Optimal fiscal policies in booms and recessions: a case study for Slovenia

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Article**
JEL: E37, E62, H62
https://doi.org/10.3326/pse.49.4.1

* Several earlier versions of this paper were presented at the 4th International Conference on Computational and Financial Econometrics (CFE'10), London, UK, 10-12 December 2010, online at the 5th International Conference on Econometrics and Statistics (EcoSta 2022), Kyoto, Japan, 4-6 June 2022, and at the 23rd Management International Conference (MIC), Trento, Italy, 4-8 June 2024. Comments from participants at these meetings and especially from two anonymous reviewers are gratefully acknowledged. We also thank Helen Heaney for language correction of the paper. The usual caveat applies.

The authors gratefully acknowledge financial support from the Austrian Science Fund FWF (project no. I 2764-G27) and the Slovenian Research Agency ARRS (contract no. 630-31/2016-1).

** Received: February 11, 2025
Accepted: May 13, 2025

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Abstract

Optimal fiscal policies are determined for Slovenia for the next few years under alternative assumptions about global developments. We construct a baseline scenario, two scenarios with a recession and two with a boom, each with a demand side and a supply side shock. We use the macroeconometric model SLOPOL12 and assume an intertemporal objective function for Slovenian policy makers containing the main targets derived from a survey among policy makers as arguments. Approximately optimal policies are calculated for all scenarios. Fiscal policies are characterized by an unequal design for dealing with the trade-off between output stabilization and budgetary sustainability: instruments with demand side and supply side effects (direct taxes and public investment) are used for output and employment stabilization, while government consumption and other instruments with only demand side effects are assigned to budget consolidation. The results are rather similar in the different scenarios and only mildly counter-cyclical.

Keywords: macroeconomics, fiscal policy, dynamic optimization, Slovenia

1 INTRODUCTION

When policy makers in a certain country deliberate the appropriate design of economic policies, they usually cooperate with experts from research institutes and think tanks to obtain information about the effects of their measures on important variables like economic growth, (un)employment, inflation, the government budget and the current account. Often, they ask directly for advice on what measures would be best in a given situation. The advisors normally provide forecasts of future developments, often in the form of alternatives under certain assumptions about the global political and economic situation. What is often missing, however, is a detailed – and even quantitative – list of measures that would be best for the attainment of the policy makers' goals. Although in a democracy the ultimate decisions are the prerogative of elected policy makers, a systematic analysis of appropriate actions to reach the policy makers' goals in the form of a decision support system could be desirable.

The present paper is a step towards such a system. It provides a case study for deriving optimal macroeconomic policies, fiscal policies in particular, for a specific country. We use an econometric model, called SLOPOL12, and an optimal control approach to derive optimal fiscal policies for Slovenia under specific assumptions about future developments in relation to five scenarios: a baseline, two recession scenarios and two boom scenarios, in each case for global demand and supply shocks. The objective function used is based on the results of a survey among Slovenian policy makers. As a result, we can assess the appropriate course of budgetary policies for Slovenia, given the preferences of the policy makers and the state of the economy through the lens of the econometric model. Using an empirically estimated macroeconometric model has the advantage of including the specifics of a particular economy as compared to the stochastic dynamic general equilibrium models used in the theoretical literature on optimal fiscal policies

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(for a survey, see, e. g., Alogoskoufis, 2019) with more solid theoretical foundations but less empirical relevance.

The structure of the paper is as follows: section 2 gives a brief overview of the optimal control approach used in this paper, including the econometric model and the objective function. Section 3 describes five different scenarios of macroeconomic development: a baseline forecast and two recession and boom scenarios initiated by either demand or supply side shocks. The main results of the optimal policy design are presented in section 4. Section 5 concludes.

