7%	21.5%	4.6%	2.1%	3.2%	3.7%	2.4%	7.4%	8.7%	8.6%

Table 13: Variance decomposition. Share of the deviation from the steady state explained by each shock: mean value for the sample 1Q2003-4Q2019.

Using the sequences of shocks identified through the estimation procedure, our model allows us to trace the channels through which different phases of the business cycle have affected the French economy. Figure 18 reports results for all variables used in the estimation. The 2008 financial crisis serves as an illustration of how the model identifies the sources of fluctuations underlying a major economic downturn.

In 2008, we observed a reversal in consumer demand shocks compared to the pre-crisis period.[37] While demand had been supporting the economy before the crisis, it contributed to a decline in GDP during the crisis. Our model therefore attributes a significant part of the drop in demand to an increase in household patience, leading them to postpone consumption —a behavior likely driven by the high level of uncertainty surrounding the resolution of the banking crisis. This negative demand shock was amplified by rising spreads, but partially offset by a reduction in markups, accommodative monetary policy, and falling oil prices. All these sources of fluctuations identified by our model are consistent with numerous analyses of the crisis, thereby confirming the empirical relevance of our approach.

[36] Fluctuations represent the differences between the current values of economic variables and their long-term values.

[37] We therefore set aside the dynamics of technology shocks which, although sizable in magnitude, did not exhibit any particular disruption during the 2008 crisis.

