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Fiscal Multipliers and Liquidity Constraints: a HANK approach

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Abstract

Fiscal stimuli in the aftermath of COVID-19 were similar in size but generated different economic responses across countries. This paper studies the role of Poor Hand-to-Mouth and Wealthy Hand-to-Mouth agents in shaping fiscal multipliers, comparing a Heterogeneous Agents New Keynesian Model with one and two assets, to properly account for the correct share of liquidity-constrained agents. The findings suggest that multipliers are greater when the two-asset framework is employed, but only the share of Poor Hand-to-Mouth agents is significant to explain cross-country heterogeneity in multipliers. These results are robust to the multiplier choice, the shock financing and the monetary policy employed.

JEL Classification: D31, E12, E62, H31

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1 Introduction

It was late December 2019 and news about a disease were coming from Wuhan, in the Hubei province of China. Far was the world from knowing that a great pandemic, COVID-19, was spreading and creating unprecedented economic impacts. In the first quarter of 2020, many countries initiated full-scale lockdowns to protect lives and ensure the response capacity of national health systems. This came together with the greatest fiscal stimulus packages. National governments supported the economy, providing liquidity to households and firms, cutting taxes, or increasing public spending.

Despite the similarities between countries on the targeting and size of the fiscal packages, strikingly different economic responses occurred, with distinct GDP growth rates. This motivates the need to reassess why fiscal multipliers are so different across countries. In fact, ever since the verge of the Great Recession, more attention has been given to fiscal multipliers and which factors influence them. What is proposed in this paper is to study how agents' heterogeneity is influencing the size of the multipliers.

Heterogeneity in macroeconomics is a shining new avenue of research that has been emerging throughout the past decade. It has been used to study multiple phenomena from Investment Specific Technological Change (Brinca et al., 2019; Ferreira, 2020; Nóbrega, 2020) to carbon mitigation policies (Malafry and Brinca, 2022). In this paper, the stance taken on heterogeneity is in the spirit of Kaplan et al. (2014), with the distinction of the two types of Hand-to-Mouth behaviours. The Poor-Hand-to-Mouth (P-HtM) are defined as agents who hold no liquid or illiquid wealth, while the Wealthy-Hand-to-Mouth (W-HtM) are those who hold very little or no liquid wealth, despite holding sizeable amounts of illiquid assets. All the other agents are defined as Non-Hand-to-Mouth (N-HtM). Since these agents will have different responses in the face of transitory income shocks, this microeconomic heterogeneity will likely produce impacts on macroeconomic aggregates.

Brinca (2020) already synthesized some of the macroeconomic implications of microeconomic heterogeneity, including through the fiscal channel. In this paper, this connection is also intended to be studied, but with a different approach to heterogeneity and by using a New Keynesian framework to be able to capture the effects of wage and price rigidity in the analysis, as well as the role of

monetary policy. A Heterogeneous Agents New Keynesian (HANK) Model with one asset is first calibrated for 5 European economies - Austria (AT), Germany (DE), France (FR), Portugal (PT) and Slovakia (SK). In this specification, the different types of Hand-to-Mouth (HtM) households fail to be captured. While both agents are actually liquidity constrained, the one-asset approach considers the W-HtM as N-HtM agents. Consequently, there is a need to calibrate these economies also in a HANK model that features two assets with different liquidities and a portfolio adjustment cost, in the spirit of [Auclert et al. \(2018\)](#).

Doing so is significant, as misidentifying the W-HtM ignores a significant share of liquidity-constrained agents in the economy. Figure 1 below shows the share of the different types of households in the 5 economies calibrated, pointing out significantly large shares of agents which fall under the categorization of W-HtM. This data comes from the first wave of the Household Finance and Consumption Survey (HFCS). In particular, in some countries, the share of W-HtM agents is almost 9 times greater than the P-HtM.

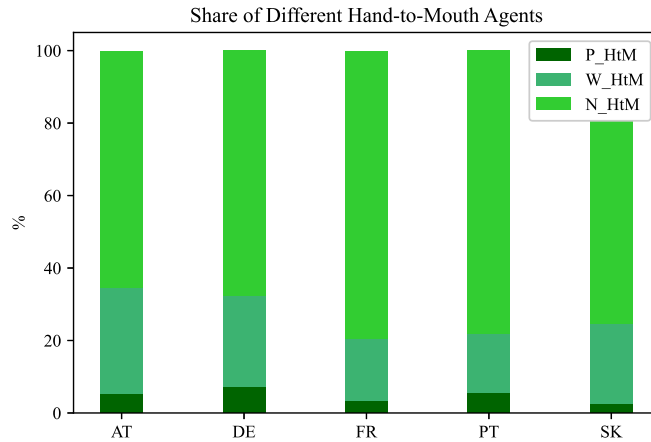


Figure 1: Share of Different Hand-to-Mouth Agents across the several countries analyzed: Austria (AT), Germany (DE), France (FR), Portugal (PT) and Slovakia (SK). This data was estimated using the Households Finance and Consumption Survey, as detailed in Section 4.

Computing the fiscal multipliers for each country in the two models yields several important conclusions. Firstly, fiscal multipliers are greater when the model is calibrated in the two-assets framework in comparison with the one-asset scenario, for every single country calibrated. This highlights how a higher proportion of liquidity-constrained agents increases the size of the multipliers,

in accordance with existing literature, which drew similar conclusions under different frameworks. Secondly, this cross-country analysis shows that only the share of Poor Hand-to-Mouth households seems to be quantitatively relevant in explaining differences across countries in the size of the fiscal multipliers. Thirdly, it is found that these results are robust when looking either at the impact multipliers or the cumulative multipliers, as well as robust to the choice of how the government spending shock is financed (either tax or deficit-financed) and to the Taylor Rule of the Central Bank, which responds only to inflation deviations in the baseline scenario and to inflation and output deviations in the extended specification. Finally, it is also found that cumulative multipliers are lower than impact multipliers, that deficit-financed impact multipliers are higher than tax-financed impact multipliers, and that a Taylor Rule that only responds to inflation generates higher multipliers overall.

The rest of the paper is organized as follows: in section 2, the relevant literature on what influences fiscal multipliers, on how household heterogeneity had been identified in the literature, and on how those two blocks connect is discussed. Then, in section 3, the one-asset and the two-asset HANK models employed are described. Next, in section 4 the calibrations used are explained. Then, section 5 presents the results of the fiscal experiments and, finally, section 6 concludes.

2 Literature Review

Since the 2008's crisis, a particular interest has been raised to study fiscal multipliers (Brinca et al., 2016; Brinca et al., 2019; Bernardino, 2020; Brinca et al., 2020; Brinca et al., 2021). Ramey (2019) showed how fiscal multipliers evolved since then and presented important distinctions between Neoclassical and New Keynesian Models. In the first category of models, there is a prediction of positive spending multipliers and negative tax multipliers. For spending multipliers, the increase in spending generates negative wealth effects that induce households to work more and thus raises GDP. As for tax multipliers, distortionary taxation can have amplifying channels through supply-side mechanisms. On the other hand, New Keynesian models, while sharing qualitatively the same predictions, have a completely different mechanism behind them, with the addition of heterogeneous agents generating different marginal propensities to consume among agents, because of different

asset holdings, affecting the size of multipliers. [Brinca \(2020\)](#) reviewed how the availability of more microdata and the demand for the departure of a representative agent framework has bolstered the usage of heterogeneous agents' frameworks, both Neoclassical and New Keynesian, and how those representations change the impacts of shocks on macroeconomic aggregates.

The question then poses on what drives fiscal multipliers. [Barrell et al. \(2013\)](#) used the National Institute Global Econometric Model (NiGEM) and found that, besides the differences in fiscal multipliers due to the different policy instruments employed and the way agents form expectations, the main forces explaining cross-country heterogeneity on multipliers include: i) the country size, ii) its openness to trade, and iii) the income elasticity of consumption. The authors also suggested that stronger liquidity constraints could make multipliers larger than usual, a connection that this paper aims at studying. [Ilizetzi et al. \(2013\)](#) used a SVAR approach and added that the degree of development, the exchange rate regime and the outstanding government debt also influence the size of fiscal multipliers. On its turn, [Alesina et al. \(2017\)](#) showed that for fiscal consolidation purposes, government spending or transfer cuts are less harmful than tax hikes, a result which held in a New Keynesian framework with Hand-to-Mouth agents.

[Brinca et al. \(2016\)](#) discovered a strong correlation between wealth inequality and the size of fiscal multipliers, using the data and methodology of [Ilizetzi et al. \(2013\)](#). Attempting to explain this finding, the authors developed a life cycle overlapping generations model with heterogeneous agents and uninsurable labour market risk and calibrated it to several OECD economies. They found that the magnitude of the multiplier is highly sensitive to the share of liquidity-constrained agents, as well as highly dependent on the average wealth of the economy. Greater liquidity-constrained agents exhibit higher marginal propensities to consume, responding greatly to fiscal shocks. Furthermore, wealth-poorer economies have high interest rates which imply higher fiscal responses. They also found that changing the progressivity of the tax system has little impact on the multiplier; however, [Santos \(2020\)](#) argued that labour income tax progressivity depresses fiscal multipliers, in the context of fiscal consolidation programs. [Rodrigues \(2020\)](#) also stresses the importance of the Frisch elasticity to explain cross-country differences in fiscal multipliers.

Finally, in [Brinca et al. \(2016\)](#), the authors also importantly acknowledge that their estimates for the multipliers are small in comparison with the ones from empirical exercises. In that sense, this paper suggests applying a New Keynesian framework. [Brinca et al. \(2019\)](#) were also able to reproduce the empirical findings that the relationship between the size of the fiscal stimulus and the fiscal multiplier is not linear, but rather increasing in size. This, however, is not consensual, since there is evidence that the fiscal multiplier decreases with the increase in the size of the stimulus ([Hagedorn et al., 2019](#)).

A positive association between a larger labour share and bigger fiscal multipliers on impact, regardless of the policy instrument, is also found by [Brinca et al. \(2020\)](#). [Brinca et al. \(2021\)](#) added to this literature by documenting a positive relationship between higher income inequality and stronger recessive impacts of fiscal consolidation programs. If cross-country inequality asymmetries are due to higher income risk, then agents would have a greater precautionary saving behaviour, reducing the share of credit-constrained agents. As such, since these agents' labour supply is less responsive to future income shocks, there will be a stronger output response. [Bernardino \(2020\)](#), using the distribution of total financial assets instead of net wealth, found that while fiscal expansions as in [Brinca et al. \(2016\)](#) exhibit a positive correlation between higher wealth inequality and bigger multipliers, fiscal consolidations exhibit the opposite relationship, as a greater wealth inequality produces smaller multipliers in absolute terms, because of the share of constrained agents in the economy.

Multiple studies have focused on strategies to identify liquidity-constrained agents. [Zeldes \(1989\)](#) had one of the earliest approaches to this issue, defining agents as constrained if they possessed a net worth or total wealth lower than two months of labour income. This approach was employed by [Jappelli \(1990\)](#), who used the 1983 Survey of Consumer Finances. This survey directly asks about whether households had their credit refused, at some point in their lives, or thought it might be turned down by financial intermediaries. Furthermore, [Grant \(2007\)](#) employed a model of credit constraints, separating the demand and supply of credit, and identifying constrained households as the ones who do not borrow as much as they would desire. With this strategy, the

author documents that 31% of the US population would be credit constrained, in the 90s.

Alternatively, in this paper, heterogeneity and liquidity constraints are accounted for in the spirit of [Kaplan et al. \(2014\)](#), who presented a new distinction between Hand-to-Mouth and Non-Hand-to-Mouth agents, arguing for the importance of distinguishing between the Poor-Hand-to-Mouth (P-HtM) and the Wealthy-Hand-to-Mouth (W-HtM), and thus grouping agents into 3 categories, with different marginal propensities to consume out of transitory income shocks. The W-HtM hold few or no liquid assets but have positive net holdings of illiquid assets. The authors theoretically showed how this behaviour can occur, when households face a trade-off between the long-run gains of investing in illiquid assets (that pay higher returns but face a transaction cost) and the short-run consumption smoothing costs of holding fewer liquid assets. Empirically, they found these households represent a considerable share of the population and had distinguished features in comparison with the P-HtM. Hence, despite the W-HtM having similar consumption responses as the P-HtM, they have very different demographic characteristics and portfolio compositions. This motivates the need to move to two-asset models that allow the different liquidities of the assets to represent the features of P-HtM, W-HtM and N-HtM, as is done in this paper. [Aguiar et al. \(2020\)](#) have estimated the share of these agents for the United States, while [Ampudia et al. \(2018\)](#) and [Slacalek et al. \(2020\)](#) have done so for the Euro Area, despite with different definitions of liquid wealth, which still gave rise to similar conclusions on the prevalence of these households.

[Kaplan and Violante \(2014\)](#) used this exact distinction in a life-cycle model with 2 assets (liquid and illiquid) and an adjustment cost, to assess fiscal stimulus, finding that agents with very high MPCs (close to 50%) show high consumption responses to temporary changes in income. [Kaplan and Violante \(2018\)](#) also showed how in a New Keynesian setting this distinction generates stronger and closer-to-reality MPCs. These different responses relate exactly to the fact that P-HtM and W-HtM agents may be responding at their borrowing constraint, not being able to smooth consumption.

In this discussion of MPC heterogeneity, [Carroll et al. \(2017\)](#) used heterogeneity in agents' time preferences to generate more or less patient households. This generates wealth inequality

and different marginal propensities to consume among agents. The authors then showed how the aggregate responses to transitory income shocks are highly dependent on which households bear the shock, and thus react with different MPCs. On another approach to the same issue, [Christelis et al. \(2019\)](#) used a survey of Dutch households to find an empirical distribution of MPCs. Their results showed that the MPC is larger for negative income shocks and for poorer households. Moreover, in the presence of liquidity constraints, the MPC is much larger for negative income shocks than for positive ones and is also dependent on the size of the shock. Large income increases make liquidity-constrained consumers more likely to overcome the constraint and thus exhibit lower MPCs, whereas for negative income shocks the MPC should be 1, irrespective of the size of the shock.

This has implications for fiscal multipliers. [Sá \(2022\)](#) made use of an overlapping generations model with heterogeneous agents, calibrated to match empirical estimations of the share of Hand-to-Mouth agents, and while the author found that the share of these agents is not quantitatively relevant to explain cross-country heterogeneity in fiscal multipliers, he acknowledged the importance of considering a model with two asset types (liquid and illiquid) to properly represent the Wealthy-Hand-to-Mouth agents, allowing a better assessment of the role of liquidity constraints. This is precisely what is done in this paper. However, it is worth stressing that the results are not comparable, as a New Keynesian framework is employed.

[McKay and Reis \(2016\)](#) early analyzed fiscal policy in such a framework but focused more on the role of automatic stabilizers. It is, nonetheless, with [Kaplan et al. \(2018\)](#) that HANK models become more popularized, in a paper where the authors focused on the transmission mechanisms of monetary policy. Later, [Hagedorn et al. \(2019\)](#) measured the size of multipliers in a heterogeneous agents, incomplete markets and nominal rigidities framework, where they documented the importance of market incompleteness and of the response of monetary policy for the size of multipliers, which are greater if they are deficit instead of tax-financed. [Broer et al. \(2021\)](#) also discussed important factors that influence fiscal multipliers in a HANK framework, finding that the distribution of factor incomes and the source of nominal rigidities (sticky wages or sticky prices) are key determinants of the size of fiscal multipliers.

Finally, in close relation to this work, [Guo et al. \(2023\)](#) uses a local projections method and data for 20 European countries to find that a higher share of Hand-to-Mouth households enhances fiscal multipliers, as liquidity constraints positively influence the size of the multipliers. The authors found that the size of tax multipliers is more amplified by the W-HtM, whereas government spending multipliers are more amplified by P-HtM households. This result carries important policy recommendations for which fiscal stimulus to choose, in accordance with the composition of the HtM households in each economy. This seems to confirm earlier evidence on how liquidity constraints bolster the size of multipliers ([Galí et al., 2007](#); [Bilbiie et al., 2008](#); [Oh and Reis, 2012](#)).

The advantage of the methodology that is being employed in this paper is that, firstly, in opposition with empirical studies such as the one of [Guo et al. \(2023\)](#), which tend to only capture correlations in the data, this study aims at capturing the causal relationship between liquidity constrained agents and the size of fiscal multipliers. Secondly, this is one of few studies which compare a one-asset with a two-asset model, thus capturing the effect of accounting for the proper share of liquidity-constrained agents.

3 Model

In this section, the Heterogeneous Agent New Keynesian (HANK) model used in this paper is described, following [Auclert et al. \(2018\)](#). Agents are infinitely lived, facing an uninsurable idiosyncratic income risk, for which they can save using two types of assets – a liquid and an illiquid one – with different levels of return, such that the return on the illiquid asset exceeds that of the liquid one. Households are induced to accumulate higher amounts of liquid assets, due to precautionary and consumption-smoothing motives. In the presence of an income shock, if a given household is in shortage of liquid wealth, it may retrieve funds from its illiquid wealth, but incurring in a portfolio adjustment cost.

In that sense, households choose in each period how much to consume and save, deriving utility from consumption and disutility from working. In the one-asset model specification that is also employed, there is only one type of liquid asset that aggregates both measures of wealth. This

implies only a slight modification in the household problem, which is to be detailed below. The model also features sticky wages and a number of hours worked defined by a union labour demand. Finally, monetary policy follows a standard Taylor rule, and the government balances its budget.

3.1 Households

A mass of heterogeneous agents populates this economy, facing idiosyncratic uncertainty, in the form of an uninsurable idiosyncratic income risk $e(s)$. At state s , the household faces a fixed transition matrix Π , with a mass of households equal to π_s , such that $\sum_s \pi_s e(s) = 1$. Given their state, they choose consumption and saving, which can be done in two different assets: the liquid, b_t with return r_t^b , and the illiquid one, a_t with return r_t^a . The different returns capture the liquidity and risk differences between the two assets, such that the higher risk of the illiquid one implies that $r_t^a > r_t^b$. Changing the allocations between the two assets incurs into a convex portfolio adjustment cost $\Phi_t(a_{it}, a_{it-1})$, with $\chi_0, \chi_1 > 0$ and $\chi_2 > 1$:

$$\Phi_t(a_{it}, a_{it-1}) = \frac{\chi_1}{\chi_2} \left| \frac{a_{it} - (1 + r_t^a) a_{it-1}}{(1 + r_t^a) a_{it-1} + \chi_0} \right|^{\chi_2} [(1 + r_t^a) a_{it-1} + \chi_0] \quad (1)$$

Households work the same number of hours, with n being determined by unions, and are paid an individual after-tax wage of $y_t \equiv Y_t e(s)$, where $Y_t \equiv (1 - \tau_t) \omega_t N_t$. Households' utility is dependent on consumption, c , and working time, n , given by:

$$U(c, N) = \frac{c_{it}^{1-\sigma}}{1-\sigma} - \varphi \frac{N_t^{1+\eta}}{1+\eta}$$

where φ captures the disutility of work, and η denotes the Frisch elasticity of labor supply. The utility function is of the CRRA type, in order to produce a balanced growth path. Taking this into account, the household problem can be summarized by the following Bellman equation:

$$V_t(e_{it}, b_{it-1}, a_{it-1}) = \max_{c_{it}, b_{it}, a_{it}} \{U(c, N) + \beta \mathbb{E}_t V_{t+1}(e_{it+1}, b_{it}, a_{it})\}$$

s.t.

$$c_{it} + a_{it} + b_{it} = (1 - \tau_t) w_t N_t e_{it} + (1 + r_t^a) a_{it-1} + (1 + r_t^b) b_{it-1} - \Phi_t(a_{it}, a_{it-1}) \quad (2)$$

$$a_{it} \geq 0, \quad b_{it} \geq \underline{b}$$

In the one-asset model, the only difference is that the single asset type that is held by households can be viewed as a portfolio of the two previous assets, $h_t = \{a_t, b_t\}$, which are now indistinguishable from each other, meaning there is no portfolio adjustment cost. As such, the equations of the model are the same as the ones presented here, abstracting from the differences in asset types and the portfolio adjustment cost. The Bellman equation for the one-asset model can thus be written as:

$$V_t(e_{it}, h_{it-1}) = \max_{c_{it}, h_{it}} \{U(c, N) + \beta \mathbb{E}_t V_{t+1}(e_{it+1}, h_{it})\}$$

s.t.

$$c_{it} + h_{it} = (1 - \tau_t) w_t N_t e_{it} + (1 + r_t) h_{it-1} \quad (3)$$

$$h_{it} \geq 0$$

3.2 *Financial Intermediary*

A financial intermediary issues the assets. Its two main activities are to collect liquid short-term deposits and invest them in government debt, B_t , (banking activity) and to collect illiquid wealth and invest it into government bonds, B_t^g , and firm equity, p_t , (fund activity). Such liquidity transformation implies a cost of $\omega \int b_{it} di$. The financial intermediary seeks to maximize the expected return on illiquid liabilities, $\mathbb{E}_t [1 + r_{t+1}^a]$, which requires the imposition of a non-arbitrage condition. In equilibrium, the ex-ante return, $\mathbb{E}_t [1 + r_{t+1}]$, must equal the expected returns on nominal government bonds and equity. The returns pass on to households, accounting for the intermediation costs:

$$\mathbb{E}_t [1 + r_{t+1}] = \frac{1 + i_t}{\mathbb{E}_t [1 + \pi_{t+1}]} = \frac{\mathbb{E}_t [d_{t+1} + p_{t+1}]}{p_t} = \mathbb{E}_t [1 + r_{t+1}^a] = \mathbb{E}_t [1 + r_{t+1}^b] + \omega \quad (4)$$

The ex-post returns r_t , r_t^a and r_t^b are still subject to inflation and capital gains. Assuming, as in [Auclert et al. \(2021\)](#), that capital gains accrue to the illiquid account, the Fisher Equation is reached:

$$1 + r_t = \frac{1 + i_{t-1}}{1 + \pi_{t-1}} = 1 + r_{t-1}^b + \omega \quad (5)$$

and

$$1 + r_t^a = \Theta_p \left(\frac{d_t + p_t}{p_{t-1}} \right) + (1 - \Theta_p) (1 + r_t) \quad (6)$$

where Θ_p denotes the share of equity in the illiquid portfolio. Equation 6 reveals how the return on the illiquid asset is an average of firm equity and dividends, and capital returns.