2 THE OPTIMAL CONTROL APPROACH USED IN THIS PAPER: ECONOMETRIC MODEL AND OBJECTIVE FUNCTION

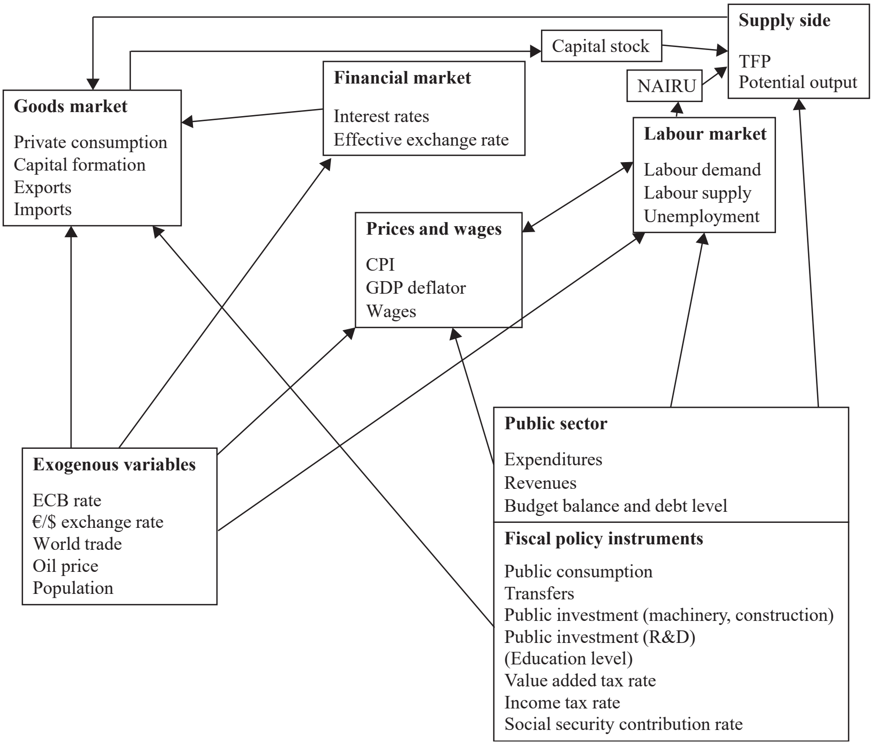
The optimal control approach to quantitative economic policy design, which was initiated by Chow (1975, 1981) and Kendrick (1981, 1988), among others, consists of two elements: an empirical macroeconometric model and an objective function to be optimized. In this study, we use the SLOPOL12 model, a nonlinear medium-sized macroeconometric model of the small open economy of Slovenia. It consists of 75 equations, 23 of which are behavioural equations and 52 identities. In addition to the 75 endogenous variables, the model contains 41 exogenous variables. Almost all behavioural equations are specified in error correction form. The model allows for forecasts and policy simulations for the near future. The model was estimated with data up to the end of 2023.

The model contains behavioural equations and identities for the goods market, the labour market, the foreign exchange market, the money market and the government sector. It combines Keynesian and neoclassical elements, the former determining the short- and medium-run solutions in the sense that the model is demand-driven and persistent disequilibria in the goods and labour markets are possible. Graph 1 is a diagram of the building blocks of the model.[1] A more detailed description of an earlier version of the model with essentially the same structure is given in Weyerstrass et al. (2018).

Potential GDP is determined via a Cobb-Douglas production function with trend employment, capital stock and the trend of total factor productivity (TFP) as factors of production. Trend TFP is determined in a behavioural equation depending on public expenditures on research and development (R&D), the proportion of the population with tertiary education and the investment-GDP ratio. With public R&D expenditures and educational attainment (although the government can influence this only indirectly), two supply-side policy instruments can be considered in the simulations that are targeted primarily at potential GDP.

[1] A detailed description of the version used here can be obtained from the corresponding author at: reinhard.neck@aau.at.

Graph 1
SLOPOL12 building blocks



Source: Authors' construction.

As can be seen from graph 1, the fiscal policy instruments directly affect the goods market, i.e., GDP and its components (both real and nominal). The primary effect is on the demand side, as in most Keynesian models. Indirect effects also come from the supply side via real GDP, capital stock, the labour market and the wage-price system. Simulations showed that the impact of government expenditures is stronger on GDP while government revenues (through tax rates) have stronger effects on the labour market and (un)employment. The side effects on public debt originate directly from the policy variables and indirectly from nominal GDP. In the long run, the model converges to a balanced growth path with real GDP equalling potential GDP, depending on the exogenous variables determining potential GDP. With appropriate paths of the exogenous variables, in the long run potential and actual real GDP and their components grow at approximately the same rate, as do nominal GDP and its components, albeit plus an inflation rate of 2%. Adapted for exogenous disturbances in the scenarios, this long-term path is the starting point for the "ideal" path (to be discussed below) from the viewpoint of the policy makers.