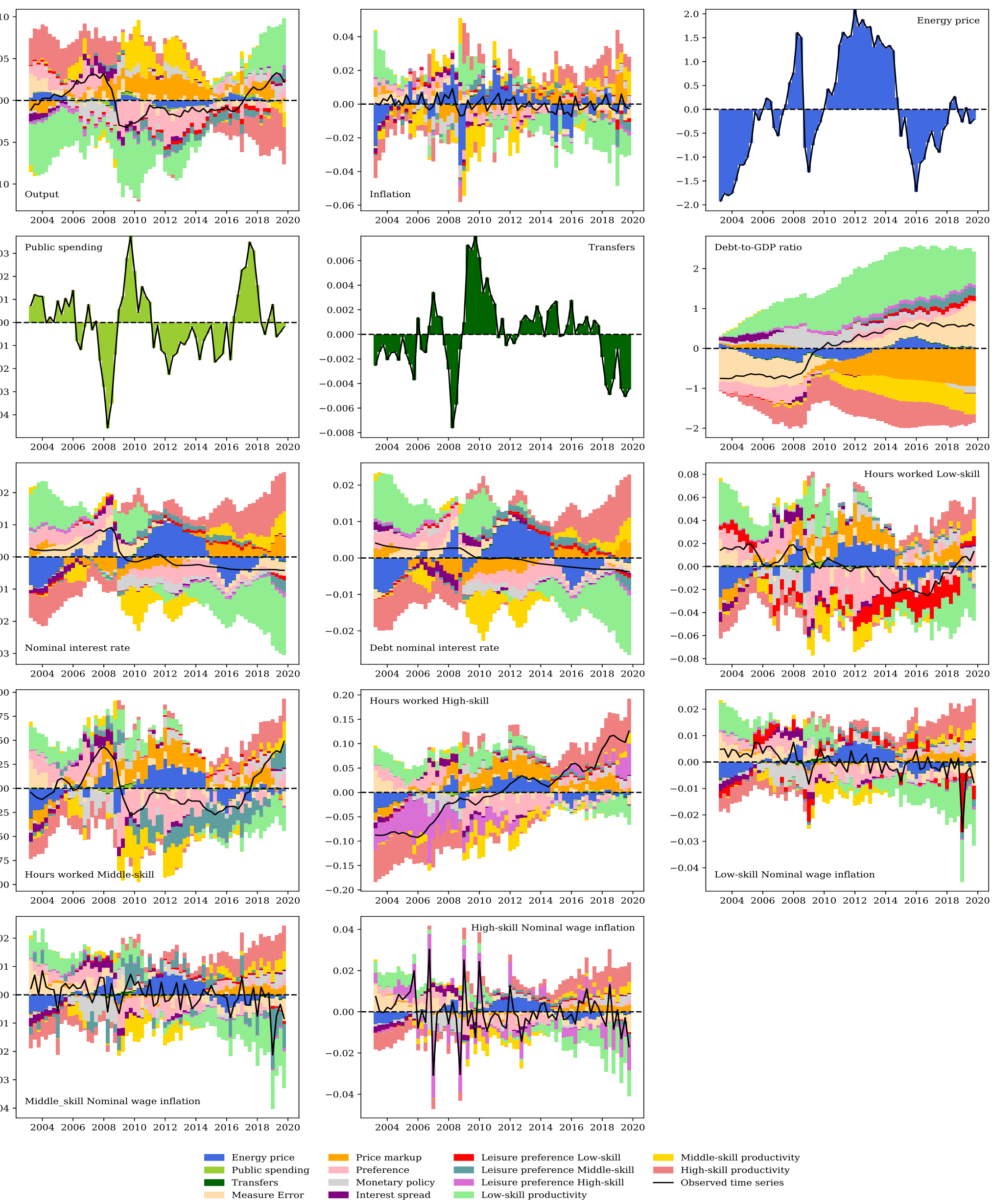
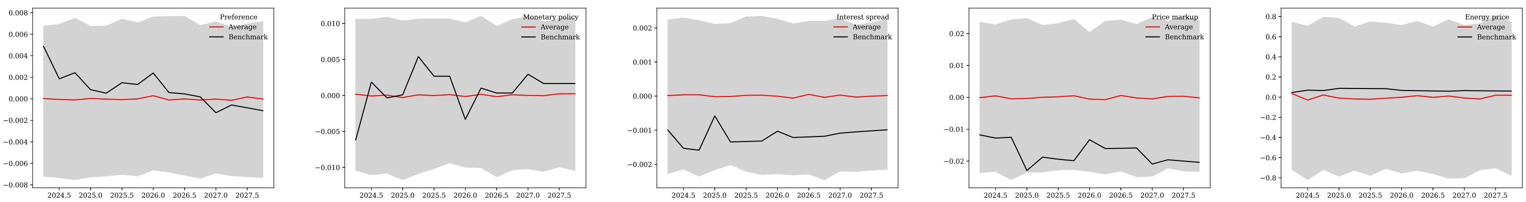
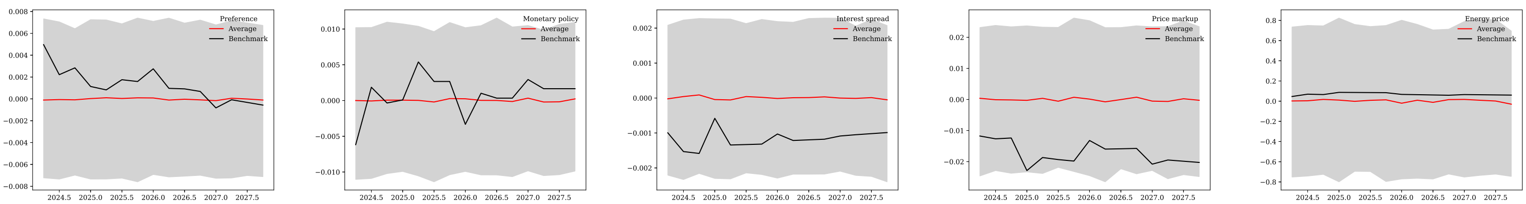


Figure 18: Historical decomposition.

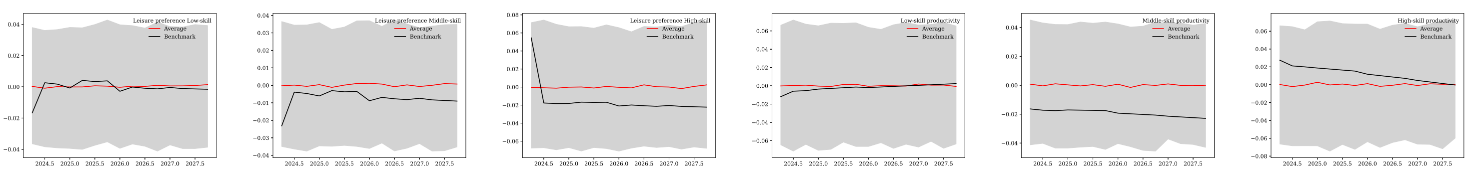
H Innovations Before and After Estimation