3.3 Firms

A competitive final goods firm and monopolistically competitive firms that produce a continuum of intermediate goods, j , compose this economy. Intermediate goods firms have a standard Cobb-Douglas production function, where α denotes the capital share:

$$Y_{jt} = AK_{jt}^\alpha N_{jt}^{1-\alpha} \quad (7)$$

Firms maximize profits by choosing their capital stock, subject to a quadratic adjustment cost $\zeta\left(\frac{K_{jt}}{K_{jt-1}}\right)K_{jt-1}$, where $\zeta(x) \equiv x - (1 - \delta) + \frac{1}{2\delta\epsilon_l}(x - 1)^2$. Firms set the price of their product, p_{jt} , subject to an adjustment cost of:

$$\psi_t^P(p_{jt}, p_{jt-1}) = \left(\frac{\mu_p}{\mu_p - 1} \right) \left(\frac{1}{2\kappa_p} \right) [\log(p_{jt}/p_{jt-1})]^2 Y_t$$

However, a small fraction of firms do not adjust their price index to the previous period inflation, hence their price is:

$$P_{jt} = \Pi_{t-1} P_{j,t-1} \quad (8)$$

with $\Pi_{t-1} \equiv \frac{P_{t-1}}{P_t}$. As such, the optimal price-setting of firms yields an indexed Phillips curve given by equation 9:

$$\log(1 + \pi_t) = \kappa_p \left(\frac{w_t}{F'_N(K_{t-1}, N_t)} - \frac{1}{\mu_p} \right) + \frac{1}{1 + r_{t+1}} \frac{Y_{t+1}}{Y_t} \log(1 + \pi_{t+1}) \quad (9)$$

where $w_t/F'_N(K_{t-1}, N_t)$ denotes the marginal cost mc_t . Note that the slope of Phillips curve, κ_p , is given by $\kappa_p = \frac{(1-\beta\lambda_p)(1-\lambda_p)}{\lambda_p}$, where λ_p is the Calvo price parameter. If prices were fully flexible, $\lambda_p = 0$, and all firms set the same price, a constant markup over the marginal costs, $\frac{\mu_p}{\mu_p - 1}$. Since aggregate investment can be summarized as $I_t = K_t - (1 - \delta)K_{t-1} + \zeta\left(\frac{K_{jt}}{K_{jt-1}}\right)K_{jt-1}$ and dividends as

$d_t = Y_t - \omega_t N_t - I_t - \psi_t$, the capital stock accumulation equation is reached:

$$(1 + r_{t+1}) Q_t = \alpha \frac{Y_{t+1}}{K_t} m c_{t+1} - \left[\frac{K_{t+1}}{K_t} - (1 - \delta) + \frac{1}{2\delta\epsilon_I} \left(\frac{K_{t+1} - K_t}{K_t} \right)^2 \right] + \frac{K_{t+1}}{K_t} Q_{t+1} \quad (10)$$

where Q_t is the Tobin's Q ratio, $Q_t = 1 + \frac{1}{\delta\epsilon_I} \frac{K_t - K_{t-1}}{K_{t-1}}$.

3.4 Labor Unions

As is standard to New Keynesian modelling with sticky wages, households' working hours, n_{it} , are determined by the union labour demand. Let there be a continuum of unions, k , with each labour type wage set by its respective different labour union. At a certain time, each union asks its members to supply hours of labour according to $n_{ikt} = N_{ikt}$, setting wages to maximize households' average utility, given their consumption-saving decisions. Nonetheless, setting a nominal wage, W_{kt} , implies incurring into a quadratic adjustment cost, similar to the price adjustment cost of firms:

$$\psi_t^w (W_{kt}, W_{kt-1}) = \left(\frac{\mu_w}{\mu_w - 1} \right) \left(\frac{1}{2\kappa_w} \right) [\log (W_{kt}/W_{kt-1})]^2$$

The union maximization problem then yields a Phillips curve for wage inflation:

$$\log (1 + \pi_t^w) = \kappa_w \left(\varphi N_t^{1+\eta} - \frac{(1 - \tau_t) w_t N_t}{\mu_w} \int e_{it} c_{it}^{-\sigma} di \right) + \beta \log (1 + \pi_{t+1}^w) \quad (11)$$

where κ_w represents the slope of the wage Phillips curve, such that $\kappa_w = \frac{(1-\beta\lambda_w)(1-\lambda_w)}{\lambda_w}$ and λ_w is the Calvo wage parameter. If wages were fully flexible, $\lambda_w = 0$, and all unions set the inverse wage markup to $\frac{\mu_w - 1}{\mu_w}$.

3.5 Fiscal and Monetary Policies

The government collects a proportional tax on labour income, $\tau_t w_t N_t$, spends on goods and services, G_t , and issues bonds, B^g , such that its budget constraint is balanced in every period:

$$\tau_t w_t N_t = r_t B^g + G_t \quad (12)$$

In its turn, the monetary authority follows a standard Taylor rule to set the nominal interest rate, i_t :

$$i_t = r_t^* + \phi_\pi \pi_t + \phi_y (Y_t - Y_{ss}) \quad (13)$$

where r_t^* is the optimal real interest rate, $Y_t - Y_{ss}$, is the output gap, and ϕ_π and ϕ_y are, respectively, the Taylor rule coefficient on inflation and on output¹.

3.6 *Equilibrium*

Given a distribution of agents, the competitive equilibrium may be summarized as follows:

1. Taking factor prices and initial conditions as given, households solve their maximization problem, using the value function $V_t(e_{it}, b_{it-1}, a_{it-1})$ and the respective policy functions, $c(e_{it}, b_{it-1}, a_{it-1})$, $b'(e_{it}, b_{it-1}, a_{it-1})$ and $a'(e_{it}, b_{it-1}, a_{it-1})$.
2. The financial intermediary, firms and labor unions optimize their decisions.
3. Fiscal and monetary authorities follow their rules.
4. Asset market clears, meaning total savings by households equal the value of firm equity and government bonds:

$$p_t + B^g = \int a_{it} di + \int b_{it} di$$

5. Goods market clears when the final good is used for private and public consumption, investment, price adjustment costs, liquidity transformation costs and portfolio adjustment costs:

$$Y_t = \int c_{it} di + G_t + I_t + \psi_t + \omega \int b_{it} di + \int \Phi_t(a_{it}, a_{it-1}) di$$

3.7 *Fiscal Experiment and Transition*

The same fiscal experiment is employed in both model specifications. With the economy initially at its steady-state equilibrium, the government, without any announcement, increases spending, G , with a degree of persistency of $\rho_G = 0.7$, as in [Auclert et al. \(2018\)](#), which is in the usual range of estimates (further see [Davig and Leeper, 2011](#); or [Nakamura and Steinsson, 2014](#)). This fiscal expansion can either be financed by raising the proportional tax on labour income such that the deficit of the government remains at zero, or it can be financed by increasing the deficit. In that case, there is a shock to government bonds, such that the government runs a deficit in the early periods to finance its increased spending. This is done with the same persistency as the G shock,

¹In fact, as it will be detailed in section 4, the baseline scenario employed considers a Taylor Rule which only responds to changes in inflation. Nonetheless, as a robustness check to the results of this paper, a Taylor Rule which responds to both inflation and output deviations is also employed.

that is $\rho_B = 0.7$, as in [Auclert et al. \(2018\)](#). Then, the economy converges back to a steady state.

3.8 Definition of the Fiscal Multiplier

The impact and cumulative multipliers are defined according to [Brinca et al. \(2021\)](#):

$$\text{Impact Multiplier} = \frac{\Delta Y_0}{\Delta G_0} \quad (14)$$

where ΔY_0 is the change in output from period 0 to period 1, and ΔG_0 the change in government spending from period 0 to period 1.

$$\text{Cumulative Multiplier} = \frac{\sum_{t=0}^{t=T} (\prod_{s=0}^{s=T} \frac{1}{1+r_s}) \Delta Y_t}{\sum_{t=0}^{t=T} (\prod_{s=0}^{s=T} \frac{1}{1+r_s}) \Delta G_t} \quad (15)$$

where ΔY_t is the change in output from period 0 to period t , and ΔG_t the change in government spending from period 0 to period t .

4 Calibration

This model is calibrated for five Euro Area economies: Austria (AT), Germany (DE), France (FR), Portugal (PT) and Slovakia (SK). There are a set of parameters which vary across countries and others held constant, according to the literature. A set of other parameters which do not have any empirical counterpart are endogenously calibrated in the models for each economy, using a computational strategy proposed by [Auclert et al. \(2021\)](#). The detailed values of the parameters may be found in [Appendix A](#).

4.1 Calibration targets

A set of parameters are empirically estimated for each economy and are then calibration targets of the models. These parameters include the share of P-HtM and W-HtM, the liquid and illiquid wealth-to-GDP ratios, and the capital-to-output ratio. When the one-asset model specification is employed instead of the two-asset one, the differences are that there is no distinction between liquid and illiquid wealth (and thus the model is calibrated for the sum of those two values) and there is no way to identify the W-HtM, meaning the only hand-to-mouth agents considered are the P-HtM.

The estimates for hand-to-mouth agents are taken from [Sá \(2022\)](#), which are obtained by replicating the methodology of [Kaplan et al. \(2014\)](#). Households are split between HtM and N-HtM, depending on the net liquid asset holdings. The HtM (which are the ones who hold virtually no net liquid wealth) are then further split into W-HtM (if they hold positive amounts of liquid assets) and P-HtM (if they do not).

The data used comes from the first wave of the Household Consumption and Finance Survey (HCFS). This is a joint project of the Euro Area central banks and national statistical agencies, providing the 15 euro area members with consolidated information on household balance sheets and related economic and demographic variables, including income, private pensions, employment, consumption measures and gifts and heritage. The sample includes more than 62,000 households and its first wave was carried out between late 2008 and mid-2011, although most countries collected data in 2010.

The liquid and illiquid assets in each country are estimated based on [Sierminska and Medgyesi \(2013\)](#) also using the data from the first wave of the HCFS. The authors report the mean liquid and illiquid wealth in each economy, defining liquid wealth as financial assets (including deposit accounts, stocks, bonds, mutual funds and life insurance) less liabilities; and illiquid wealth as housing (principal residence and investment real estate) less mortgages and other home-secured debt, plus self-employment business. These averages report mostly from surveys conducted in 2010. As such, by using population data for each country in 2010 and the constant prices GDP of that year², the variables are transformed as total liquid and illiquid assets to GDP ratios.

Finally, the capital-to-output ratios are calculated from the Penn World Table 8.0 (PWT 8.0), using the average from 1990 to 2011. All these values may be found in [Appendix A](#).

4.2 Parameters held constant across countries

A set of parameters are held constant across countries, based on their literature values. These parameters include the inverse of the income elasticity of substitution, σ , the inverse of the Frisch elasticity, η , the portfolio adjustment cost curvature, χ_2^3 , the borrowing limit, \underline{b} , the autocorrelation

²Data for population and constant prices GDP come from the World Bank database.

³This parameter, naturally, does not exist in the one-asset framework.

of earnings, ρ_z , the share of equity in the illiquid portfolio, Θ_p , the depreciation rate, δ , the slope of the price Phillips curve, κ_p , the slope of the wage Phillips curve, κ_w , the steady-state wage markup, μ_w , the government spending ratio, G , and the Taylor Rule coefficients on inflation, ϕ_π , and output, ϕ_y . The values were mostly chosen based on [Auclert et al. \(2021\)](#) and [Auclert et al. \(2018\)](#).

4.3 *Parameters calibrated endogenously*

A set of parameters which do not have any empirical counterpart are endogenously calibrated for each country. These parameters are written in the code as a set of unknowns which are computationally found to achieve the target parameters for each calibrated economy. In the one-asset model specification, these parameters are the discount factor, β , and the standard deviation of earnings, σ_z . For the two-asset model specification⁴, these previous two parameters are used for the calibration, as well as new parameters related to the portfolio adjustment cost function, namely the portfolio adjustment cost pivot, χ_0 , and the portfolio adjustment cost scale, χ_1 , as well as the liquidity premium, ω . These parameters, therefore, vary across countries to allow the calibration target of the shares of Hand-to-Mouth agents, the liquid and illiquid wealth, and the capital-to-output ratios, which were empirically estimated for each economy.

4.4 *Computational strategy*

For solving the model, the Sequence-Space Jacobian approach, proposed by [Auclert et al. \(2021\)](#) is followed. The main idea is that the authors write the equilibrium as a system of linear equations in the space of perfect-foresight sequences, which is called the sequence space. The system size, being independent of the state space size, allows the usage of this approach to solve and estimate models featuring rich heterogeneity. The key feature of their methodology is precisely the sequence-space Jacobians, which are derivatives of equilibrium mappings between aggregate sequences around the steady state. These Jacobians summarize all aspects of the model which are relevant to find the general equilibrium. Then, by computing all the relevant sequence-space Jacobians, they can then be composed and inverted to obtain the full set of impulse responses.

⁴When computationally required, the value of the autocorrelation of earnings, ρ_z , was allowed to change between a small range. More details are shown in [Appendix A](#)

In the code, a set of unknown inputs, the endogenously calibrated parameters (which have to start with a given guess), are chosen for achieving the set of calibration targets of the model. This numerical method allows for achieving the solutions for the one-asset model in a very short period of time. However, for the two-asset model, since more calibration targets are featured, the process requires a continuous update of the guesses to slowly approach the final targets.

5 Results

In this section, the results obtained from the fiscal experiments described before are analyzed. The focus is to compare the results from the one-asset model (where only the P-HtM agents are identified) and the two-asset model. That is done using both the impact and the cumulative 3-period government spending multipliers and changing the way that the government spending shock is financed (either by immediately raising taxes or by first running a deficit). Since the economies studied are all part of the Euro Area, the baseline specification is that the central bank only responds to inflation fluctuations. However, the case where the Taylor Rule responds to both inflation and output deviations is also analyzed. The multipliers computed are reported in detail in Appendix B.

5.1 *Inspecting the mechanisms*

Before looking at the multipliers obtained from the fiscal experiments, it is important to explain the mechanisms behind the results. To understand them, it is relevant to look at the Impulse Response Functions, which are reported in Appendix E.

A government spending shock directly affects households' budget constraint, by making them feel poorer, as that shock will have to be financed either by raising the proportional taxes on labour income or by issuing debt. This will imply two different effects on households' labour and leisure decisions - on one hand, an income effect makes households feel poorer and thus they will want to supply more labour to compensate for the income loss, but on the other hand, a substitution effect makes each unit of work supplied yield less utility and thus would bolster households to supply less work. What can be seen from the IRFs is that the income effect dominates and households supply a

higher amount of labour. This makes sense, especially when considering that there is a percentage of credit-constrained agents, which are already on suboptimal consumption decisions and thus try to avoid income losses by supplying more units of labour.

Private consumption, nonetheless, will still decrease, as households lost income. This is a crowding-out effect of increasing government spending, which we can see to be lower when the two-asset specification is employed. This is because a higher percentage of credit-constrained agents (the W-HtM) are being identified, who are also in a suboptimal consumption decision. The crowding-out effect is thus lower, the higher the share of hand-to-mouth agents.

The drop in consumption is however lower than the increase in government spending, which means that aggregate demand will be boosted, making firms produce more and employ more workers, given households' decision to supply more hours of work, and decrease the markups to accommodate higher demand when they are not able to increase prices. However, a percentage of firms is still able to increase prices, which will generate higher inflation.

With higher inflation and higher output than the target of the Central Bank, it responds by increasing nominal interest rates. This increase will be greater if the Taylor Rule responds to both output and inflation deviations than just to inflation (as is the baseline scenario). This increase in interest rates will not allow output to increase as much, by influencing the saving and investment decisions of households and firms. In the end, it is expected that multipliers are greater in the two-asset model specification, where the W-HtM are accounted for, and to increase across countries that have a higher share of Hand-to-Mouth agents.

5.2 Fiscal Multipliers and Hand-to-Mouth agents

Bearing in mind the mechanisms explained before, fiscal multipliers are plotted for the several countries against the different shares of Poor Hand-to-Mouth, Wealthy Hand-to-Mouth and Total Hand-to-Mouth agents in the two models, in Figure 2.

Firstly, what can be seen from Figure 2 is that the two-asset model multipliers are always greater than the one-asset model ones, for all countries studied. This suggests that accounting for these agents is significant for determining the appropriate size of the multipliers, which can be up to 9%

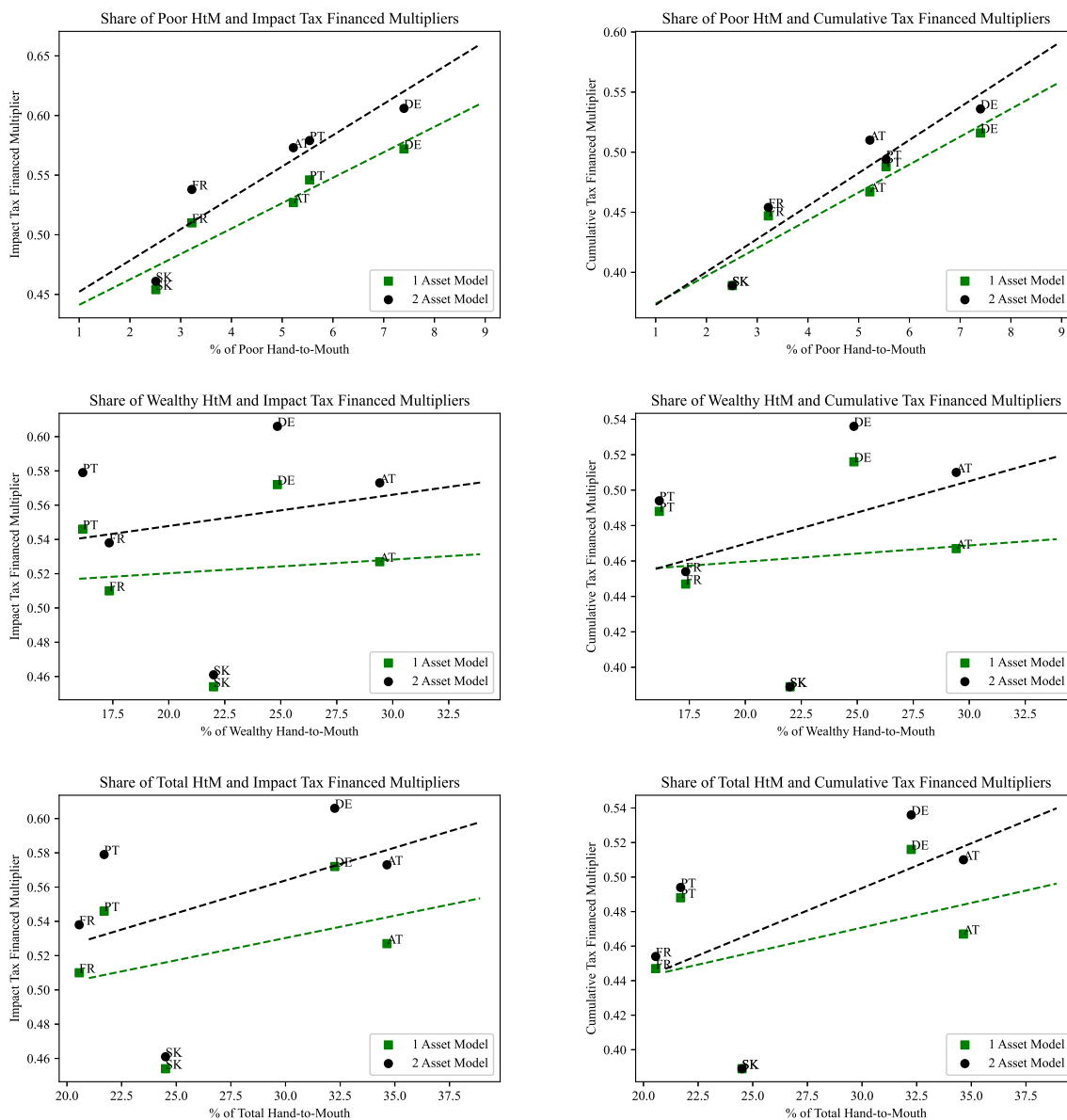


Figure 2: Fiscal multipliers (tax-financed) computed in the two model specifications for the several economies calibrated. On the left-hand side, the impact multipliers are plotted against the share of P-HtM, W-HtM and Total HtM agents that are calibrated in each economy. On the right-hand side, the same thing is shown, but for the 3 periods cumulative multipliers. Note that the one-asset model, despite being plotted against the W-HtM and the Total HtM agents, is only calibrated for the share of P-HtM agents, since those are the only ones captured in a one-asset model. The Pearson correlation coefficients, with the respective p-values in brackets, for the one asset and two asset model results, from left to right, starting at the upper left plot, are respectively: 0.938 (0.019) and 0.914 (0.03), 0.944 (0.016) and 0.934 (0.02), 0.099 (0.875) and 0.178 (0.775), 0.104 (0.867) and 0.337 (0.58), 0.373 (0.537) and 0.433 (0.466), 0.379 (0.529) and 0.576 (0.309).

higher than what is estimated when looking just at one group of Hand-to-Mouth agents.

Regarding cross-country differences in the fiscal multipliers, it can be seen that the share of P-HtM agents seems to have a much stronger explanatory power, either considering the impact or the cumulative multiplier. A higher share of these agents is associated with a statistically significant

higher multiplier. The fact that the share of W-HtM has no explanatory power in cross-country differences in the multipliers in the one-asset model is expected - that model completely ignores that share of agents. However, in the two-asset model, these agents do not seem to have much explanatory power either. The reason behind this might be that since these agents already hold savings in the form of illiquid wealth they are able to rebalance their portfolio and, as such, there is a weaker income effect, which translates into a lower impact on labour demand and, consequently, a weaker output response. When considering the total share of HtM agents, the results are also not statistically significant, but with correlation coefficients higher than when looking just at the W-HtM. This finding is in line with the ones from [Guo et al. \(2023\)](#) who found that government spending multipliers are more amplified by the P-HtM households.

Moreover, cumulative multipliers are lower than impact multipliers, which is in line with the findings of [Auclert et al. \(2018\)](#). This can be explained by the fact that agents are having stronger responses in the first period, anticipating the persistence of the government spending shock.

5.3 Tax-financed and deficit-financed multipliers

This subsection focuses on analyzing whether the results obtained hold when considering deficit-financed multipliers, instead of tax-financed ones. The tax-financed multipliers can be seen in [Figure 2](#), and the deficit-financed ones are now plotted in [Figure 3](#).

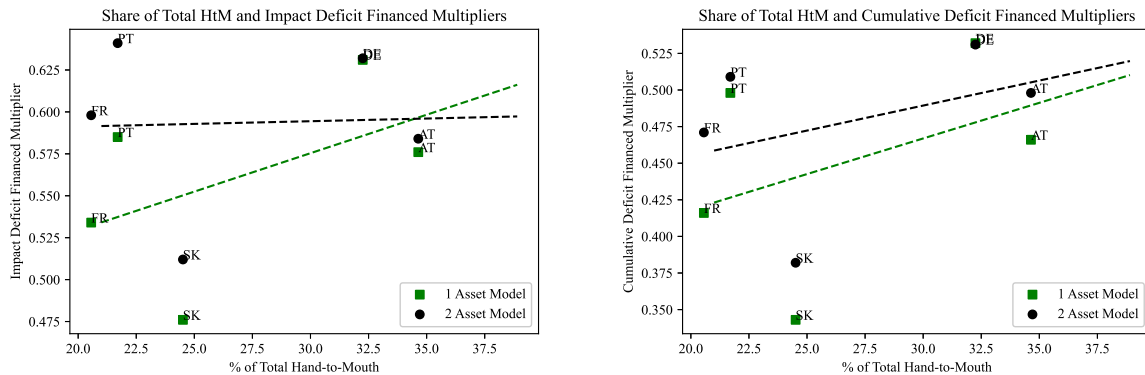


Figure 3: Deficit-financed fiscal multipliers computed in the two model specifications for the several economies calibrated. On the left-hand side, the impact multipliers are plotted against the share Total HtM agents. The same thing is shown on the right-hand side but for the 3 periods cumulative multipliers. The Pearson correlation coefficients, with the respective p-values in brackets, for the one-asset and two-asset model results, are respectively: 0.498 (0.393) and 0.04 (0.949) for impact multipliers and 0.418 (0.484) and 0.374 (0.535) for cumulative multipliers.