Modelling and estimating econometric models from empirical data is well researched and used in both academia and research institutes. By contrast, not much is known about the empirical specification of objective functions of policy makers. For practical purposes of policy analysis and design, the objective function will express the preferences of those responsible for actual policy making, that is, real politicians. In an earlier paper (Blueschke et al., 2024), we used a survey among Slovenian fiscal policy makers to obtain information about their goals. Their ordinal rankings of targets was then operationalized into the specification of a cardinal objective function.

The policy maker in this optimal control experiment is the government of Slovenia (or its advisors), which, at the beginning of 2024, needed to calculate the optimal trajectories of fiscal policy instruments for the period 2024 to 2030 based on forecasts from the SLOPOL12 model. There are nine control variables (fiscal policy instruments): government consumption, transfers, government investments, public expenditure for research and development (R&D), the average personal income tax rate, the proportion of the active working population with tertiary education (a proxy for human capital), the average social security contribution rate, remaining government revenues (a proxy for lump-sum tax revenues) and the value added tax rate.

We consider a so-called tracking problem, which consists of finding certain paths of control variables that minimize an intertemporal objective function involving squared deviations of the values of the politically relevant variables from some pre-specified "ideal" paths. As usual in economic policy applications, we assume a quadratic objective function with an annual discount factor of 3%[2]. The optimization is restricted by the dynamics of the system given in the form of a system of nonlinear difference equations, which in our case is given by the SLOPOL12 model. In order to specify the objective function, we have to decide on the weights of the different objective (evaluated control and target) variables and on the "ideal" paths for these variables.

For the weights of the objective variables, we take the results of the previous paper (Blueschke et al., 2024) based on the survey of policy makers. Accordingly, we choose eight "major" state variables to enter as arguments in the objective function, with weights in descending order, namely the growth rate[3] of real GDP (9), the public debt level ratio to GDP (8), the current account balance ratio to GDP (7), the unemployment rate (6), real private consumption (5), real private investment (4), the budget balance ratio to GDP (3), and the inflation rate (2). In addition, we define four "minor" target variables, which were not named by the policy makers and which are given a weight of 1: the level of real GDP, the level and the growth rate of potential real GDP and the ratio of government expenditures for R&D to GDP. The level variables are introduced to prevent the optimal time paths oscillating too strongly and the other ones to include the supply side of the economy, which is important in the SLOPOL12 model. Moreover, in order to

[2] As we showed in another paper (Weyerstrass and Neck, 2002), within a reasonable range, the discount factor has no significant effects on the optimal policy in such a framework.
[3] All growth rates in this paper are annual unless otherwise stated explicitly.

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formulate a well-defined optimal control problem, we have to include the instrument variables in the objective function as "minor" objectives. They are given the weight 1, except for the value added tax rate, the income tax rate and the social security contributions rate, which are more difficult to change in the political process and hence are given the high weight of 50, and the remaining tax revenues, which do not affect anything other than the budgetary variables in the model and hence are given the small weight of 0.01.

In addition, we assume "ideal" paths for all of the objective variables to be reached as closely as possible by the optimal policies in the optimal control framework. The "ideal" paths imply smooth growth in the income variables and low values for the rates of unemployment and inflation, as sketched above. Through a process of trial and error, we chose 4 percent as the "ideal" growth rate for real GDP and the other real aggregates (an ambitious value, emphasizing the importance of this target); 4 percent in 2024, 3 percent in 2023, and 2 percent afterwards for the inflation rate (the official goal of the ECB); and the sum of the "ideal" real growth rate and the "ideal" inflation rate for the nominal variables. The "ideal" values of the human capital variable grow by 0.2 percentage points per quarter from the 2023 level. The "ideal" values for the budgetary variables are also relatively ambitious: the "ideal" public debt to GDP ratio decreases from its 2023 initial value of 69.2 percent by 0.4 percentage points per quarter to the EU Stability and Growth Pact (SGP) target value of less than 60 percent at the end of the optimization period, and the "ideal" budget deficit to GDP ratio also decreases by 0.4 percentage points per quarter from its initial value of 3.5 percent.