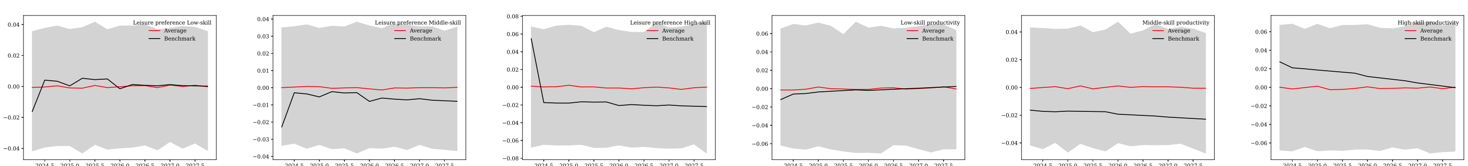
(a) Discount rate (A) (b) Nominal interest rate (A) (c) Spread (A) (d) Markup (A) (e) Energy price (A)



(f) Discount rate (B) (g) Nominal interest rate (B) (h) Spread (B) (i) Markup (B) (j) Energy price (B)



(k) Preferences l (A) (l) Preferences m (A) (m) Preferences h (A) (n) Productivity l (A) (o) Productivity m (A) (p) Productivity h (A)



(q) Preferences l (B) (r) Preferences m (B) (s) Preferences h (B) (t) Productivity l (B) (u) Productivity m (B) (v) Productivity h (B)

Figure 19: Innovations of households and firms shocks. (A) before and (B) after re-estimation.

I Evaluating a Finance Act: On the Importance of the Conditional Forecast Method

Future debt trajectories over the period 1Q2024 to 4Q2027 could be simulated using the model estimated on data from 2Q2003 to 4Q2019. This simulation represents the projected trajectory of public debt under the assumption that government behavior remains unchanged. Comparing it with the debt forecast presented in the Finance Act thus provides a measure of the deviation between the government's newly stated fiscal objectives and the counterfactual scenario in which pre-existing policies are maintained.

To assess the government's announced policy regarding the future trajectory of public debt, it is therefore necessary to incorporate into our model the key elements reflecting its decisions, as formalized in the Finance Act —particularly those related to the projected paths of public consumption (G) and household transfers (T). We have shown (see Section 3.3) that this information on the projected paths of G and T is important because it reveals that their processes have changed between the pre- and post-2024 periods.

Nevertheless, by considering only the information on debt and spending contained in the Finance Act, the evaluation of the government's fiscal policy would not be consistent with its commitments, since the public deficit generated by our model would not match that announced in the Finance Act. Indeed, for our model to produce a public deficit close to that announced by the government, it is also necessary to align the net revenues from interest payments on the debt between the model and the government's projections. Since net revenues from interest payments are endogenous —depending notably on GDP, interest rates, and inflation— they can only be controlled by using the same forecasts for GDP, interest rates, and inflation (among others) that the government relied upon to project its net revenues and thus its public deficit trajectory over the period 1Q2024 to 4Q2027. The conditional forecast method developed in this paper therefore allows for a comprehensive evaluation of the Finance Act.

	2024	2025	2026	2027
All shocks are set to match the Financial Act				
All data from Finance Act	-5.1	-4.0	-3.5	-2.9
All shocks are drawn in the historical distribution				
No information from Finance Act	-4.5	-4.2	-4.1	-4.0
	(+0.6)	(-0.2)	(-0.6)	(-1.1)
G and T from Finance Act	-4.3	-3.7	-4.0	-3.7
	(+0.8)	(+0.3)	(-0.5)	(-0.8)

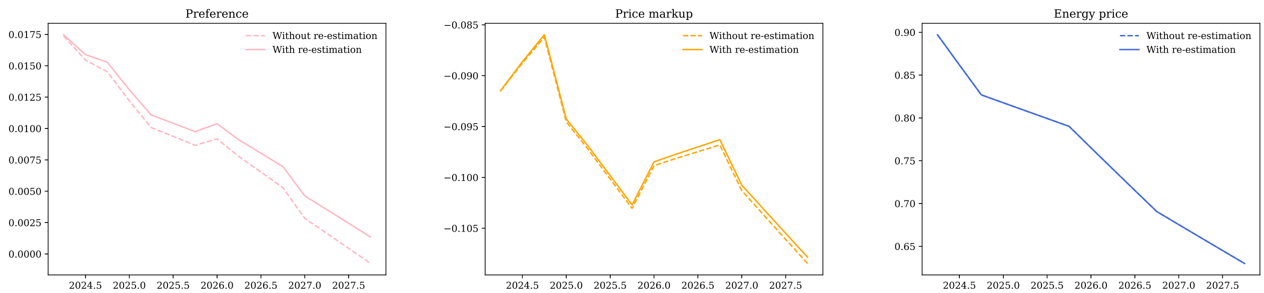
Table 14: Model predictions for the government deficit (% of GDP). Gaps with the first line in parenthesis