The conclusions drawn before seem to hold: the two-asset model generates higher multipliers

across countries when compared with the one-asset model, but these differences are not statistically significant to explain cross-country differences in the size of the multipliers. As such, it seems that the financing choice of the government spending shock is not relevant for these purposes.

However, a closer look allows for further insights into the size of these multipliers, in comparison with the tax-financed ones. Considering impact multipliers, it can be seen that tax-financed multipliers are always lower than deficit-financed ones, which makes sense as the drop in private consumption is lower when taxes are not immediately raised. However, if we consider cumulative multipliers, it is no longer the case, as the increase in taxation begins to be reflected in agents' decisions.

In Appendix C, plots that compare the two multipliers for each model specification are shown, for a better understanding of this relationship.

5.4 *The role of monetary policy*

As a final robustness exercise, the two models were recalibrated for a different Taylor Rule specification that responds not only to inflation deviations but also to output ones. This would be a more US-style approach to monetary policy, which is why the baseline scenario (since the economies studied are in the Euro Area) uses a Taylor Rule that only responds to inflation deviations. The results obtained with this different specification are shown in Figure 4.

As in the previous subsection, the results obtained before seem to hold: the two-asset model generates higher multipliers across countries when compared with the one-asset model, but these differences are not statistically significant to explain cross-country differences in the size of the multipliers. Note, however, that the statistical significance increases in the two-asset model specification but decreases in the one-asset model. As such, it seems that the choice of the Taylor Rule is not relevant for these purposes.

Despite that, a closer comparison between the multipliers that are obtained with the different Taylor Rules gives further insights. Under a Taylor Rule that only responds to inflation deviations, multipliers are higher than if the Central Bank responds to both output and inflation deviations. The reason for that is simple - since a government spending shock causes an increase in inflation

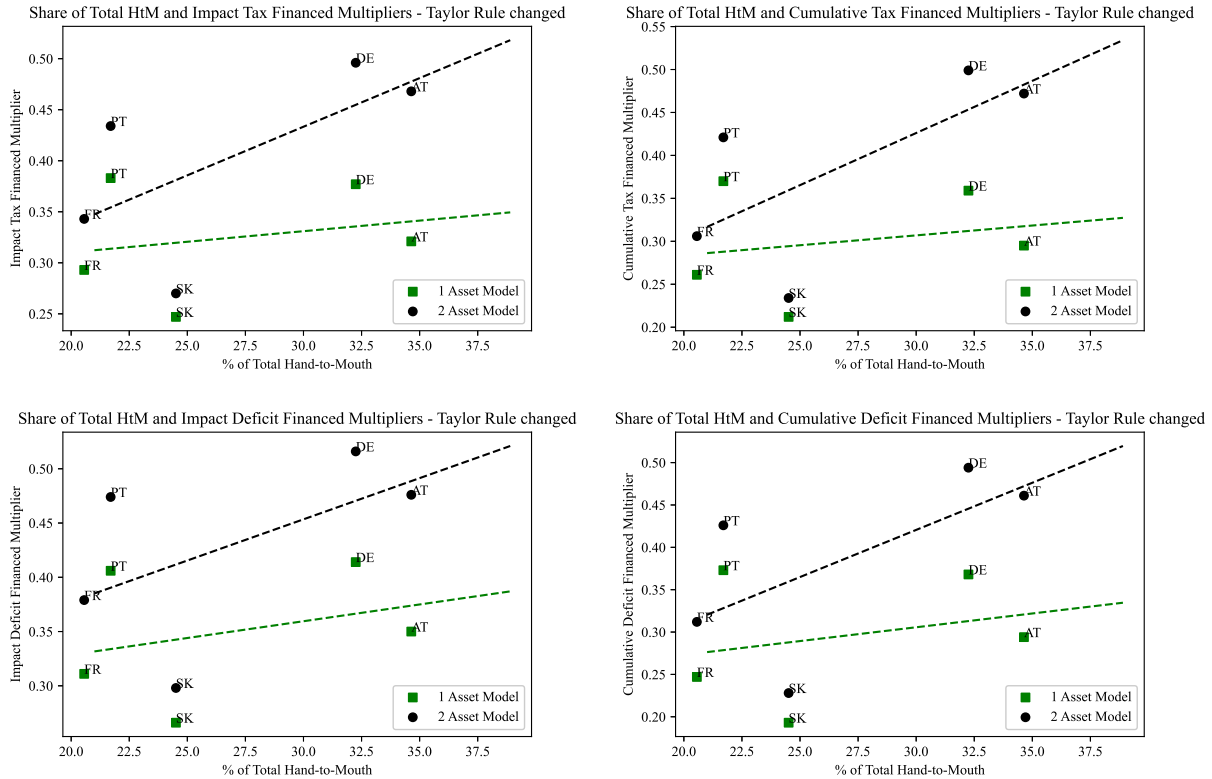


Figure 4: Fiscal multipliers (tax and deficit-financed) computed in the two model specifications for the several economies calibrated, changing the Taylor Rule to respond to both output and inflation deviations. On the left-hand side, the impact multipliers (tax and deficit-financed) are plotted against the share of Total HtM agents that are calibrated in each economy. On the right-hand side, the same thing is shown, but for the 3 periods cumulative multipliers. The Pearson correlation coefficients, with the respective p-values in brackets, for the one asset and two asset model results, from left to right, starting at the upper left plot, are respectively: 0.229 (0.711) and 0.646 (0.239), 0.219 (0.723) and 0.684 (0.203), 0.312 (0.609) and 0.544 (0.344), 0.266 (0.665) and 0.637 (0.248).

and output above the target, the monetary authority will respond more aggressively with a higher interest rate in the case where it cares both about output and inflation. This then implies that output is not allowed to respond as strongly as before, thus yielding lower multipliers.

In Appendix D, plots that compare the multipliers under the two Taylor Rules are shown, for a better understanding of this relationship.

6 Conclusion

This paper focused on analyzing the relevance of household heterogeneity for the size of fiscal multipliers. To do so, household heterogeneity was characterized by the existence of three different types of behaviours, in accordance with Kaplan et al. (2014): the Poor Hand-to-Mouth (households

who hold no liquid nor illiquid wealth), the Wealthy Hand-to-Mouth (households who despite holding considerable amounts of illiquid assets, hold no liquid assets) and the Non-Hand-to-Mouth (the remaining households who do not fit into these categories). These households show different marginal propensities to consume out of transitory income shocks and could thus be a reason explaining the differences across countries on the size of fiscal multipliers.

To analyse this issue, a Heterogeneous Agents New Keynesian model framework was chosen. The main purpose is to establish causality, which lacks in empirical approaches that tend to capture only correlations in the data. Therefore, 5 different Euro Area economies were calibrated in two similar HANK models: one of them only features one type of asset, and therefore does not distinguish between liquid and illiquid wealth, nor between the P-HtM and the W-HtM (it only captures the P-HtM and considers the W-HtM as N-HtM), and another one featuring two assets with different liquidity, and hence able to feature the heterogeneity found in the data. This is, to the best of our knowledge, one of the few studies whose focus is on comparing a one-asset with a two-asset model.

The results obtained are first that fiscal multipliers are bigger when the model is calibrated in the two-asset framework in comparison with the one-asset scenario, for all countries. This shows how a higher proportion of liquidity-constrained agents actually matters for the size of the multipliers, in accordance with existing literature, which drew similar conclusions under different frameworks. Next, the cross-country analysis shows that only the share of Poor Hand-to-Mouth households seems to be quantitatively relevant in explaining differences across countries in the size of the fiscal multipliers. This is in line with the empirical findings of [Guo et al. \(2023\)](#) for government spending fiscal multipliers, adding further robustness to their findings.

Moreover, it is found that these conclusions hold when looking either at the impact multipliers or the cumulative ones, as well as robust to the choice of how the government spending shock is financed (either tax or deficit-financed) and to the Taylor Rule of the Central Bank. In the baseline scenario, it only responds to inflation deviations (since the monetary policy of the economies considered is conducted by the European Central Bank), while in a second specification it responds

to inflation and output deviations (similarly to what the FED does in the United States). Finally, it is also found that cumulative multipliers are lower than impact multipliers, that deficit-financed impact multipliers are higher than tax-financed impact multipliers, and that a Taylor Rule that only responds to inflation generates higher multipliers overall.

These results bring important policy implications. The fact that economies respond differently to government spending shocks because of household heterogeneity suggests that attention should be drawn to the wealth distribution of households when governments want to boost output, to properly calibrate the size of the shock. However, it should be noted how the multipliers calculated are still all lower than unity, maintaining the literature-established findings that simply increasing government spending is not the best way to increase growth when output is already at its potential level.

Further research should be designed to study how the results depend on the economic scenario of the countries, as the analysis performed departs from a steady-state equilibrium and not, for instance, from a situation of economic downturn. It could also be analyzed how other country-specific parameters might change these conclusions, such as estimating and calibrating the economies for different values of the Frisch elasticity. Finally, extending the analysis to include more economies can also be useful to provide further strength to the results.

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Appendix

A Parameters of the Models

Table 1 shows the calibration targets for the one-asset model and Table 2 for the two-asset model. Note that the only change is that in the one-asset model the calibration is done using the sum of liquid and illiquid wealth and the only HtM agents that can be identified are the P-HtM. The parameters endogenously calibrated are reported in Table 3 for the one-asset model and in Table 4 for the two-asset. Finally, the parameters held constant across countries are reported in Table 5 for the two model specifications.

Table 1: Calibration targets in the one-asset model specification

Country	Total Wealth	K/Y	% of HtM
AT	6.116	3.359	0.052
DE	5.169	3.013	0.074
FR	6.549	3.392	0.032
PT	7.774	3.229	0.055
SK	5.484	3.799	0.025

Table 2: Calibration targets in the two-asset model specification

Country	Illiquid W.	Liquid W.	K/Y	% of P-HtM	% of W-HtM
AT	5.113	1.003	3.359	0.052	0.294
DE	4.008	1.160	3.013	0.074	0.248
FR	5.318	1.231	3.392	0.032	0.173
PT	6.765	1.009	3.229	0.055	0.162
SK	5.050	0.433	3.799	0.025	0.220

Table 3: Parameters calibrated endogenously for the one-asset model specification.

Country	β	σ_z
AT	0.98572	0.15897
DE	0.98413	0.19194
FR	0.98676	0.11758
PT	0.98218	0.29466
SK	0.98749	0.04328

Table 4: Parameters calibrated endogenously for the two-asset model specification.

Country	χ_0	χ_1	β	σ_z	ω	ρ_z
AT	0.14500	5.27220	0.97987	0.29787	0.003	0.95
DE	0.11732	3.16578	0.97888	0.29151	0.002	0.95
FR	0.51287	12.28398	0.98508	0.15932	0.001	0.94
PT	0.80000	29.85067	0.98328	0.16903	0.003	0.93
SK	3.00000	9.16413	0.98646	0.11292	0.001	0.91

Note: the parameter ρ_z was only changed when necessary for calibration purposes. If not needed, it was left at its initial value of 0.95, as Table 5 suggests.

Table 5: Parameters held constant across countries.

Parameter	2-asset	1-asset
<i>Households</i>		
σ	2	2
η	1	1
χ_2	2	nd.
\underline{b}	0	nd.
ρ_z	0.91-0.95	0.95
<i>Financial Intermediary</i>		
Θ_p	0.85	0.85
<i>Firms</i>		
δ	0.06	0.06
κ_p	0.1	0.1
<i>Labor Unions</i>		
κ_w	0.1	0.1
μ_w	1.1	1.1
<i>Policy</i>		
G	0.2	0.2
r^*	0.125	0.125
ϕ_π	1.5	1.5
ϕ_y	0 or 0.5	0 or 0.5

B Fiscal Multipliers

Table 6 reports the impact multipliers calculated in the two models and Table 7 reports the cumulative (3 periods) multipliers.

Table 6: Impact government spending multipliers calculated with the two models.

Country	Taylor Rule - Inflation Only				Taylor Rule - Inf. and Output			
	1 Asset		2 Asset		1 Asset		2 Asset	
	Tax	Deficit	Tax	Deficit	Tax	Deficit	Tax	Deficit
AT	0.527	0.576	0.573	0.584	0.321	0.350	0.468	0.476
DE	0.572	0.631	0.606	0.632	0.377	0.414	0.496	0.516
FR	0.510	0.534	0.538	0.598	0.293	0.311	0.343	0.379
PT	0.546	0.585	0.579	0.641	0.383	0.406	0.434	0.474
SK	0.454	0.476	0.461	0.512	0.247	0.266	0.270	0.298

Table 7: Cumulative (3 periods) government spending multipliers calculated with the two models.

Country	Taylor Rule - Inflation Only				Taylor Rule - Inf. and Output			
	1 Asset		2 Asset		1 Asset		2 Asset	
	Tax	Deficit	Tax	Deficit	Tax	Deficit	Tax	Deficit
AT	0.467	0.466	0.510	0.498	0.295	0.294	0.472	0.461
DE	0.516	0.532	0.536	0.531	0.359	0.368	0.499	0.494
FR	0.447	0.416	0.454	0.471	0.261	0.247	0.306	0.312
PT	0.488	0.498	0.494	0.509	0.370	0.373	0.421	0.426
SK	0.389	0.343	0.389	0.382	0.212	0.193	0.234	0.228

C Tax financed vs. Deficit financed multipliers

Figure 5 illustrates the differences in the several multipliers, depending on how the government spending shock is financed - either by raising taxes immediately or by financing it with debt. It shows that impact tax-financed multipliers are always lower than deficit-financed ones. However, if we consider cumulative multipliers, it is no longer the case.

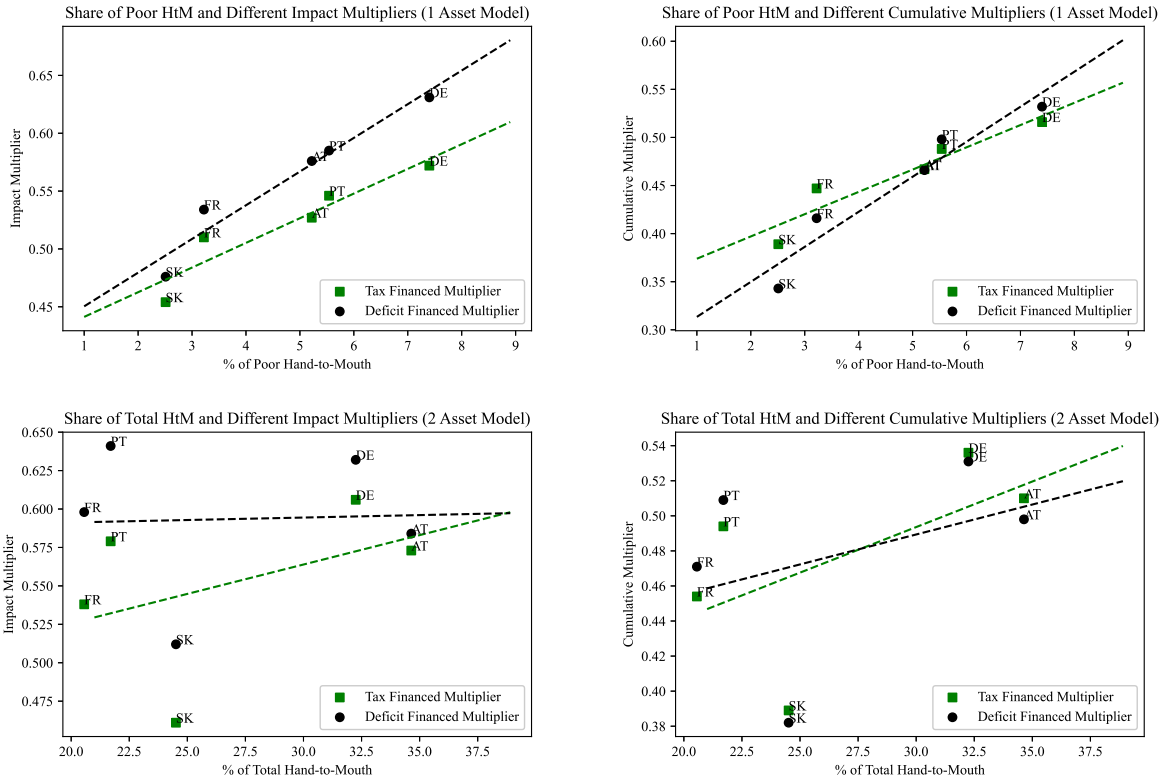


Figure 5: Fiscal multipliers (tax and deficit-financed) computed in the two model specifications for the several economies calibrated. On the left-hand side, the impact multipliers are plotted, firstly in the one-asset model and then in the two-asset model, against the share of HtM agents that are calibrated in each economy. On the right-hand side, the same thing is shown, but for the 3 periods cumulative multipliers.

D Multipliers under different Taylor Rules

Figure 6 illustrates the differences in the several multipliers, depending on the choice of the Taylor Rule. Under a Taylor Rule that only responds to inflation deviations, multipliers are higher than if the Central Bank responds to both output and inflation deviations.

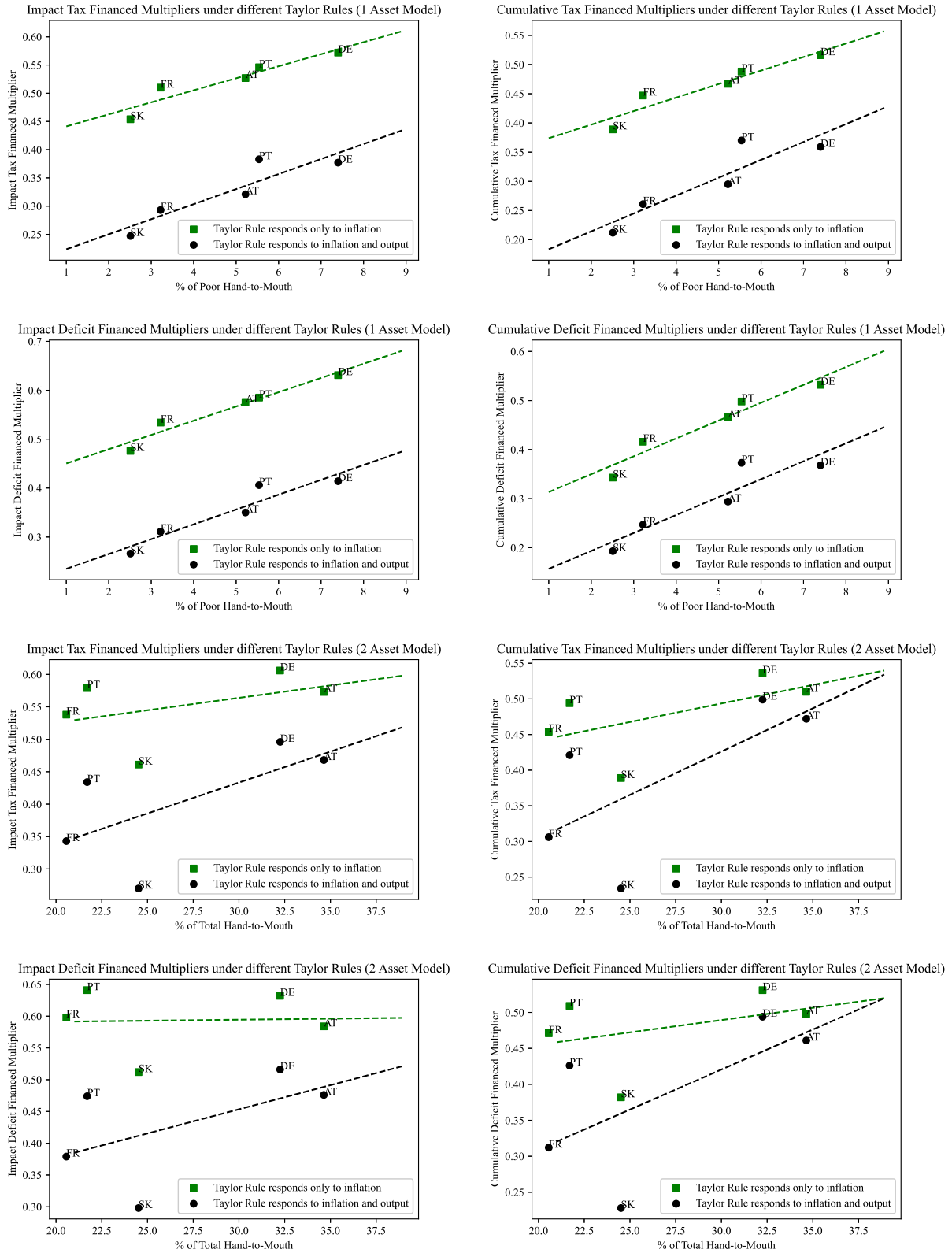


Figure 6: Fiscal multipliers computed in the two model specifications for the several economies calibrated, under different Taylor Rules. On the left-hand side, impact multipliers are plotted, firstly in the one-asset model and then in the two-asset model, under different financing, against the share of HtM agents calibrated in each economy. On the right-hand side, the same thing is shown, but for the 3 periods cumulative multipliers.

E Impulse Response Functions

Below are reported all the impulse response functions of the models. Each economy reports eight sets of impulse response functions. This is because two different models are employed (one-asset and two-asset), two different fiscal shocks are simulated (an increase in government spending which can be either financed by raising taxes or issuing debt), and the two different Taylor Rule specifications are tried.

Figures 7, 8, 9, 10, 11, 12, 13 and 14 refer to Austria. Figures 15, 16, 17, 18, 19, 20, 21 and 22 refer to Germany. Figures 23, 24, 25, 26, 27, 28, 29 and 30 refer to France. Figures 31, 32, 33, 34, 35, 36, 37 and 38 refer to Portugal. Figures 39, 40, 41, 42, 43, 44, 45 and 46 refer to Slovakia. For each country, the first two figures report the two different government spending shocks (tax and deficit-financed) in the one-asset model, with the baseline Taylor Rule. The next two figures do the same thing, but for the two-asset model specification. The last four figures repeat the exercise for the changed Taylor Rule that responds to both output and inflation deviations.