3 SIMULATION OF POSSIBLE MACROECONOMIC SCENARIOS WITH THE SLOPOL12 MODEL

We use the SLOPOL12 model for simulating and optimizing five alternative macroeconomic scenarios over the period 2024 to 2030. Results for the last years of a forecast are less reliable than the earlier ones, and optimization results over a finite time horizon for the last few periods tend to suffer from a neglect of developments after the last period; therefore, we include a longer time horizon (until 2030) although we are interested primarily in the results for 2024 to 2028 in this study of short-term stabilization policies. We confine ourselves to relatively small shocks arising during a normal business cycle; for large global shocks, problems with structural changes of the model (the famous Lucas critique) may arise.

The scenarios are:

1) The *baseline* scenario, which we consider the most likely one. It was constructed using the most recent available forecast for Slovenia at the time we started working on the paper, the IMAD Spring Forecast 2024 (IMAD, 2024), to calibrate the time paths of the main macroeconomic variables of the model in the noncontrolled simulation as closely as possible to this IMAD forecast. This results in a modestly optimistic view for the years after the COVID-19 pandemic, with real GDP growing between 2 and 2.5 percent per year, a sharply decreasing inflation rate but also a fall in the human-capital variable by about one percentage point

due to the long-term effects of the COVID-19-induced measures (school closures, etc.), an increasing unemployment rate and high budget deficits (well above the EU SGP reference value of 3 percent of GDP) and, hence, increasing public debt. The temporarily decreasing current account surplus is due to increasing import demand from forced savings during the pandemic. This scenario is the baseline for all the other simulations and the optimization experiments.

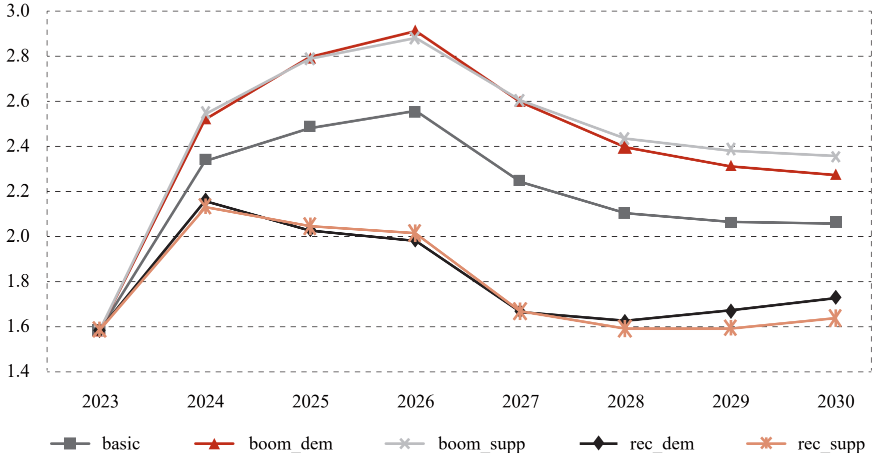
2) The scenario of a (mild) *demand recession* modelling an exogenous negative transitory demand shock. This is obtained from the baseline scenario by assuming a decrease in the growth rate of world trade volume by 2 percentage points relative to the baseline scenario in 2024 and 2025. This may be caused, for instance, by reduced global trade with countries like China due to political measures originating in the United States or Europe. It primarily affects Slovenian exports and aggregate demand variables as well as the unemployment rate in an unwanted way but has virtually no effect on the price level and inflation.
3) The scenario of a *demand boom* modelling an exogenous positive transitory demand shock. It is constructed in exactly the same way as the demand recession shock but with an increase in the growth rate of world trade by 2 percent percentage points relative to the baseline scenario in 2024 and 2025. The effects qualitatively mirror those of the demand recession shock, showing that in spite of the nonlinearities in the model, the negative and positive demand shocks affect the simulations in a nearly symmetric way[4].
4) The scenario of a (mild) *supply recession* modelling an exogenous negative transitory supply shock in 2024 and 2025. Here we combine the decrease in world trade growth by 2 percent percentage points relative to the baseline scenario in 2024 and 2025 from the demand recession with an exogenous increase in the import deflator. Actually, this is a combined supply shock, modelling a leftward shift of the aggregate supply curve, thereby raising the price level exogenously and lowering aggregate demand. This may result from a global increase in energy or food prices or from disturbances in supply chains, for example. We expect a depressing effect on output and an increasing price level effect from this supply shock. Actually, the supply recession scenario shows a slightly stronger depressing effect on real GDP and the other aggregate variables than the demand recession and especially affects the rate of unemployment, which rises by more than 0.5 percentage points in the later periods of the simulation. The combined effect on price level and inflation is negligible because the small negative effect of decreasing aggregate demand and the positive effect of the exogenous price increase on these variables nearly cancel out each other.
5) Finally, the scenario of a *supply boom* modelling the "best of all (macroeconomic) worlds" of an exogenous increase in output and decrease in inflation in 2024 and 2025. Here the effects are less symmetric than for the demand-side shocks but, as expected, favourable for nearly all of the macroeconomic target variables.