Table 14 shows that when all the series included in the Finance Act (debt, public spending, GDP, interest rates, inflation, etc.) are used and the model identifies the sequences of shocks required to match all of the government's forecasts, the public deficit generated by the model is, by construction, identical to that reported in the Finance Act (the first line of Table 14 gives this predicted deficit). When none of the data from the Finance Act are incorporated into the model used to forecast through 4Q2027 (the second line of Table 14), the projected deficit is lower in 2024 (indicating that the model-implied revenues net from interest paiements are higher than those anticipated by the Finance Act), nearly identical in 2025, but systematically higher in both 2026 and 2027 (suggesting that the model generates lower net revenues than those assumed in the Finance

Act for these two years). When the trajectories of public spending are corrected to incorporate the information on G and T provided in the Finance Act, the deficit is reduced over the entire forecast horizon, highlighting the government's shift toward tighter expenditure control. However, the projected deficits for 2026 and 2027 remain consistently higher than those set out in the Finance Act, indicating that the fiscal plan is only sustainable if macroeconomic conditions turn out more favorable than the median scenario.

J Shocks Underlying the Government Forecasts

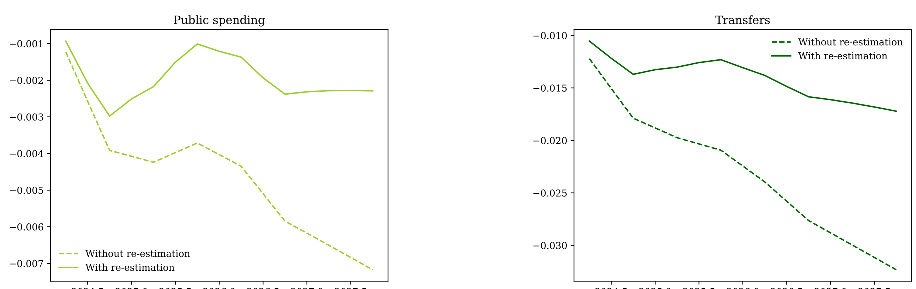
Figures 20 to 23 show deviations from the steady-state values for all time series in $\mathcal{E}_{T+H}$. In each panel, two trajectories of shock realizations are compared: the first is generated using a model that does not incorporate the re-estimation of public expenditure processes, while the second accounts for this re-estimation. This comparison provides an indirect measure of the impact of the bias associated with the Lucas (1976) critique.



(a) Discount rate (b) Mark-up (c) Energy price

Figure 20: Estimated shocks $\{\beta, \mu, P_E\}$. Before (dotted line) and After re-estimation (solid line)

Panels (a), (b) and (c) of Figure 20 shows that the discount factor (β_t) and the energy price ($P_{E,t}$) take values above their steady-state —adverse shock sequences that dampen economic activity and thereby deteriorate public finances—, whereas the price markup (μ_t) takes values below its steady state —favorable shocks for economic activity and public finances.

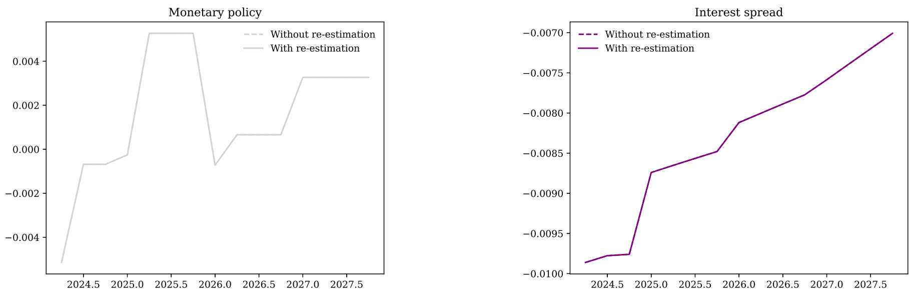


(a) Govt. consumption (b) Govt. transfers

Figure 21: Estimated shocks $\{G, T\}$. Before (dotted line) and after re-estimation (solid line)