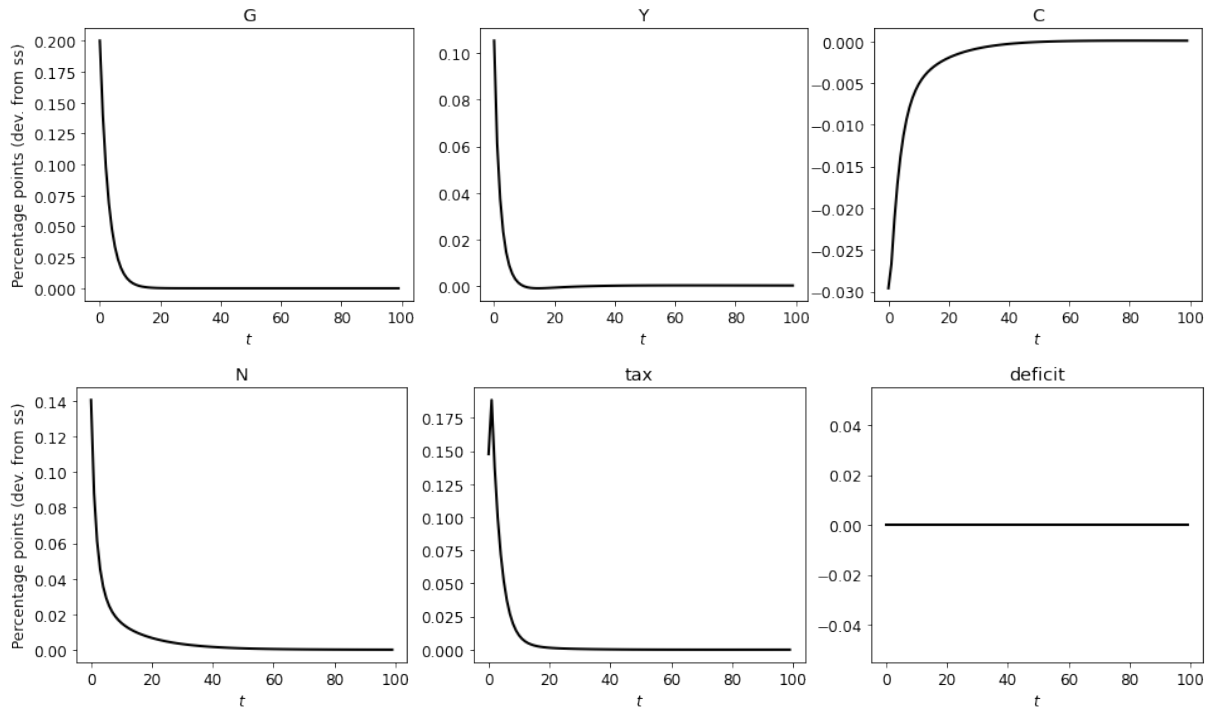


Figure 7: IRFs for Austria in the one-asset model, tax-financed shock, baseline Taylor Rule.

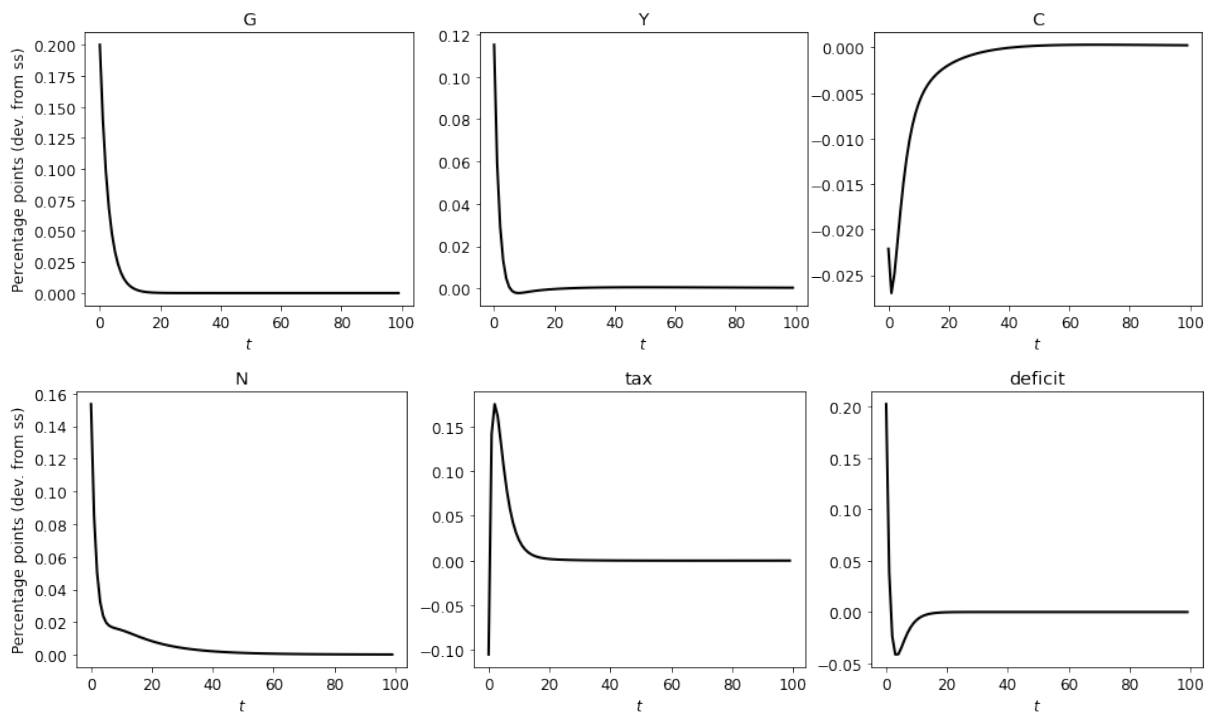


Figure 8: IRFs for Austria in the one-asset model, deficit-financed shock, baseline Taylor Rule.

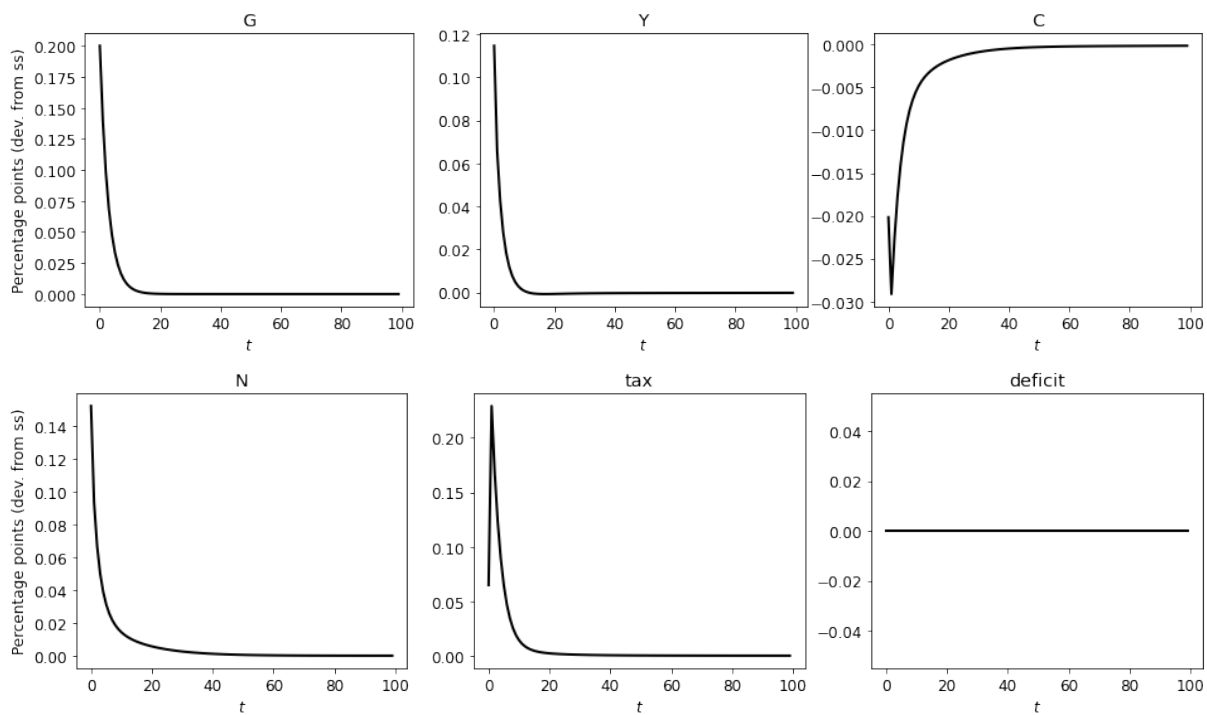


Figure 9: IRFs for Austria in the two-asset model, tax-financed shock, baseline Taylor Rule.

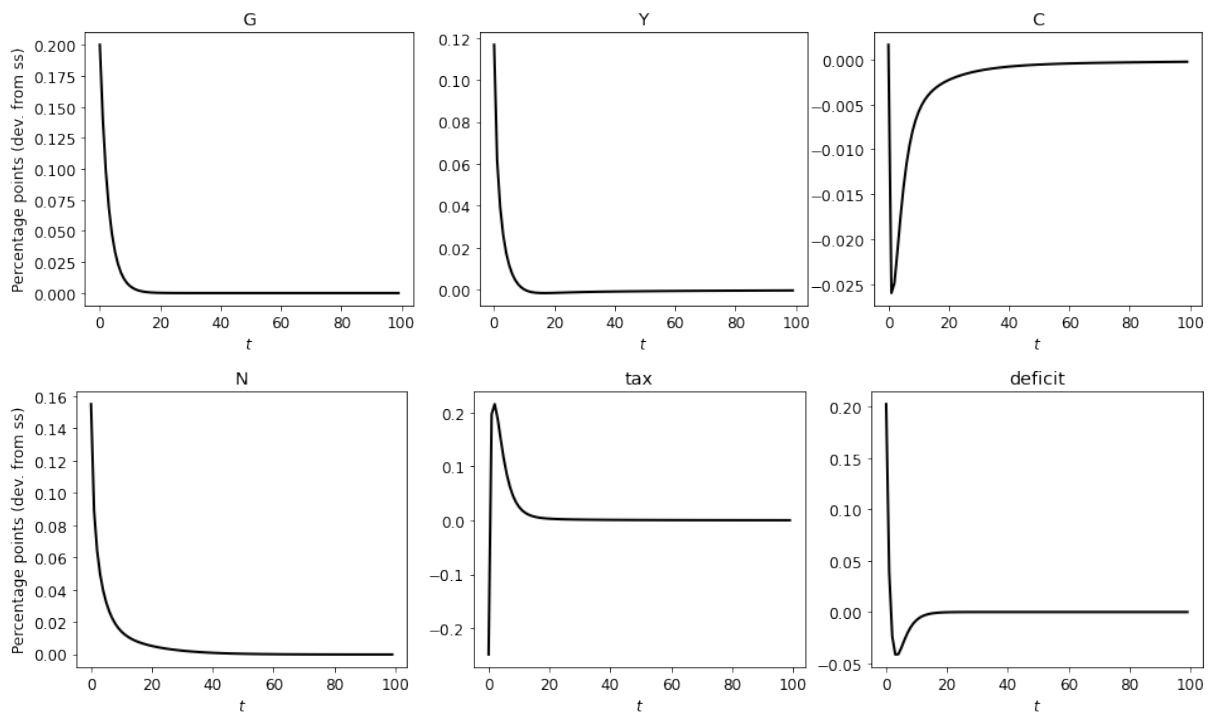


Figure 10: IRFs for Austria in the two-asset model, deficit-financed shock, baseline Taylor Rule.

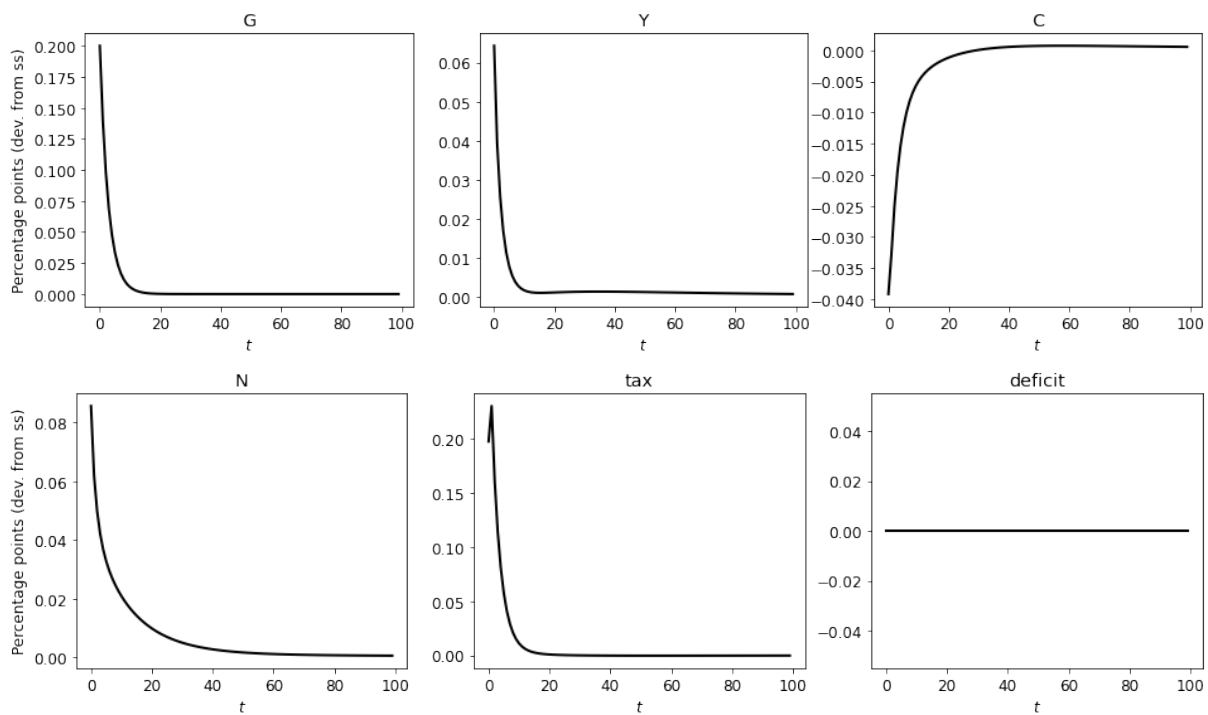


Figure 11: IRFs for Austria in the one-asset model, tax-financed shock, changed Taylor Rule.

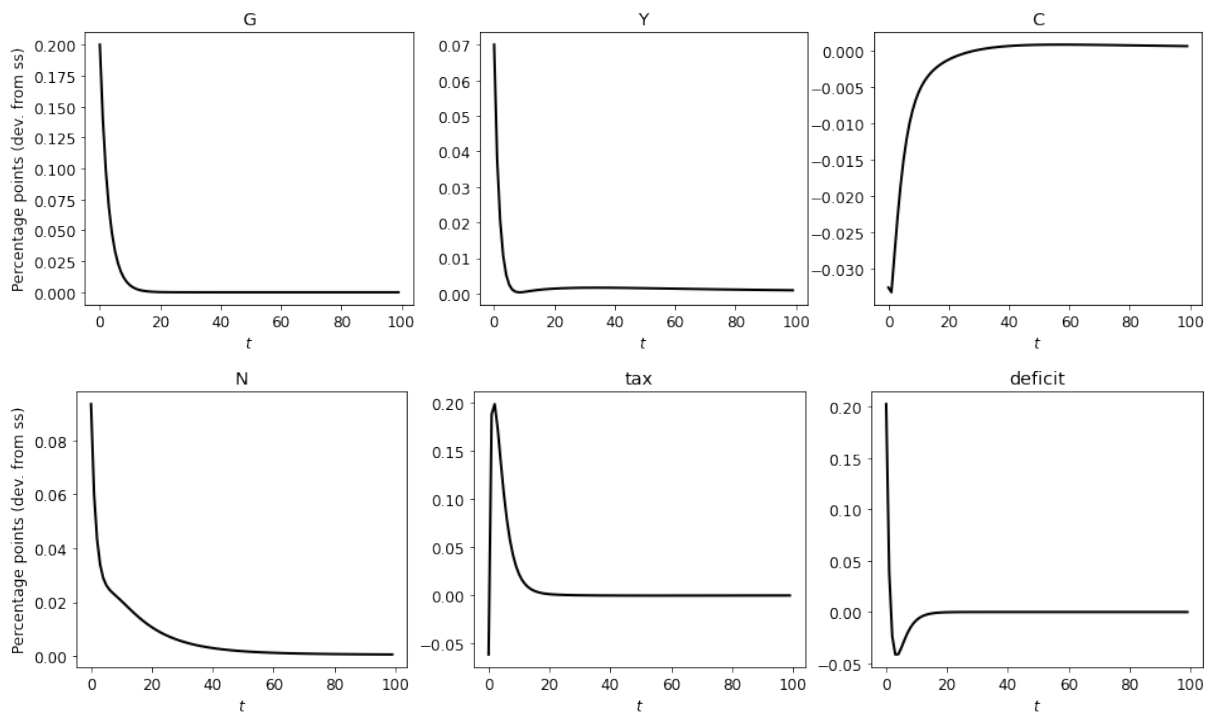


Figure 12: IRFs for Austria in the one-asset model, deficit-financed shock, changed Taylor Rule.

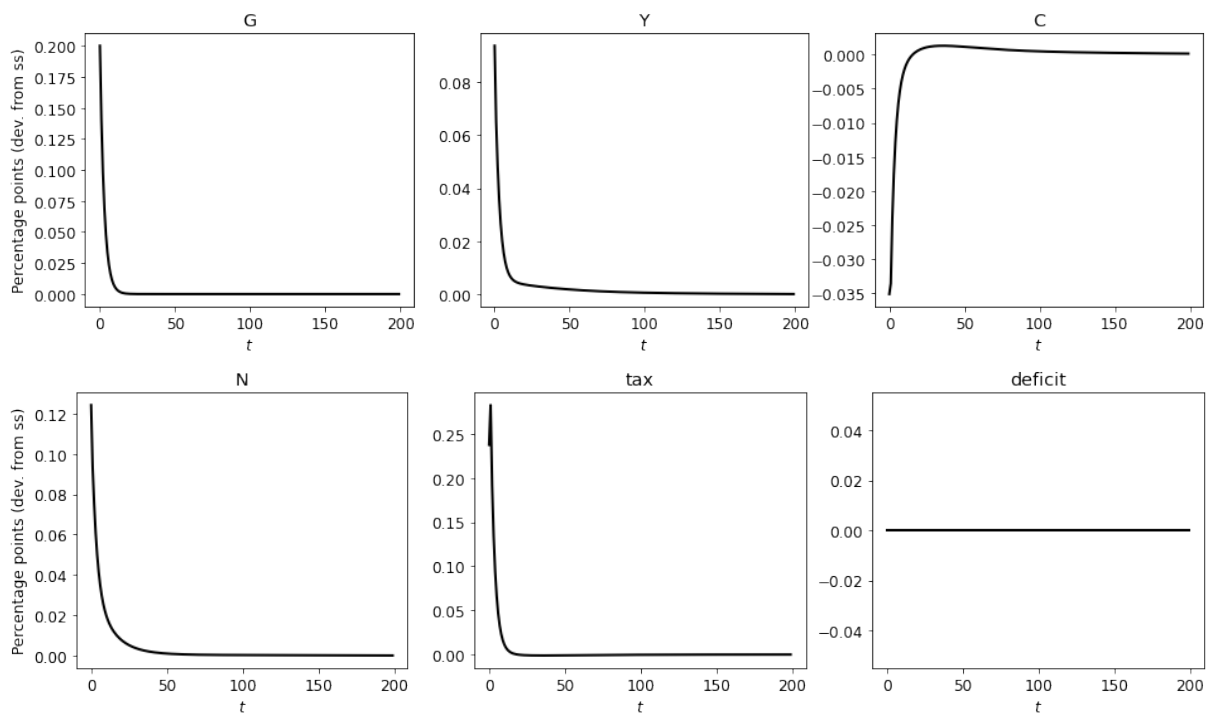


Figure 13: IRFs for Austria in the two-asset model, tax-financed shock, changed Taylor Rule.

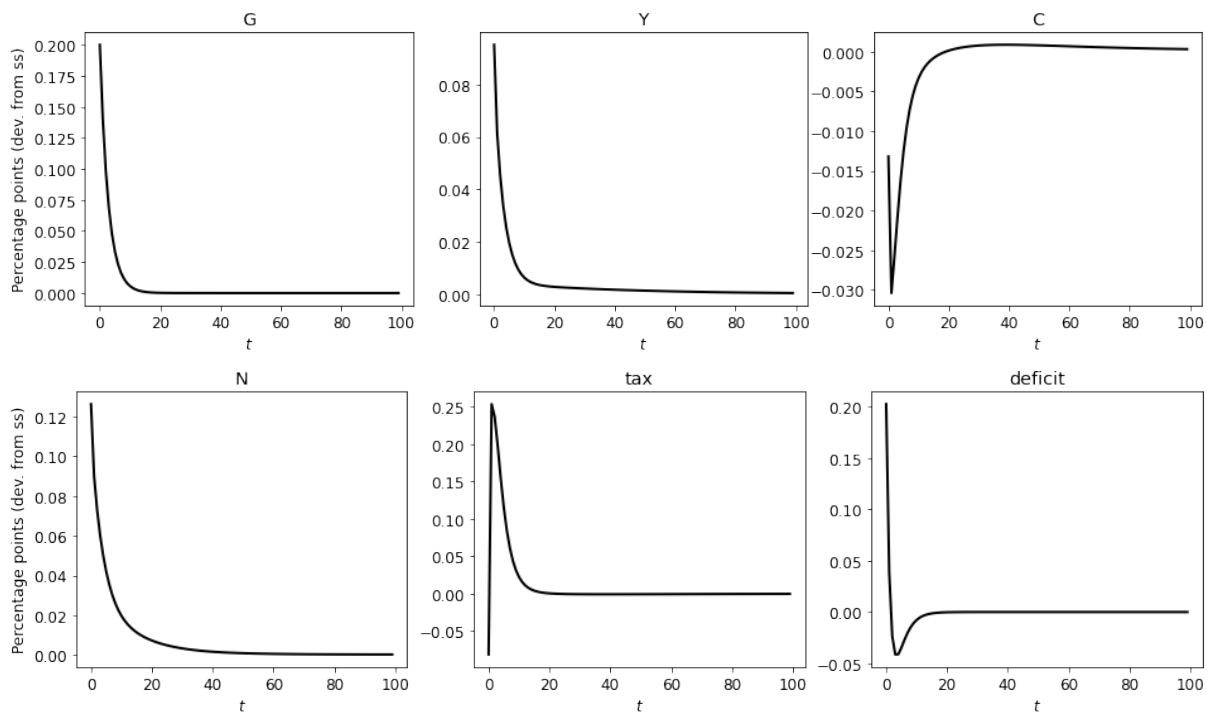


Figure 14: IRFs for Austria in the two-asset model, deficit-financed shock, changed Taylor Rule.