[4] This is due to the fact that the SLOPOL12 model is nonlinear as its equations contain products, ratios, logs and growth rates of variables but no nonlinearities that could easily produce more asymmetric affects, e.g., those that generate complex behaviour. In our case, we have qualitative but not quantitative asymmetries.

Graphs 2 to 8 show the results of the simulations for a few key variables in the model. The abbreviations "rec", "dem" and "supp" denote recession, demand and supply, respectively. To make the interpretation easier, level variables are presented as ratios to GDP.

Graph 2

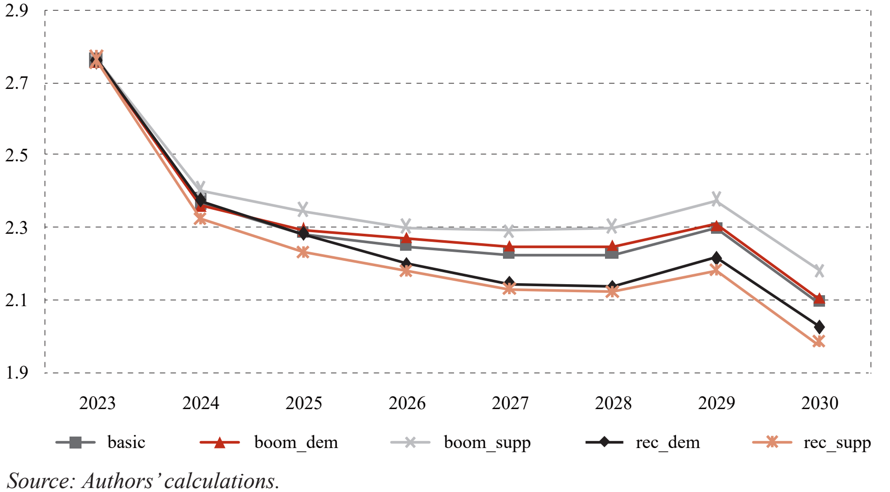
Growth rate of real GDP, percent



Source: Authors' calculations.