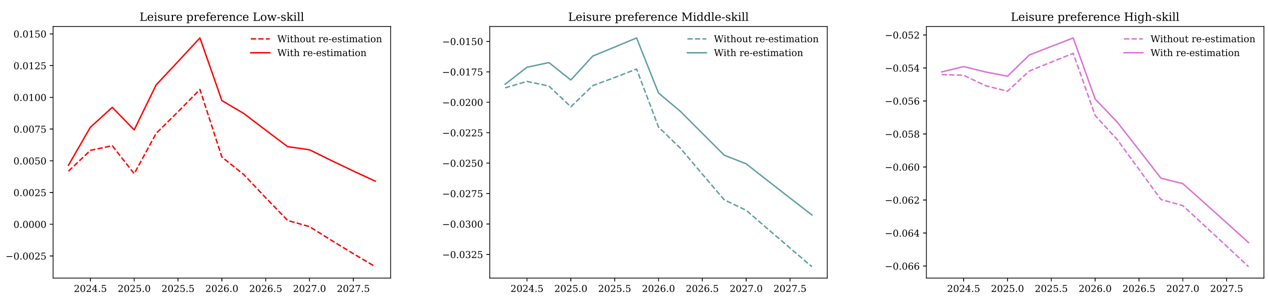
Panels (a) and (b) of Figure 21 shows that the government consumption (G_t) and transfers (T_t) take values below their steady-state over the entire forecast period. These estimates show that G_t will take values consistently around -0.02 over the forecast period (after re-estimation), meaning a reduction of around 2% of government consumption with respect to its 4Q2019 value, whereas T_t is 1% to 1.5% below its 4Q2019 value.

If the monetary policy shock oscillates around zero (see panel (a) of Figure 21), the payments of interests on debt seems to be underestimated because the risk premium paid by the government when it repays its debt is continuously below its long-term value, even if it rises towards it at the end of the forecast period (see panel (b) of Figure 21).

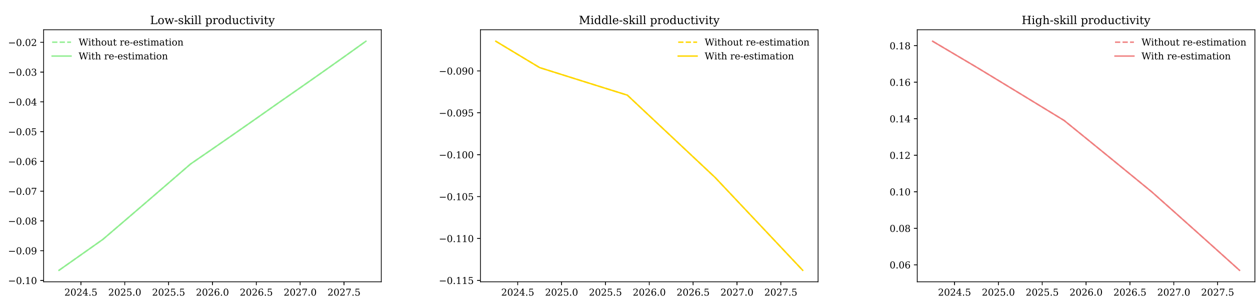


(a) Nominal interest rate (b) Spread

Figure 22: Estimated shocks $\{\varepsilon, \vartheta\}$. Before (dotted line) and after re-estimation (solid line)



(a) Disutility of working l (b) Disutility of working m (c) Disutility of working h



(d) Work efficiency l (e) Work efficiency m (f) Work efficiency h

Figure 23: Estimated shocks $\{A^s, \varphi^s\}_{s=l,m,h}$. Before (dotted line) and after re-estimation (solid line)

Panels (d) and (e) of Figure 23 show that the labor productivity of all low-skill and middle-skill employees declines over the forecast period. Panel (f) of Figure 23 shows that high-skill workers benefit from productivity gains. Concerning the labor-disutility, panel (a) of Figure 23 shows that its rise for low-skill workers whereas it is below zero for middle- and hight-skill workers. (see Panels (b) and (c) of Figure 23). This decrease in the disutility of labor corresponds to the increase in labor supply resulting from the gradual increase of the retirement age decided by the government for the middle- and hight-skill workers, whereas exception reduce labor supply of low-skill workers.