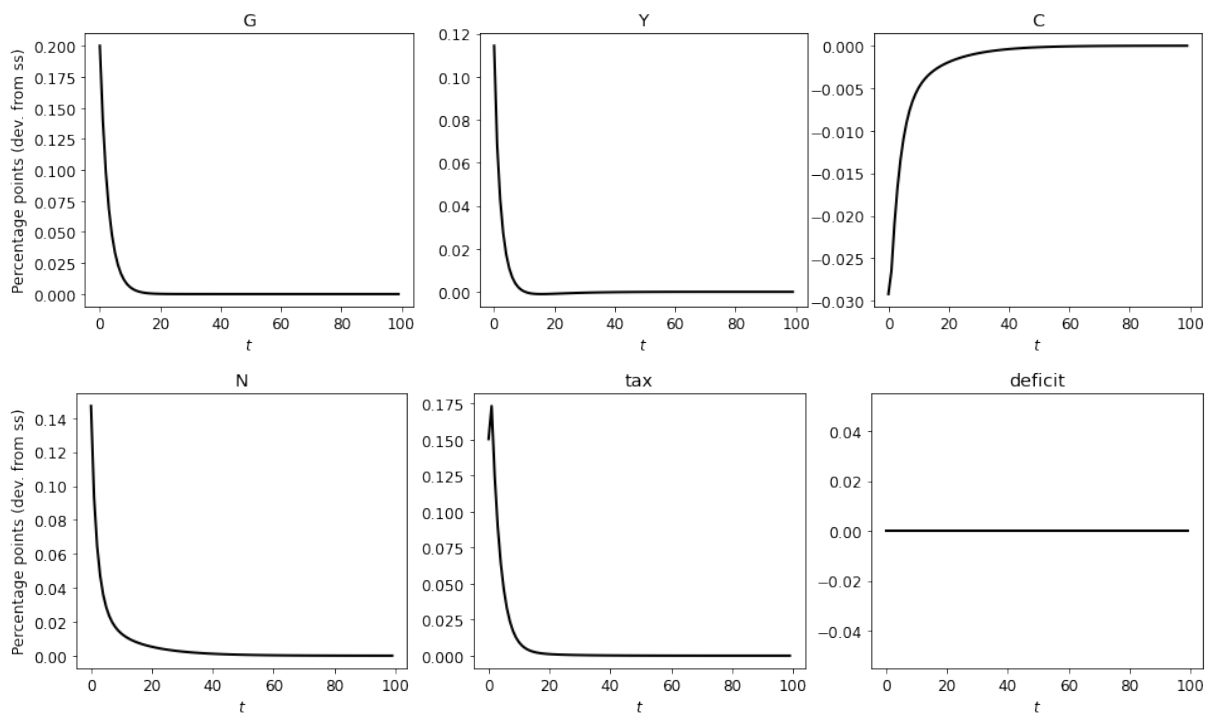


Figure 15: IRFs for Germany in the one-asset model, tax-financed shock, baseline Taylor Rule.

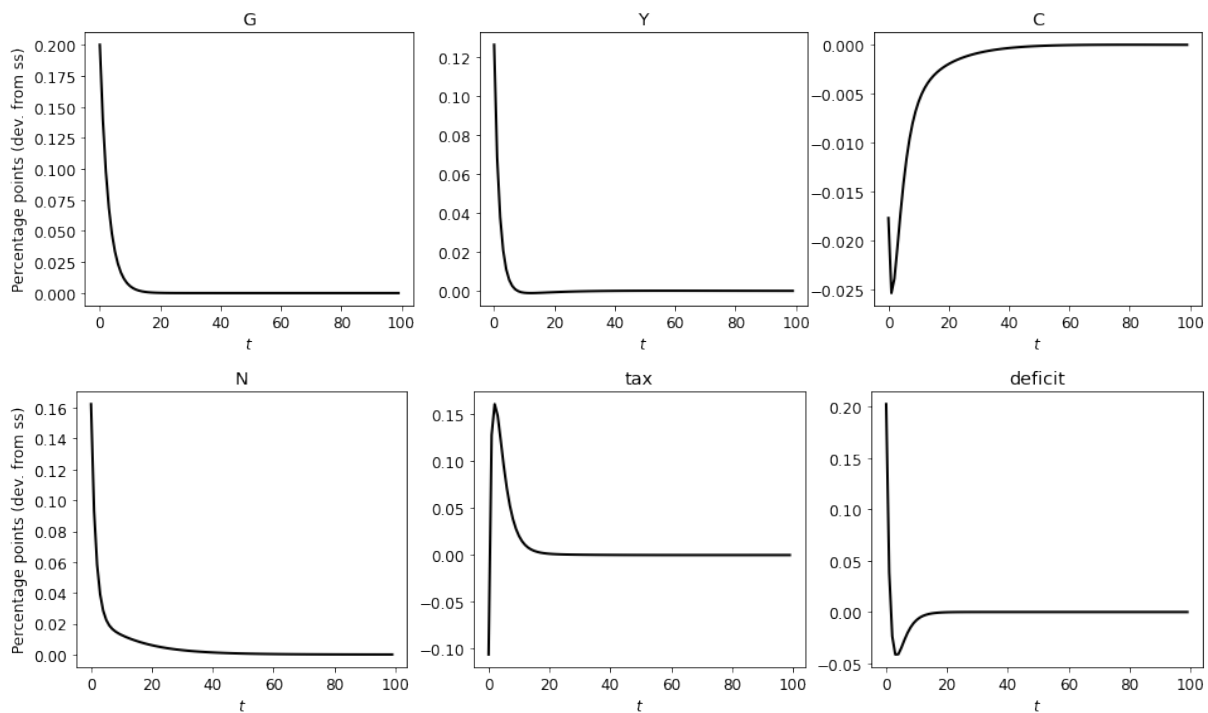


Figure 16: IRFs for Germany in the one-asset model, deficit-financed shock, baseline Taylor Rule.

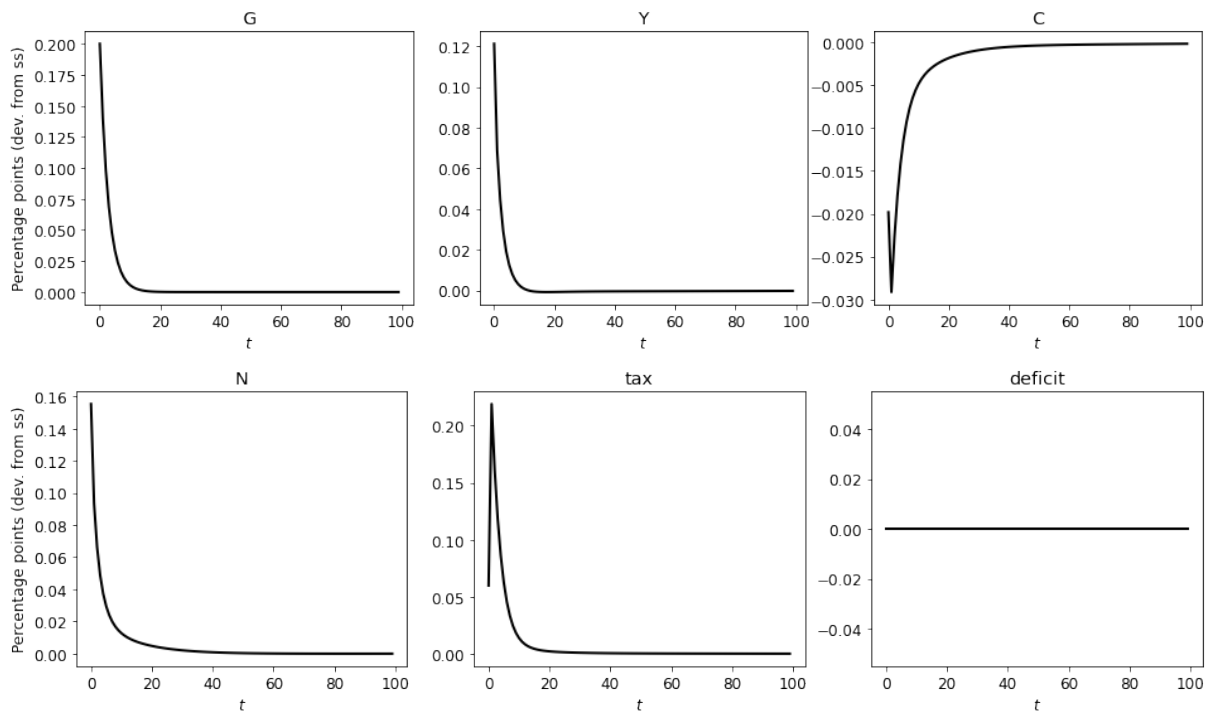


Figure 17: IRFs for Germany in the two-asset model, tax-financed shock, baseline Taylor Rule.

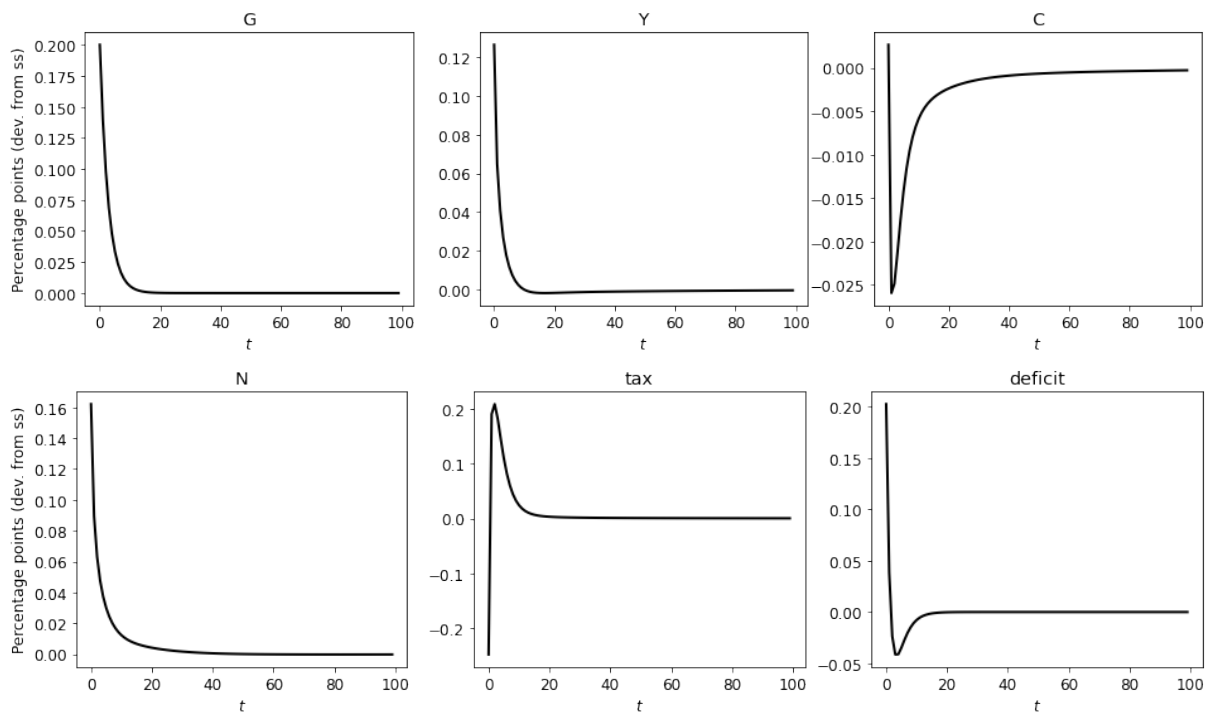


Figure 18: IRFs for Germany in the two-asset model, deficit-financed shock, baseline Taylor Rule.

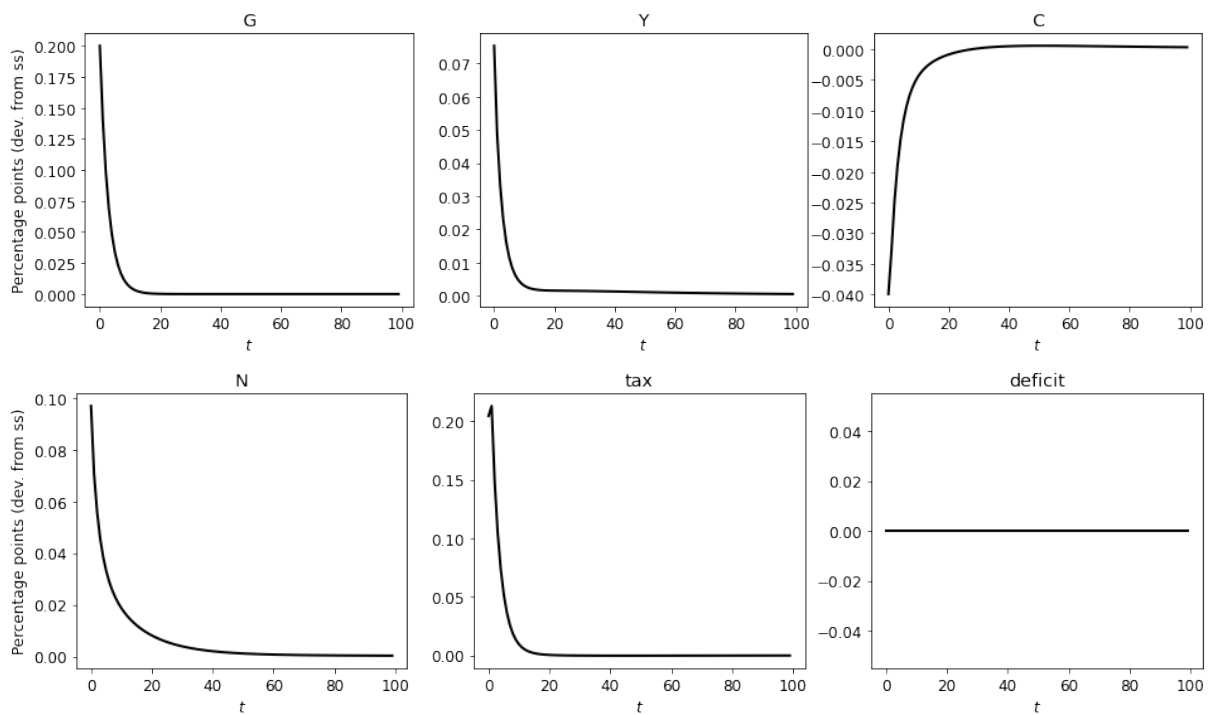


Figure 19: IRFs for Germany in the one-asset model, tax-financed shock, changed Taylor Rule.

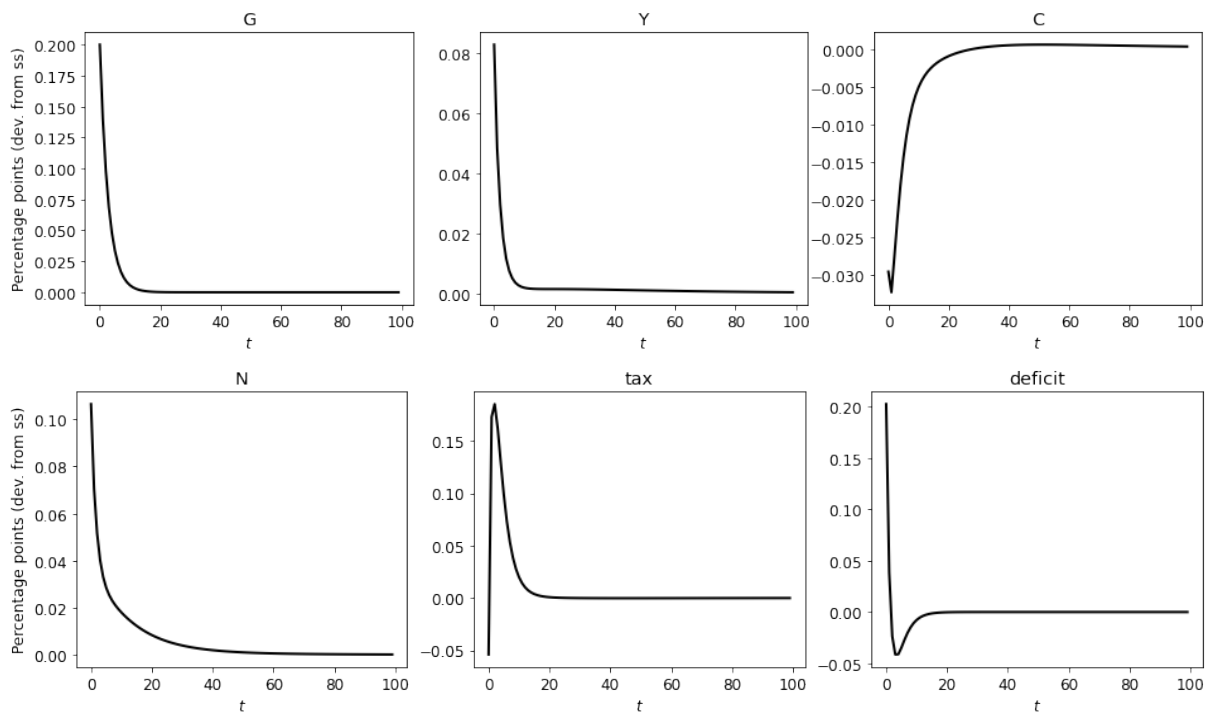


Figure 20: IRFs for Germany in the one-asset model, deficit-financed shock, changed Taylor Rule.

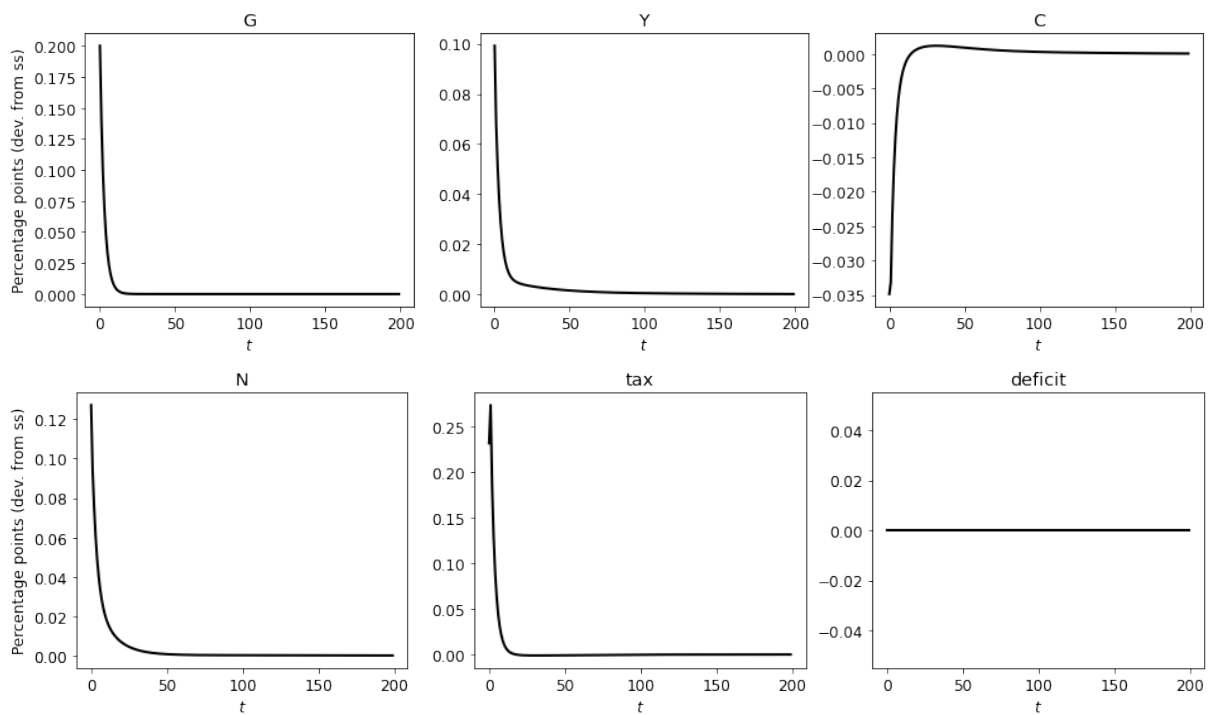


Figure 21: IRFs for Germany in the two-asset model, tax-financed shock, changed Taylor Rule.

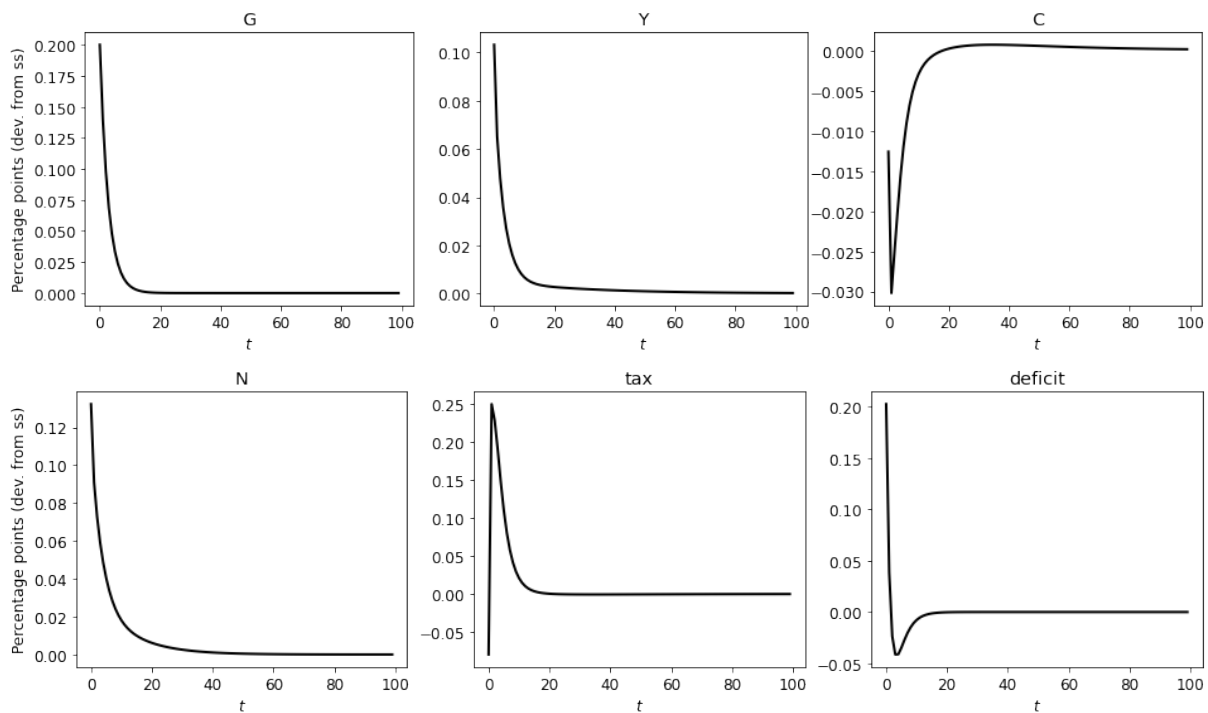


Figure 22: IRFs for Germany in the two-asset model, deficit-financed shock, changed Taylor Rule.