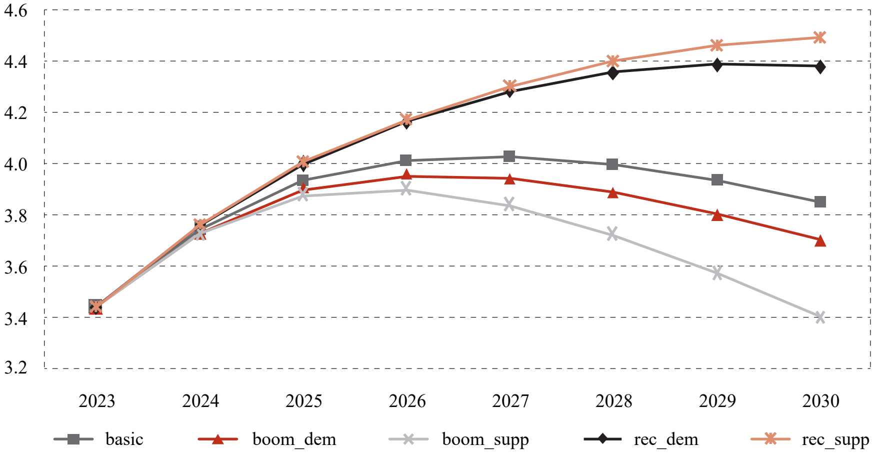
Graph 3

Growth rate of real potential GDP, percent



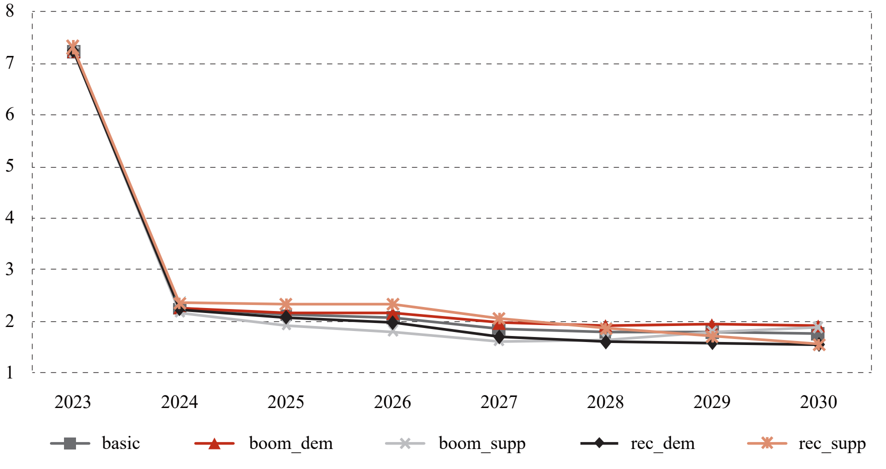
Source: Authors' calculations.

Graph 4
Unemployment rate, percent



Source: Authors' calculations.

Graph 5
Inflation rate, percent



Source: Authors' calculations.

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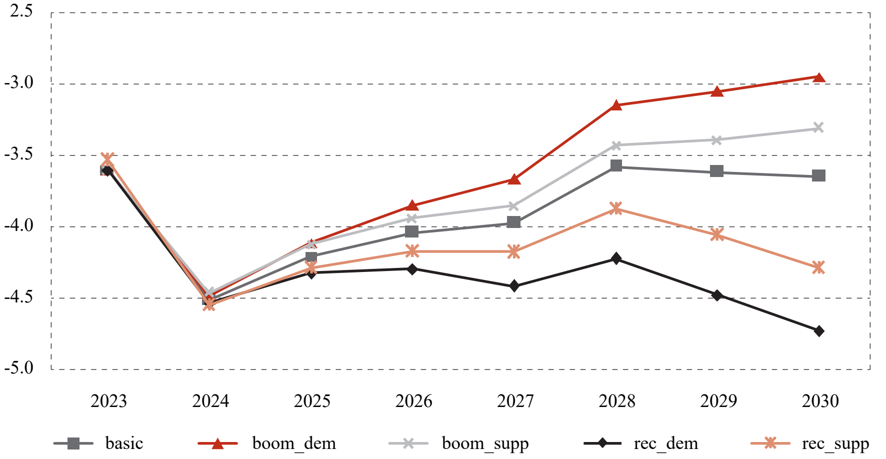
Graph 6

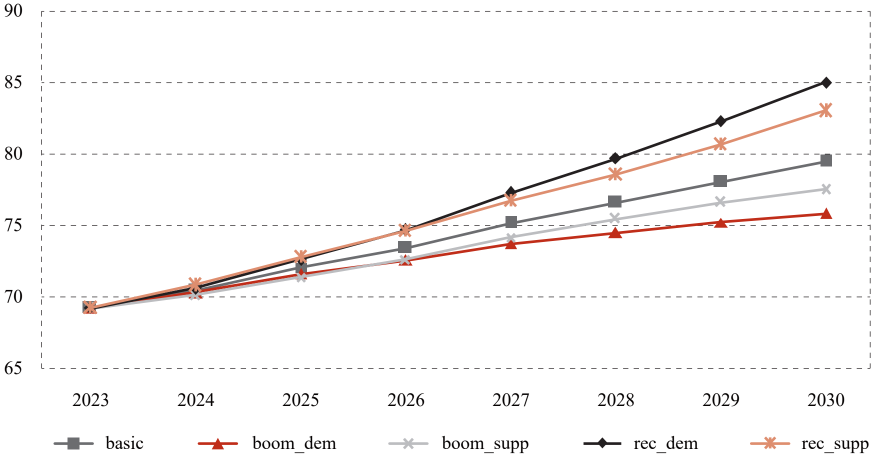
Budget balance, nominal, percent of nominal GDP



Source: Authors' calculations.