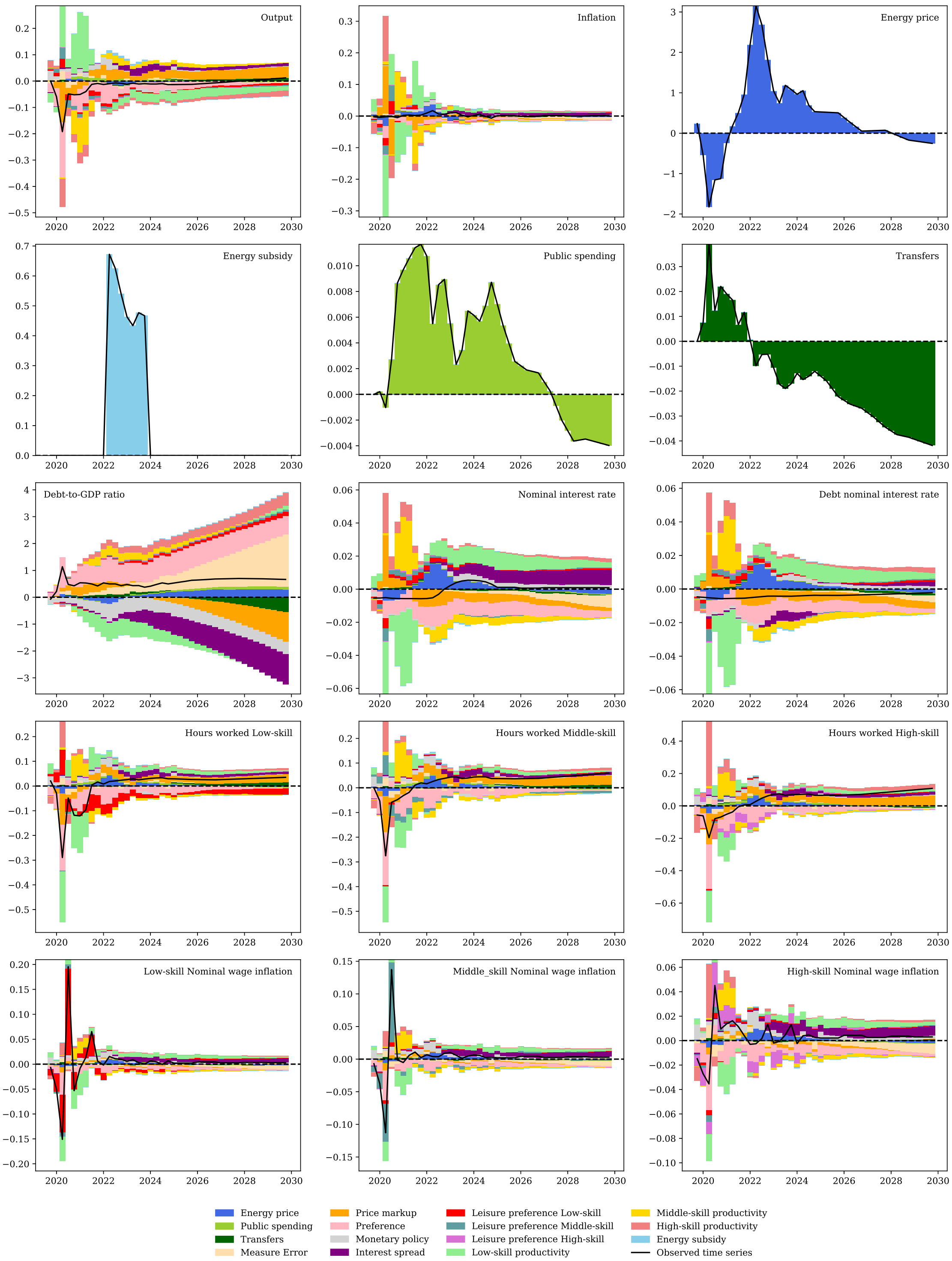


Figure 24: Shock Decomposition after re-estimation

Taken together, these shocks contribute to the dynamics of the variables, as illustrated in Figure 24. It is worth noting that preference and productivity shocks account for the COVID-19 crisis, as they capture the effects of containment measures (store closures affecting demand, and shutdowns of certain production centers impacting productivity). The oil price shock explains the surge in inflation and the contraction in activity during the Ukraine crisis. Finally, it should be noted that throughout the entire sample period, both firms' markups and the spread must remain consistently below their steady-state levels in order for the government's forecasts to materialize.