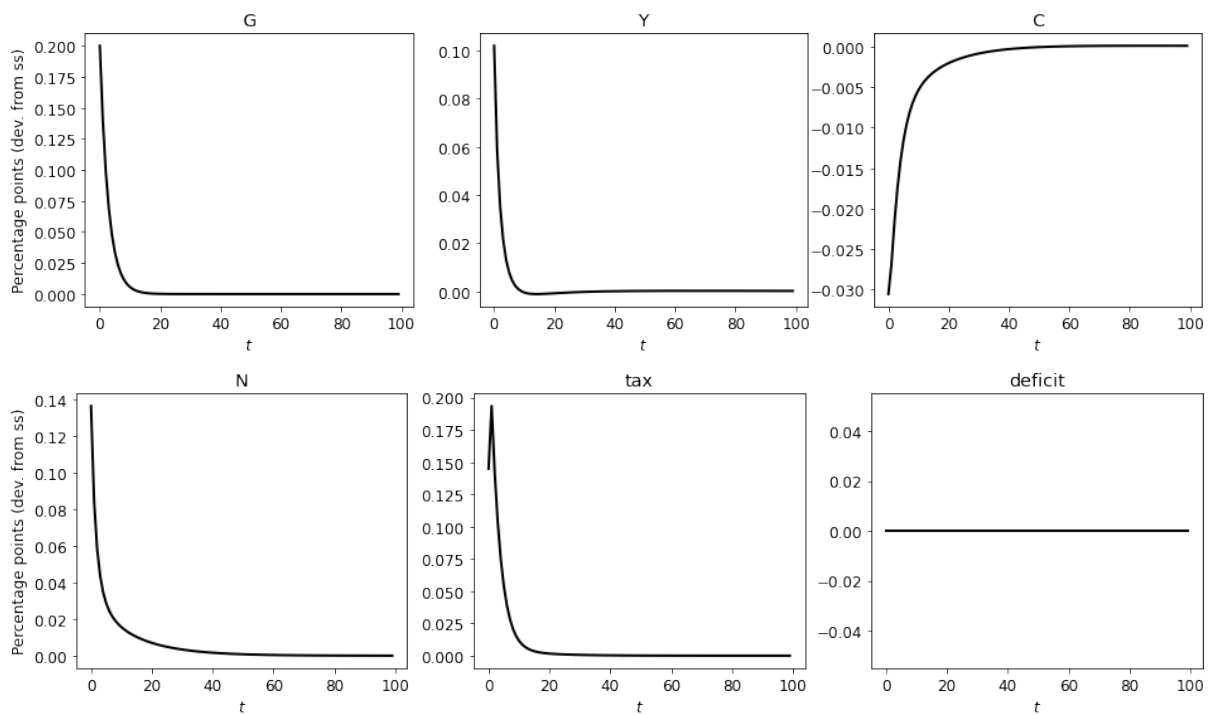


Figure 23: IRFs for France in the one-asset model, tax-financed shock, baseline Taylor Rule.

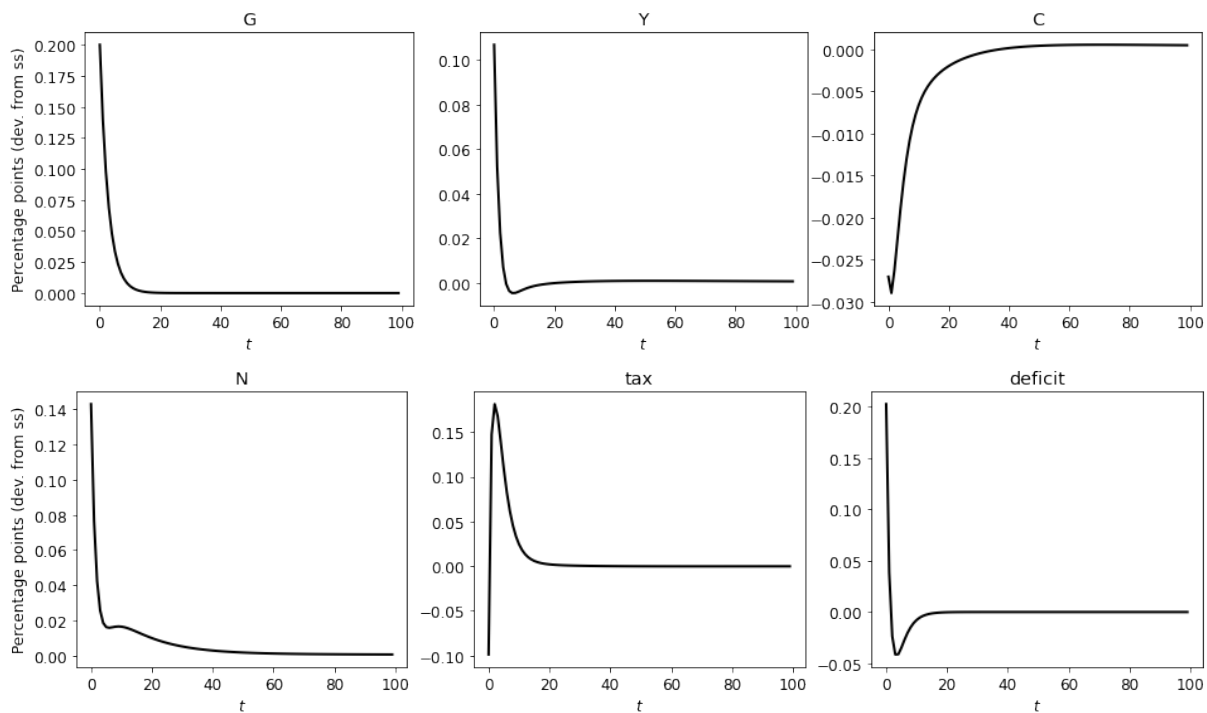


Figure 24: IRFs for France in the one-asset model, deficit-financed shock, baseline Taylor Rule.

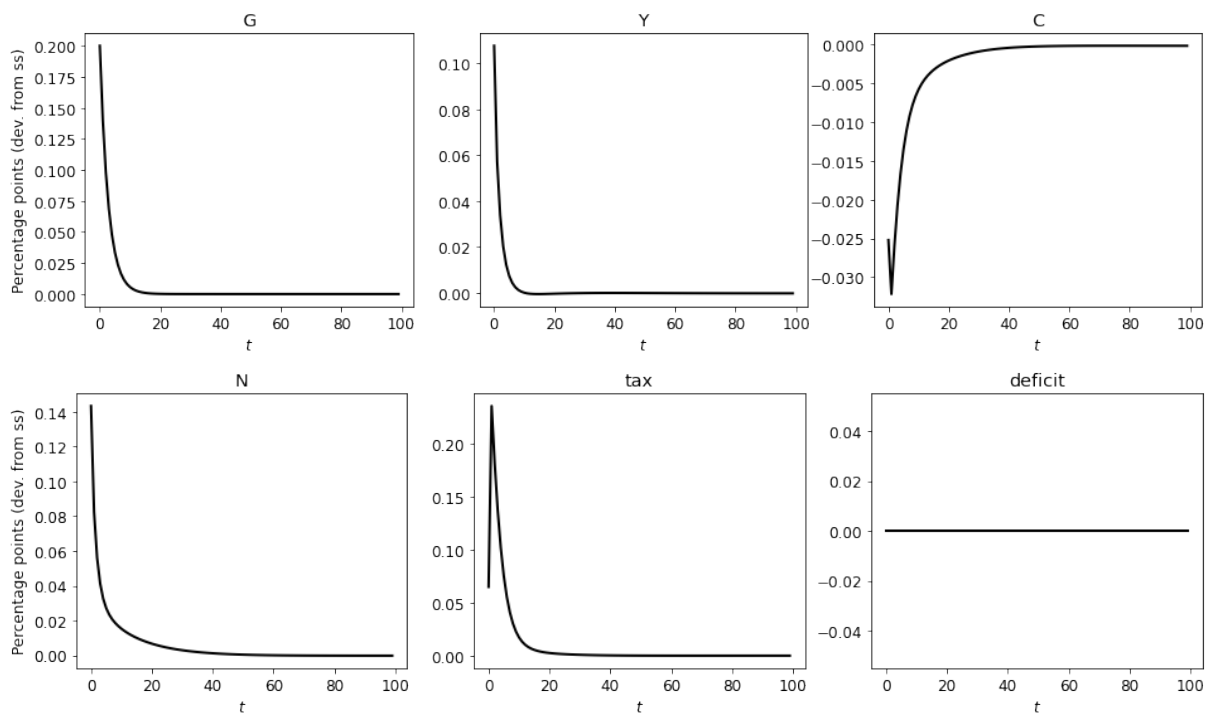


Figure 25: IRFs for France in the two-asset model, tax-financed shock, baseline Taylor Rule.

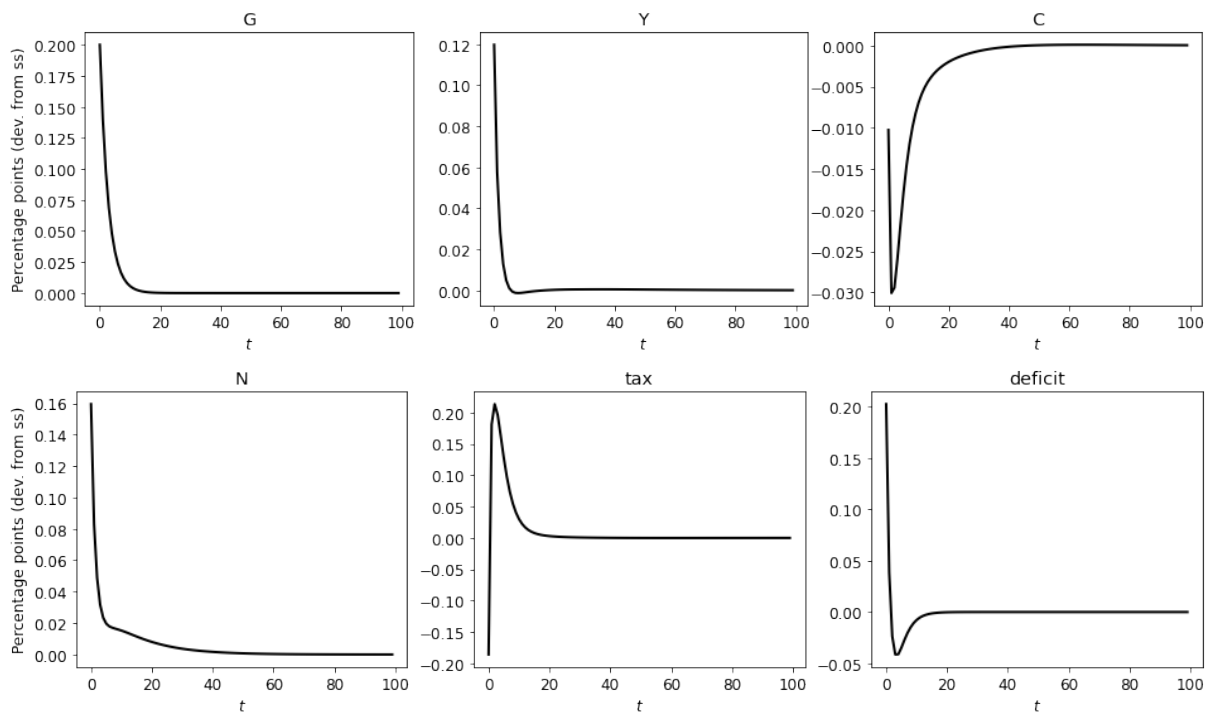


Figure 26: IRFs for France in the two-asset model, deficit-financed shock, baseline Taylor Rule.

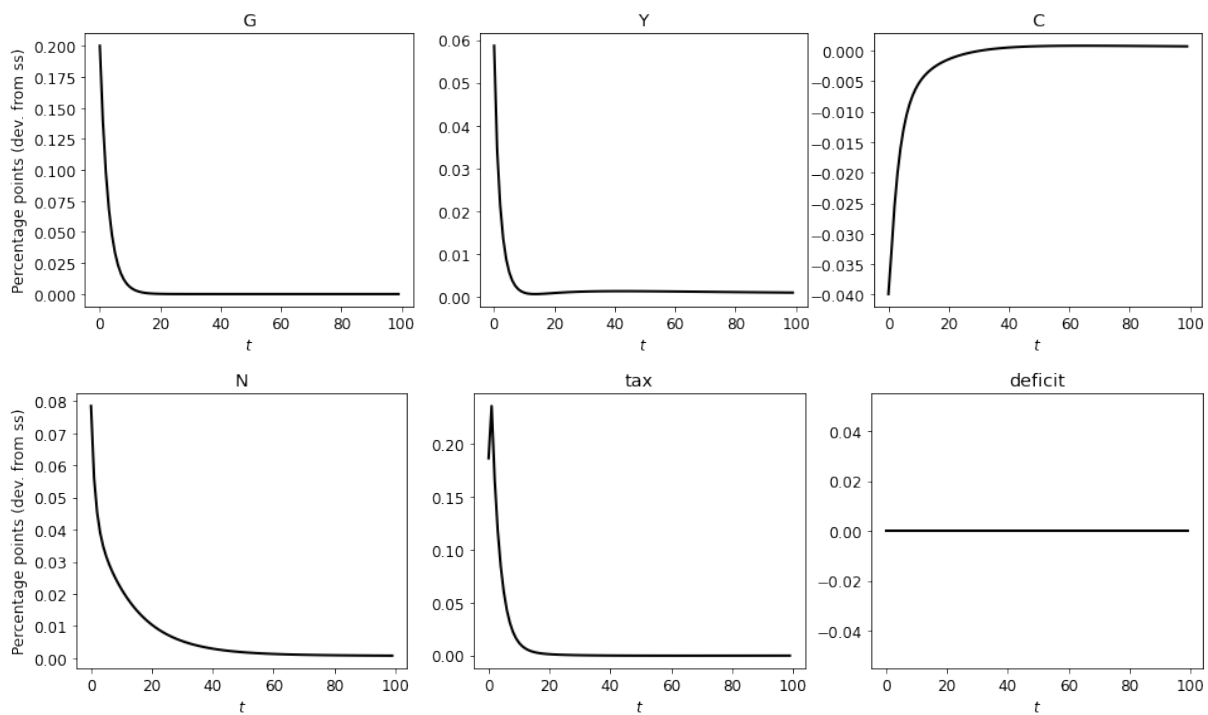


Figure 27: IRFs for France in the one-asset model, tax-financed shock, changed Taylor Rule.

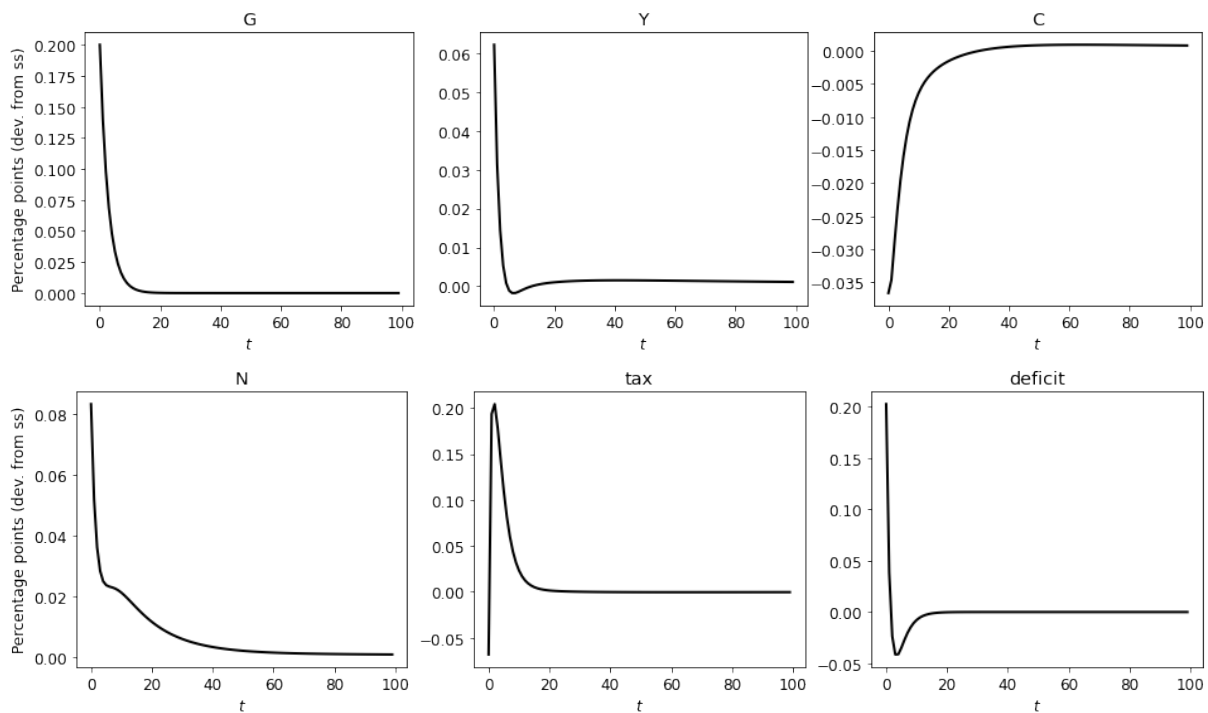


Figure 28: IRFs for France in the one-asset model, deficit-financed shock, changed Taylor Rule.

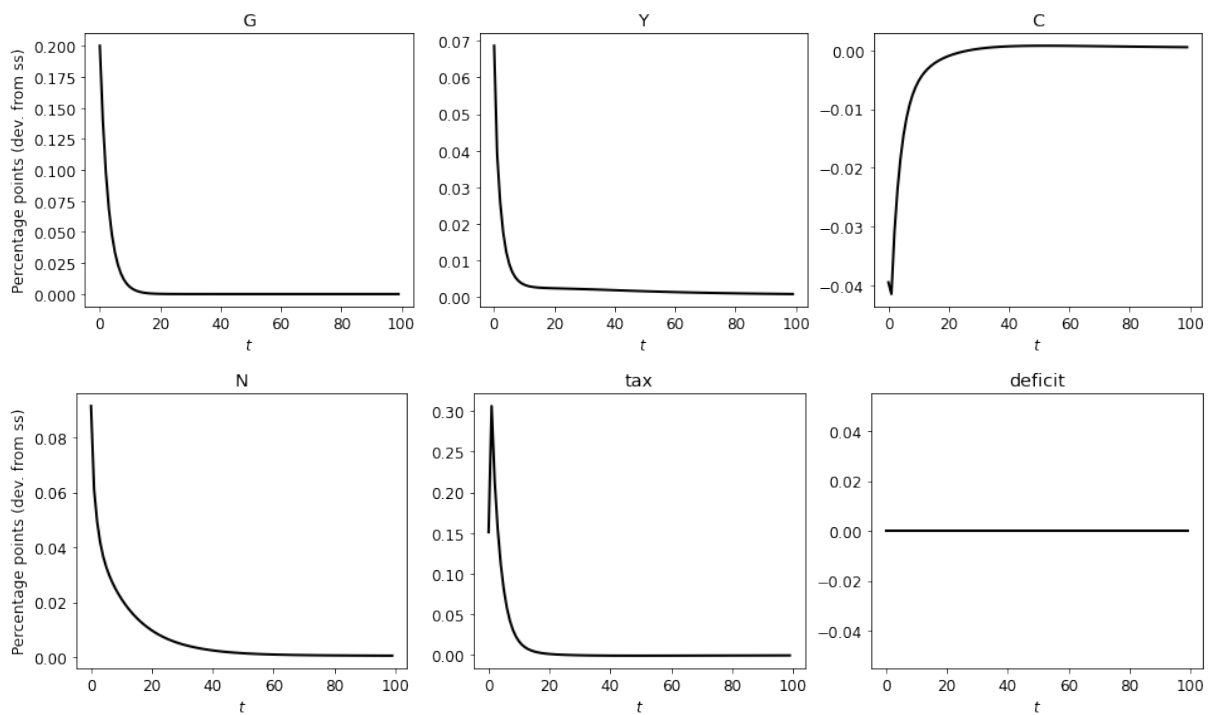


Figure 29: IRFs for France in the two-asset model, tax-financed shock, changed Taylor Rule.

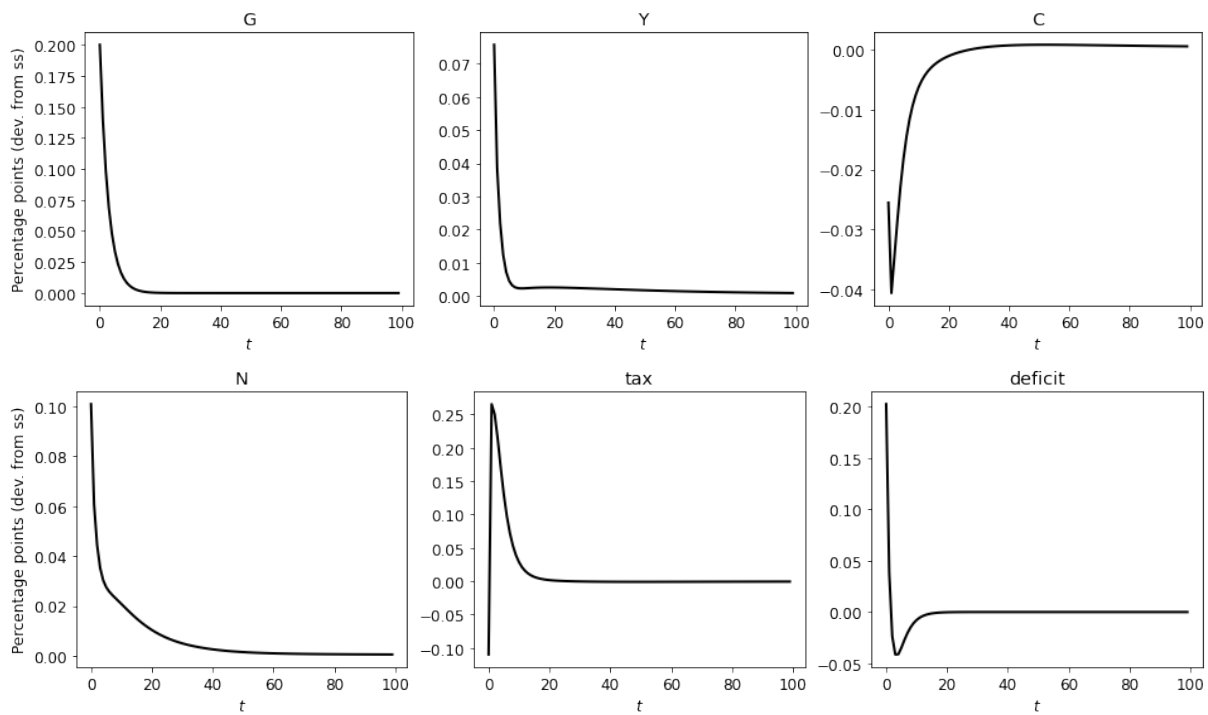


Figure 30: IRFs for France in the two-asset model, deficit-financed shock, changed Taylor Rule.

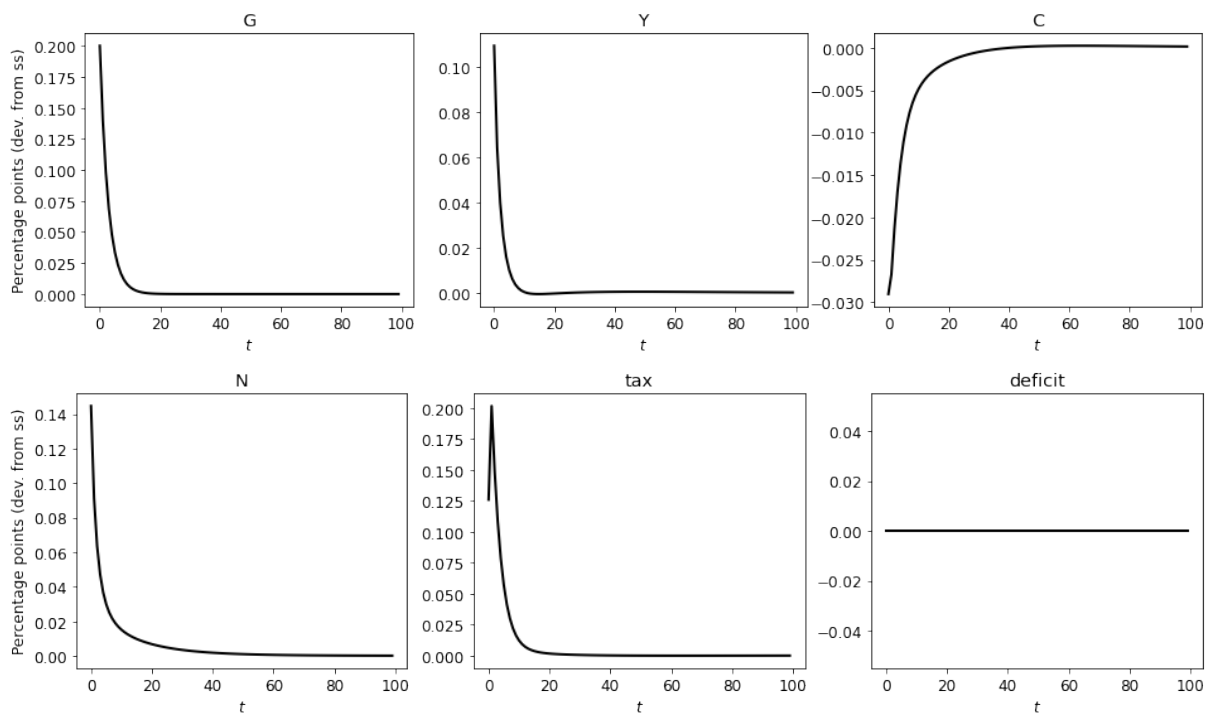


Figure 31: IRFs for Portugal in the one-asset model, tax-financed shock, baseline Taylor Rule.

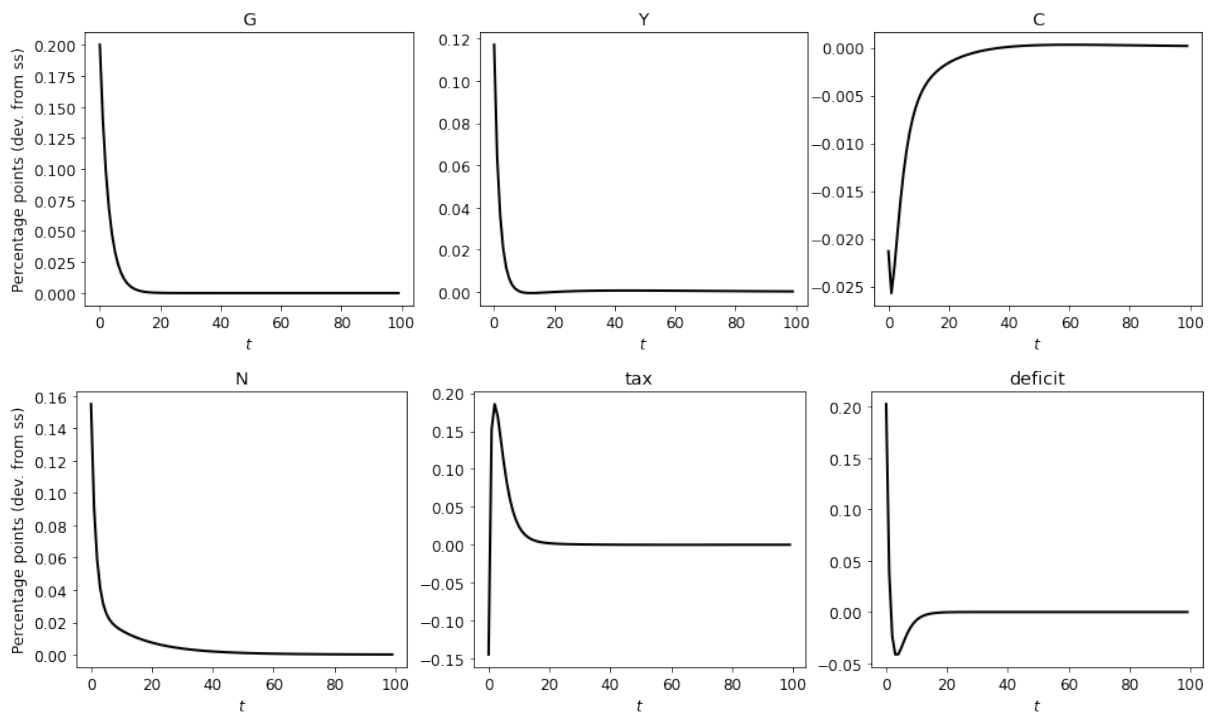


Figure 32: IRFs for Portugal in the one-asset model, deficit-financed shock, baseline Taylor Rule.

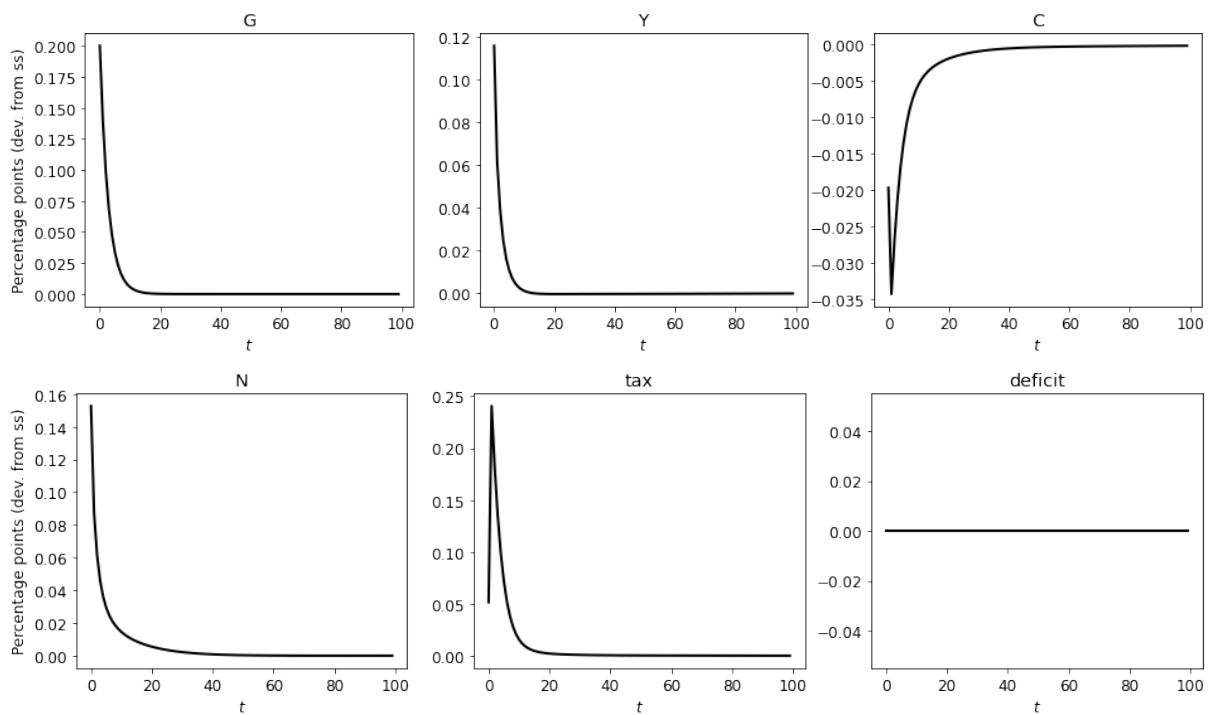


Figure 33: IRFs for Portugal in the two-asset model, tax-financed shock, baseline Taylor Rule.

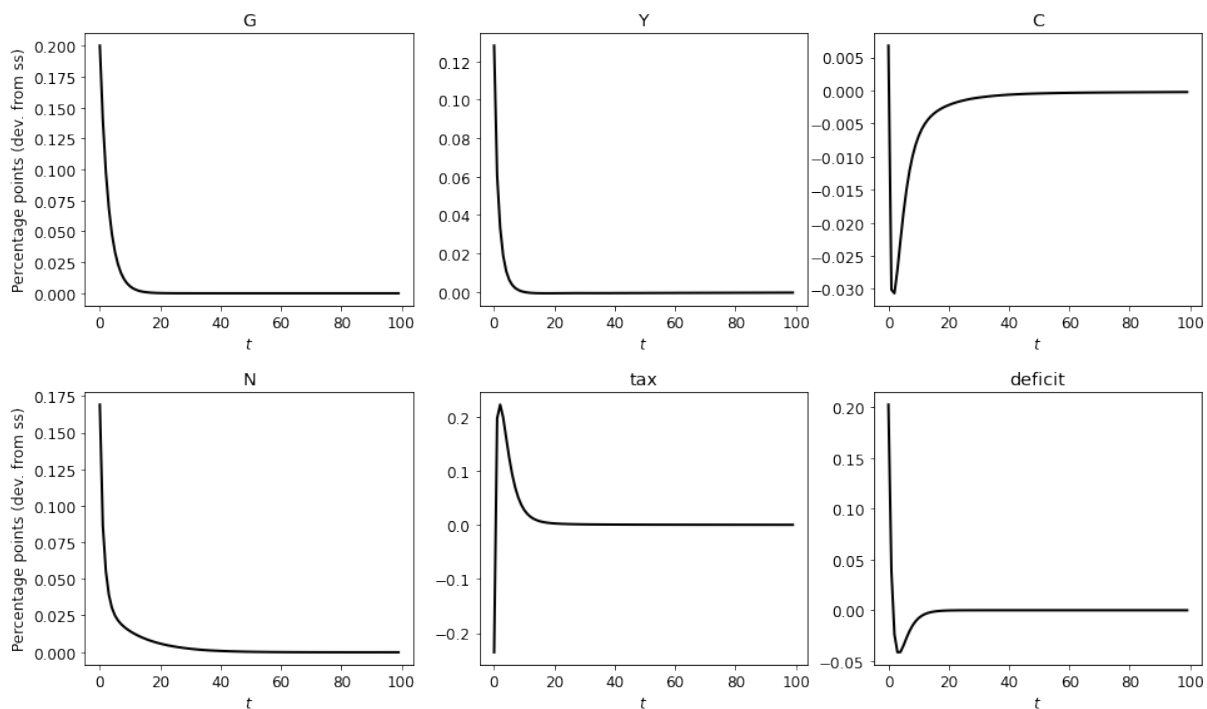


Figure 34: IRFs for Portugal in the two-asset model, deficit-financed shock, baseline Taylor Rule.

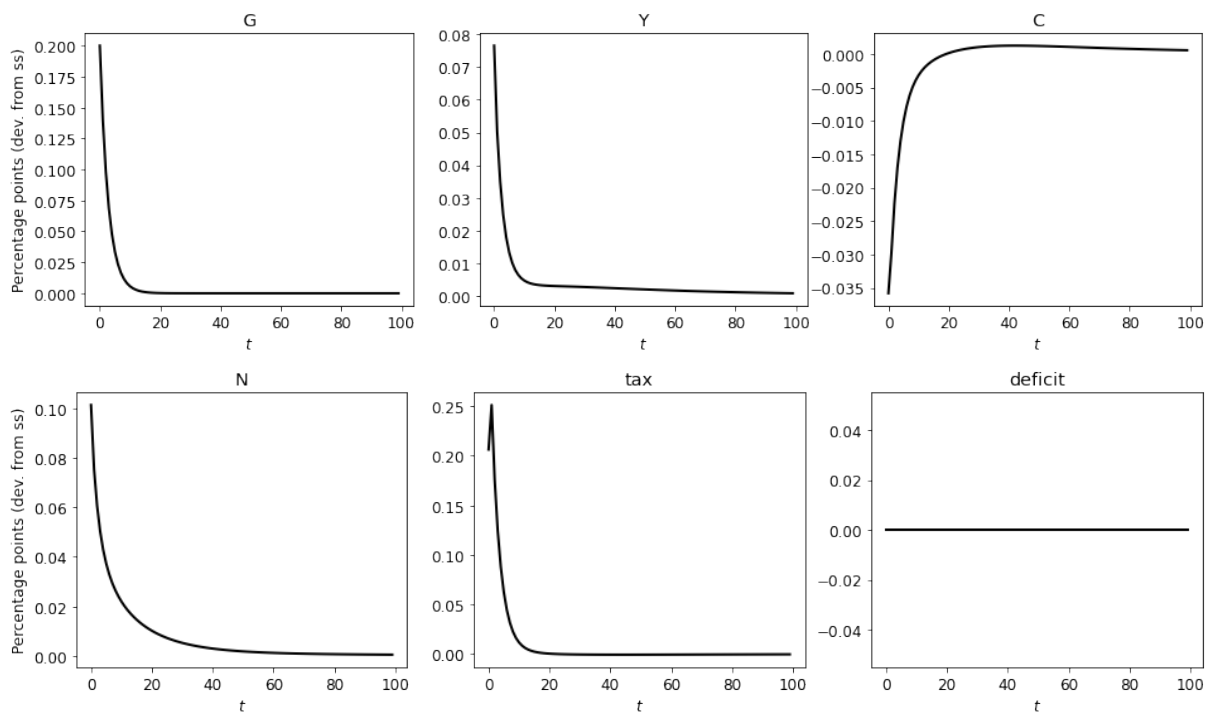


Figure 35: IRFs for Portugal in the one-asset model, tax-financed shock, changed Taylor Rule.

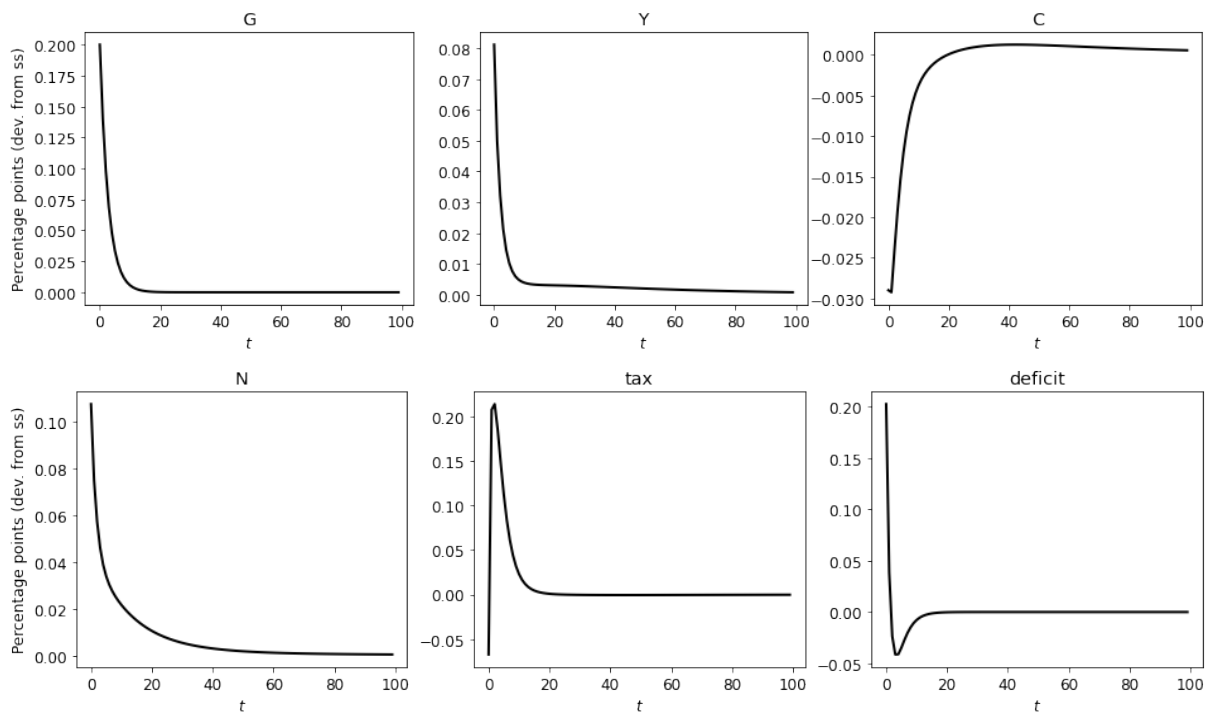


Figure 36: IRFs for Portugal in the one-asset model, deficit-financed shock, changed Taylor Rule.

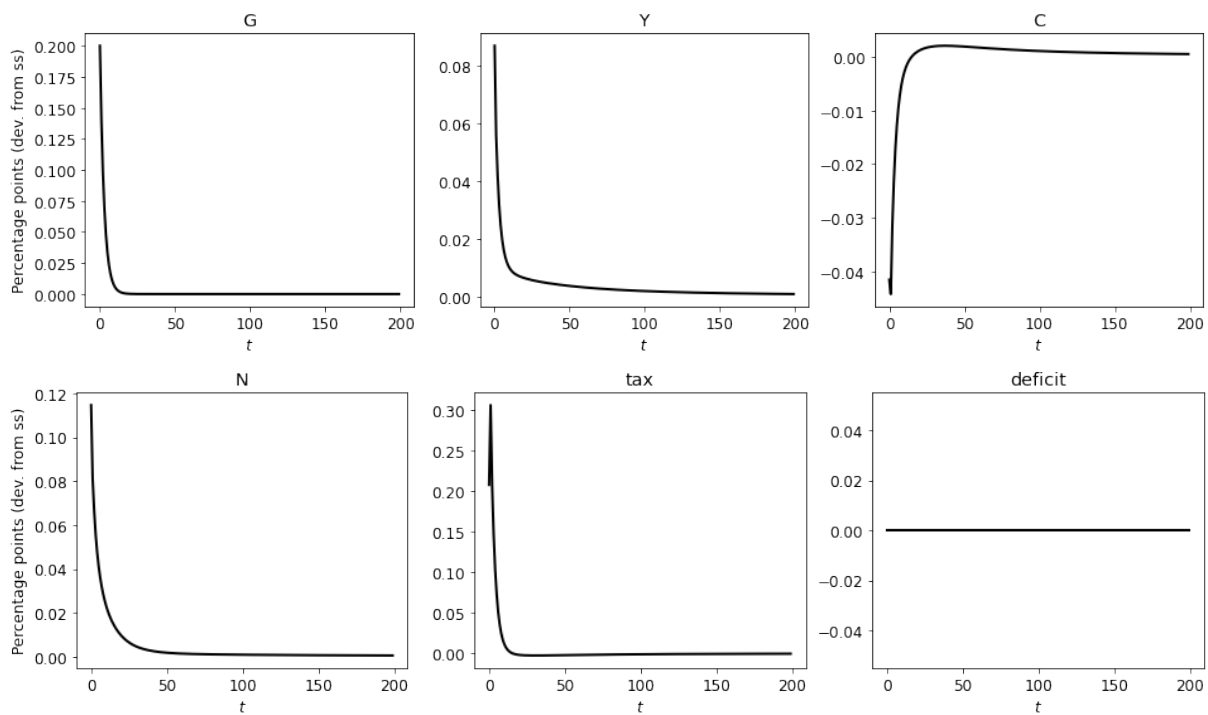


Figure 37: IRFs for Portugal in the two-asset model, tax-financed shock, changed Taylor Rule.

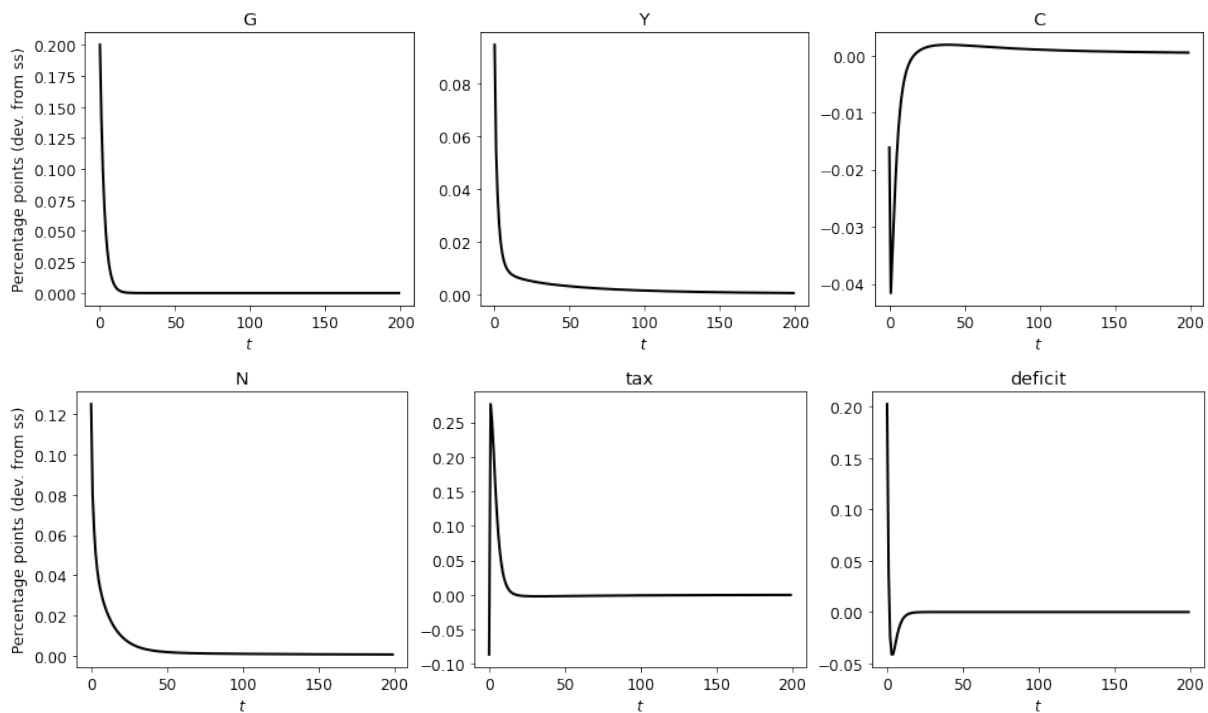


Figure 38: IRFs for Portugal in the two-asset model, deficit-financed shock, changed Taylor Rule.

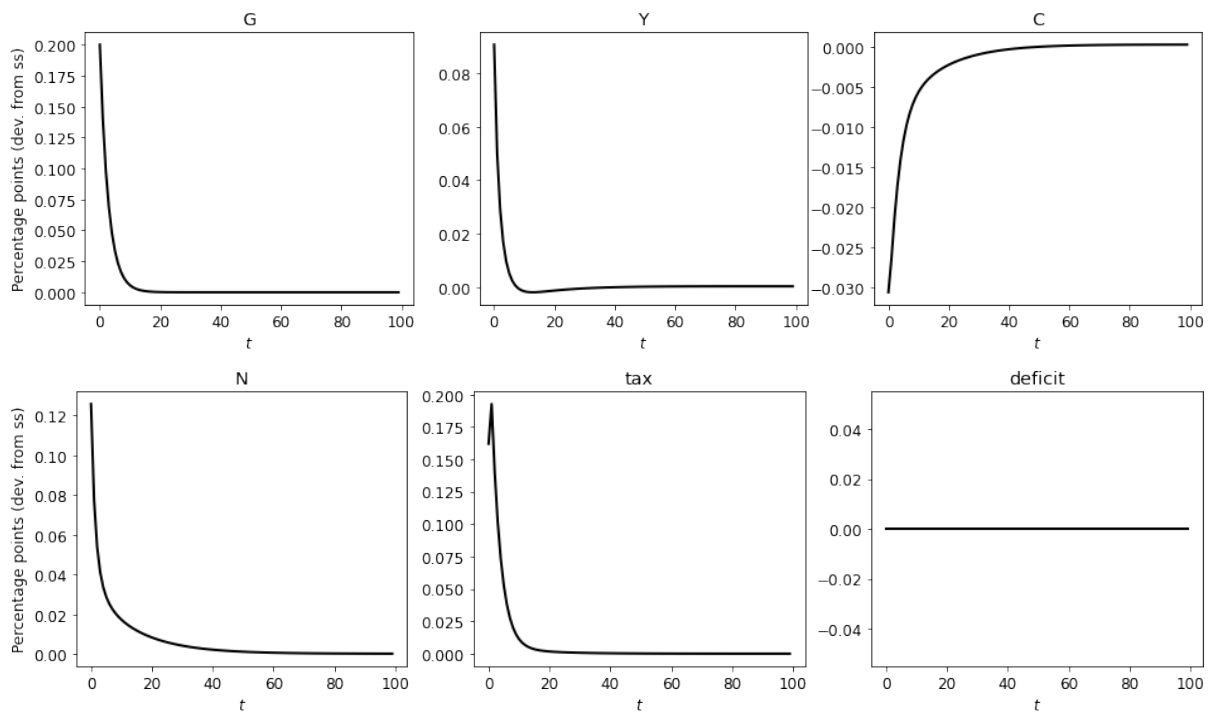


Figure 39: IRFs for Slovakia in the one-asset model, tax-financed shock, baseline Taylor Rule.

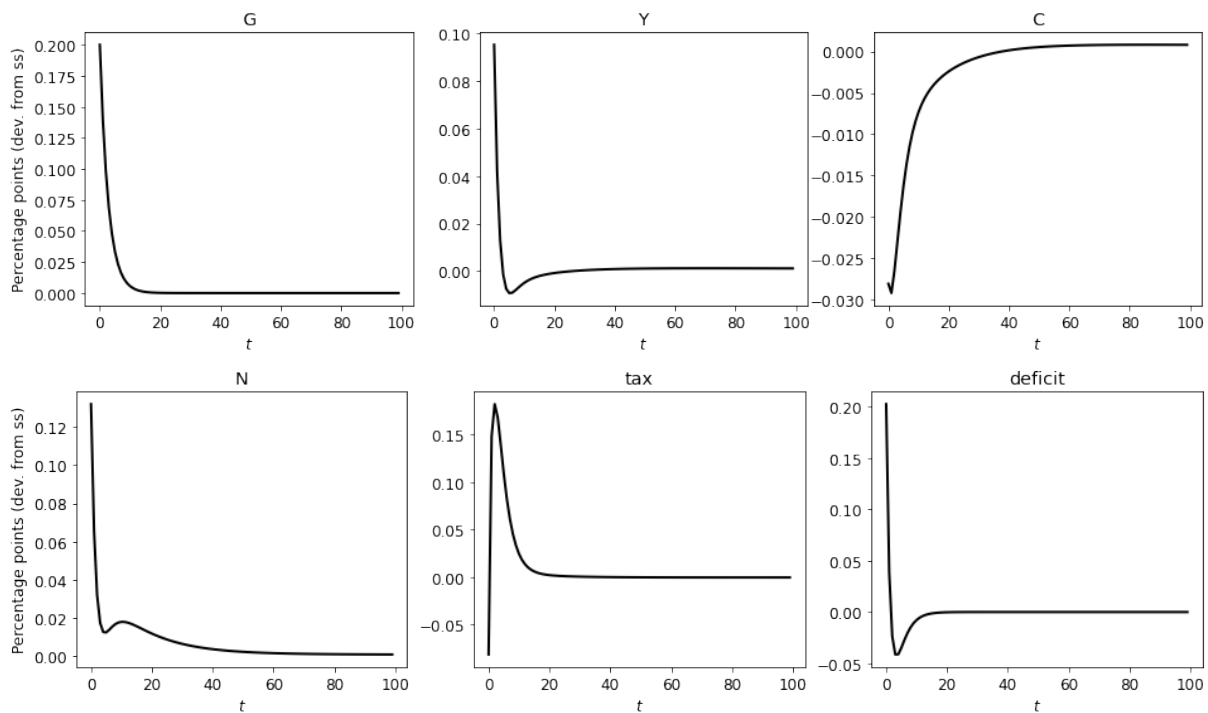


Figure 40: IRFs for Slovakia in the one-asset model, deficit-financed shock, baseline Taylor Rule.

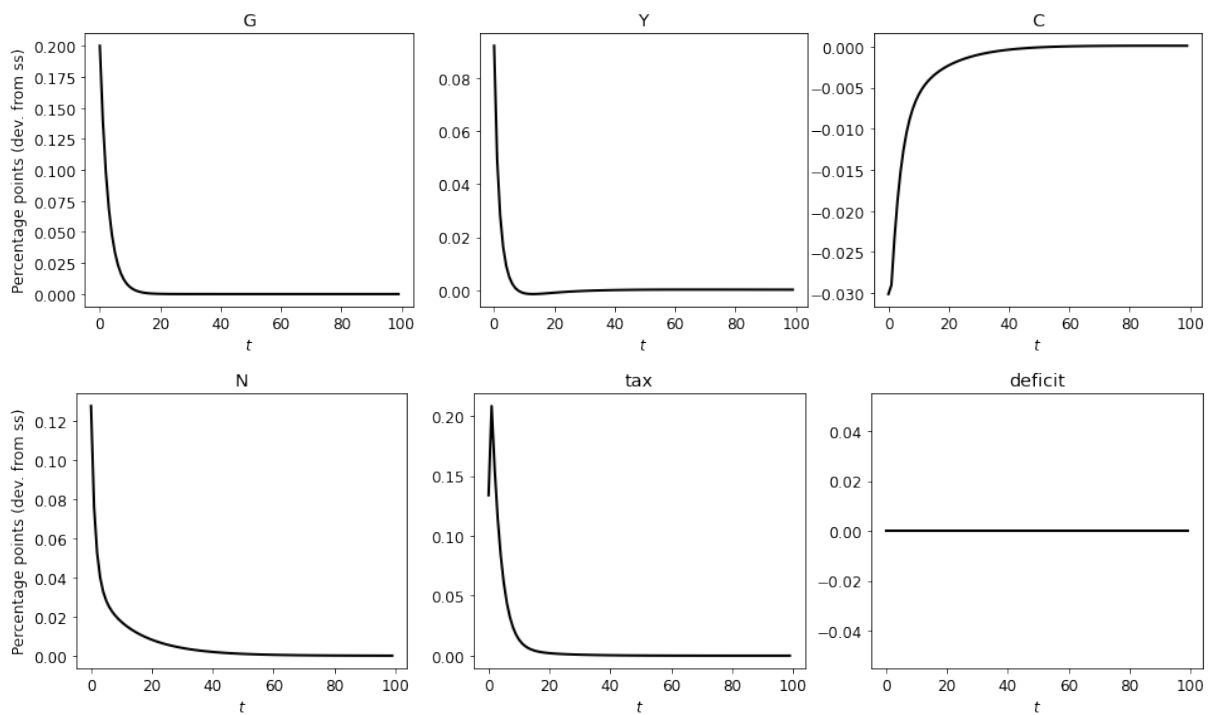


Figure 41: IRFs for Slovakia in the two-asset model, tax-financed shock, baseline Taylor Rule.

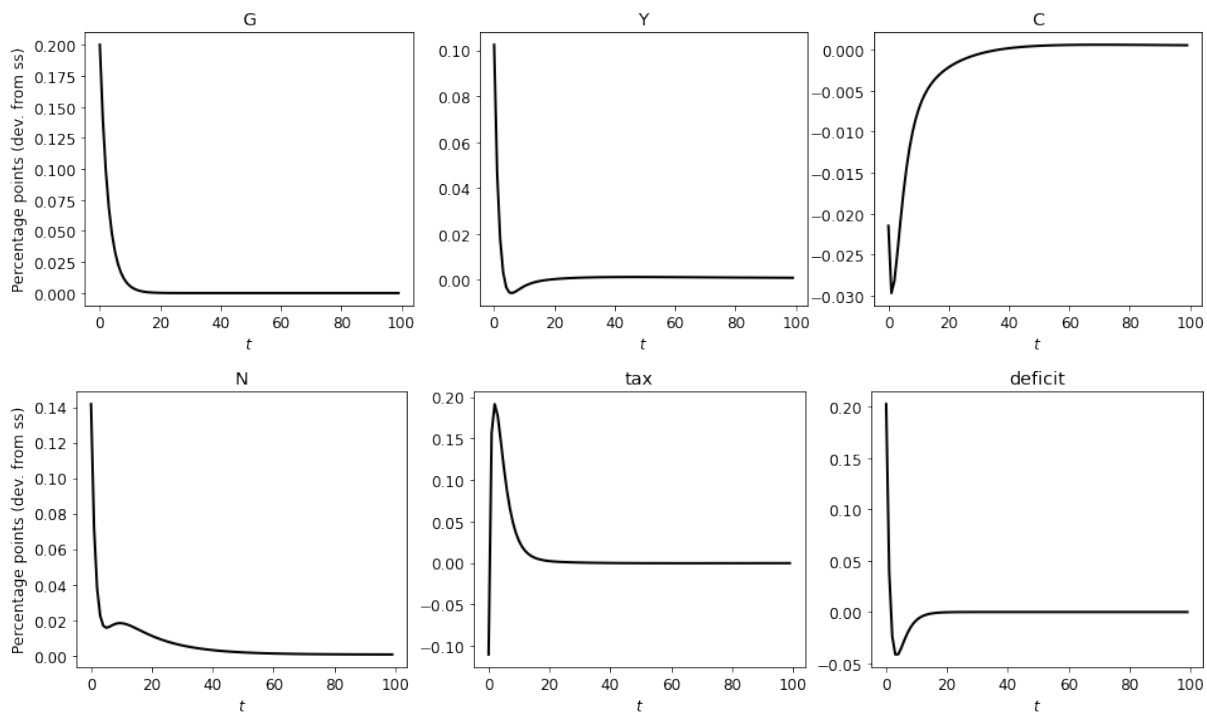


Figure 42: IRFs for Slovakia in the two-asset model, deficit-financed shock, baseline Taylor Rule.

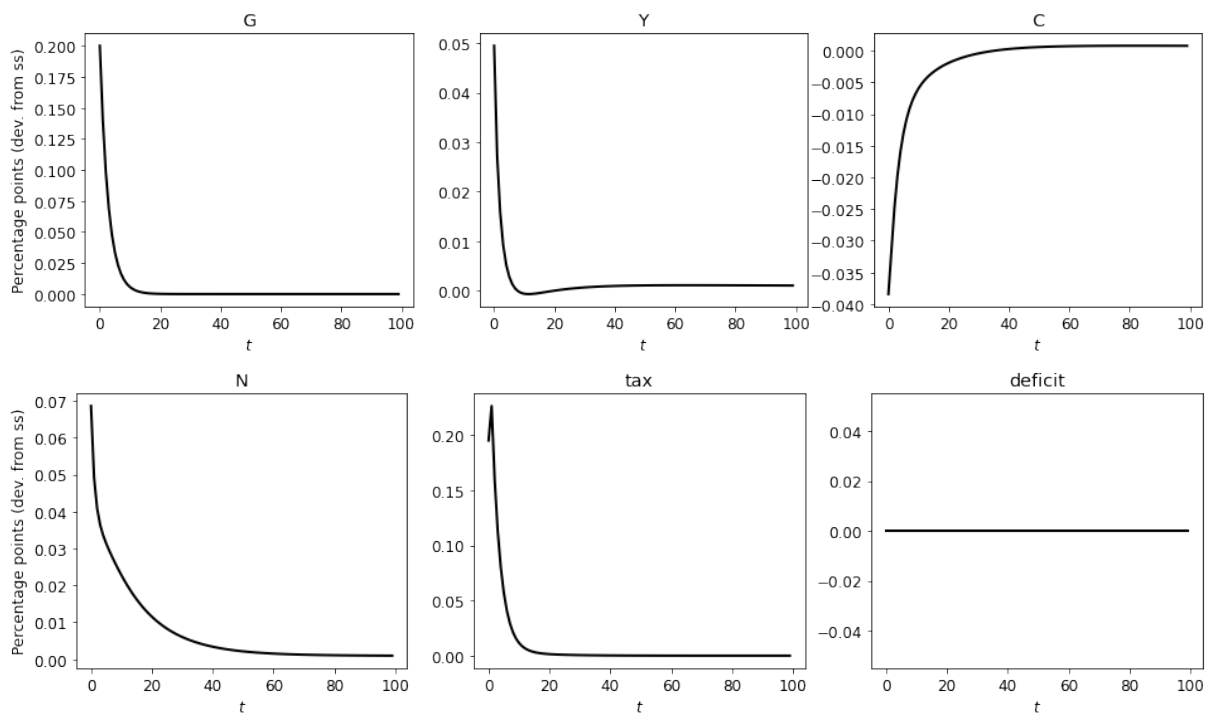


Figure 43: IRFs for Slovakia in the one-asset model, tax-financed shock, changed Taylor Rule.

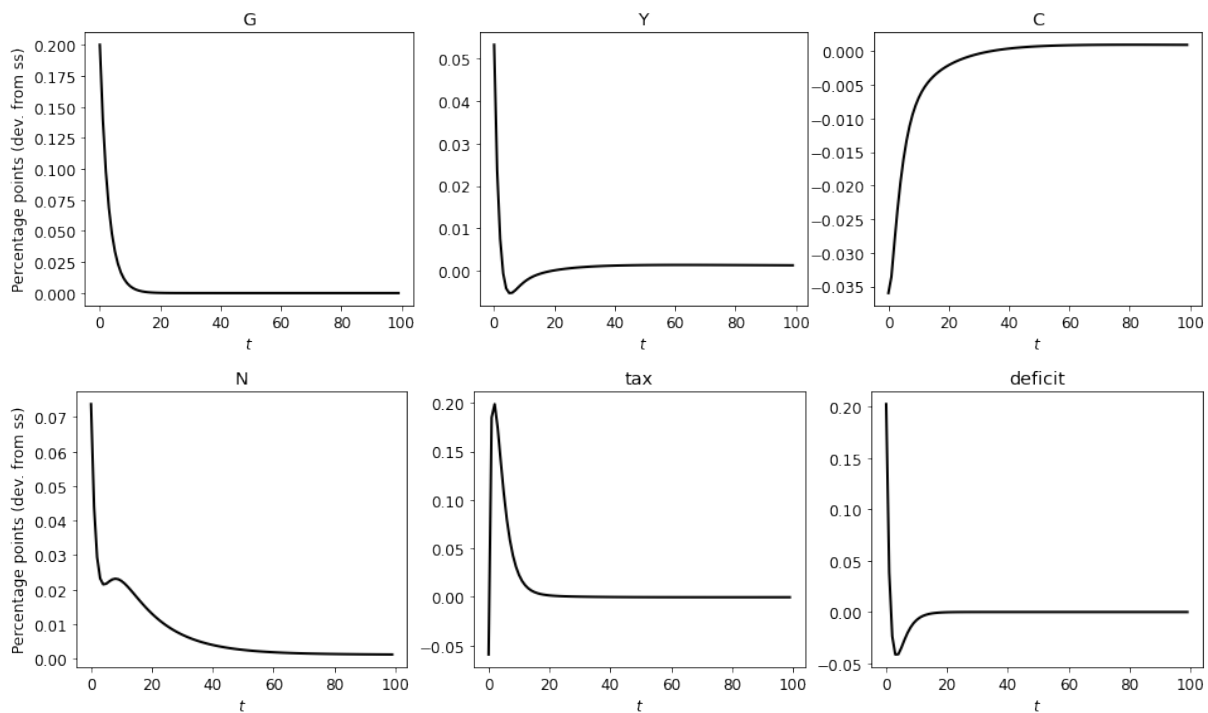


Figure 44: IRFs for Slovakia in the one-asset model, deficit-financed shock, changed Taylor Rule.

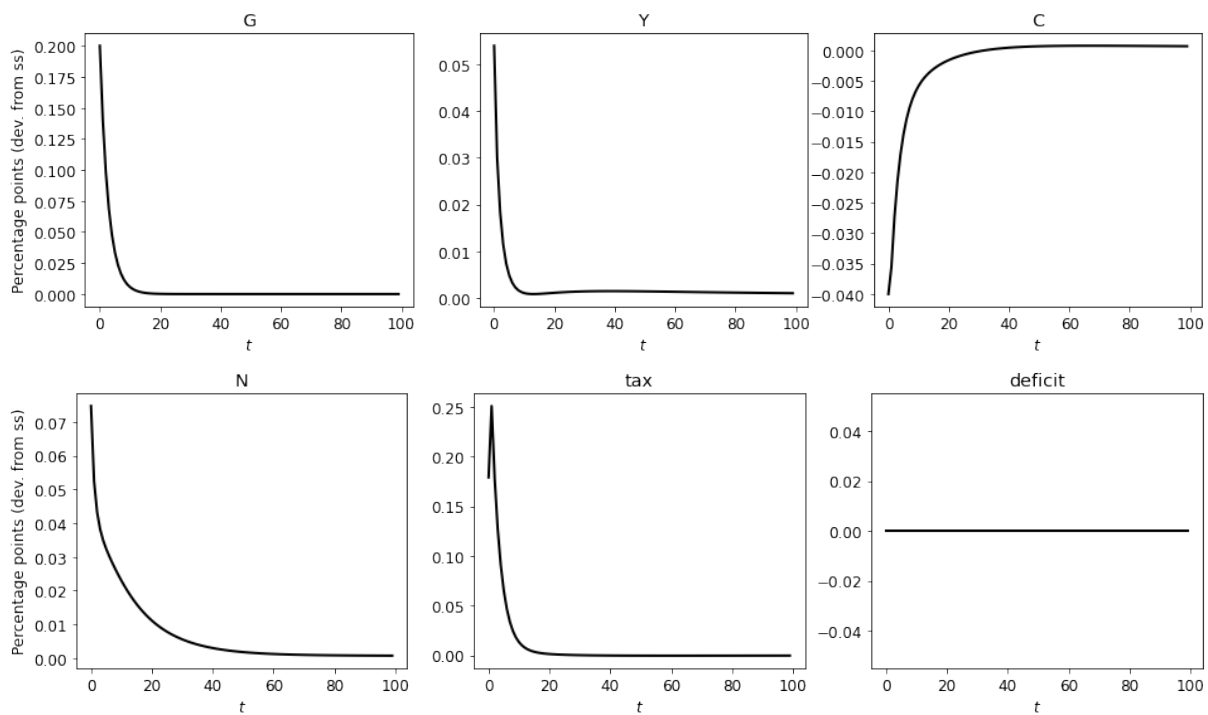


Figure 45: IRFs for Slovakia in the two-asset model, tax-financed shock, changed Taylor Rule.

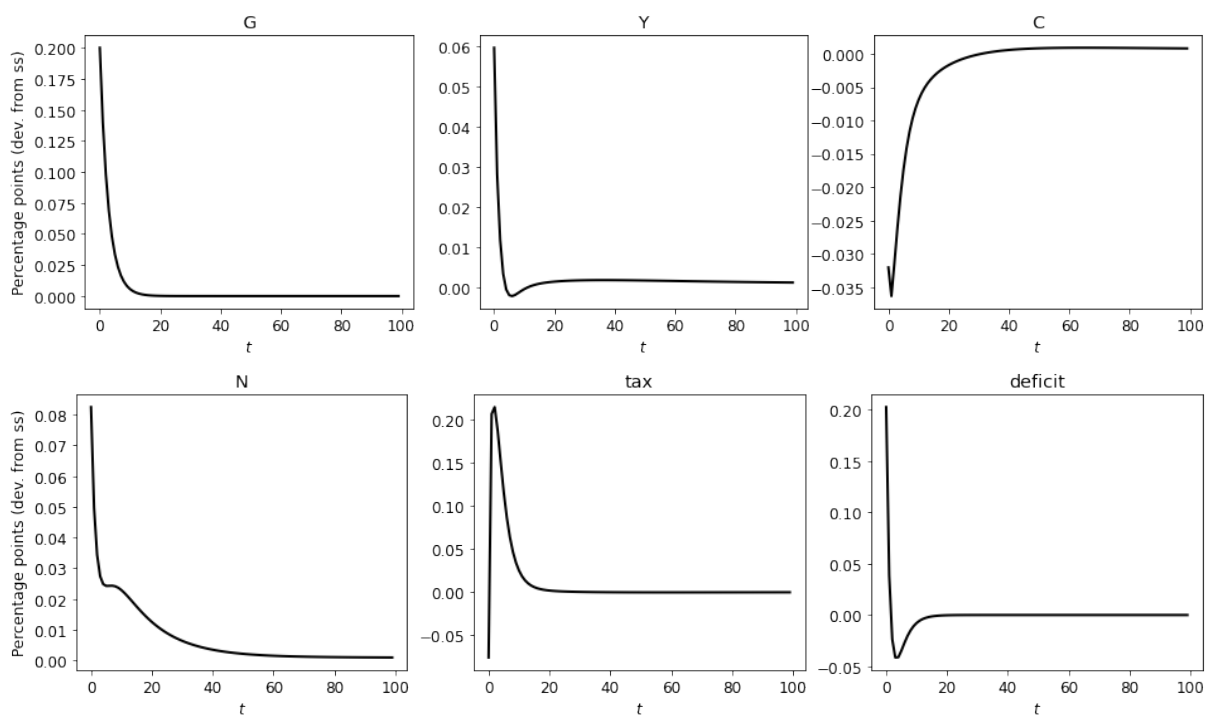


Figure 46: IRFs for Slovakia in the two-asset model, deficit-financed shock, changed Taylor Rule.