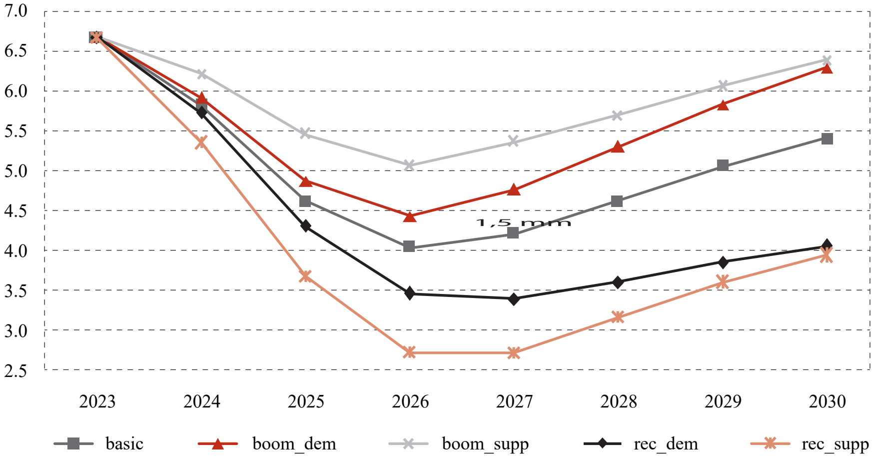
Graph 7

Public debt, nominal, percent of nominal GDP



Source: Authors' calculations.

Graph 8
Current account surplus, nominal, percent of nominal GDP



Source: Authors' calculations.

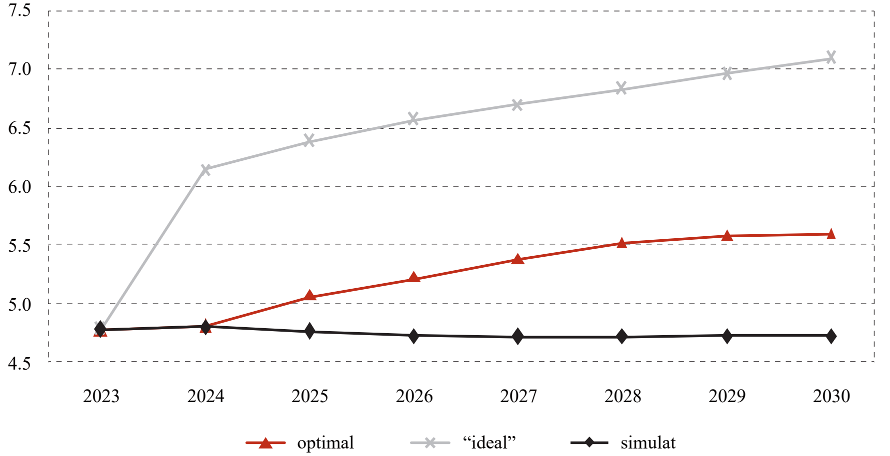
4 OPTIMAL FISCAL POLICIES FOR THE FIVE SCENARIOS

In order to obtain optimal trajectories for the fiscal policy instruments, we run several optimal-control exercises using the OPTCON2 algorithm (Blueschke-Nikolaeva, Blueschke and Neck, 2012; Blueschke et al., 2024). The OPTCON2 algorithm allows us to calculate numerical solutions (approximately) for optimum control problems with a quadratic objective function and a nonlinear multivariate dynamic system with or without additive and parameter uncertainties. Here we confine ourselves to deterministic optimizations, which allows us to perform more optimization runs and avoid the time-consuming stochastic analysis. The intertemporal objective function minimizes the sum of the weighted sums of deviations of target and control (instrument) variables from given "ideal" paths of these variables over a finite time horizon. The SLOPOL12 model, in the form of a dynamic system of nonlinear difference equations, is the intertemporal constraint of the optimization problem. In the nonlinear optimal control problem, we determine trajectories of control variables that minimize the postulated objective function subject to the dynamic system.

In the following optimizations, the weights and the "ideal" paths of the control and target variables are the same for all five scenarios. We first present some results for the baseline scenario and then some for all five together to show the different impact of the shocks on the policy prescriptions. Graphs 9-23 show the results of the optimal policies together with the simulated and the "ideal" paths for the baseline scenario.

Graph 9

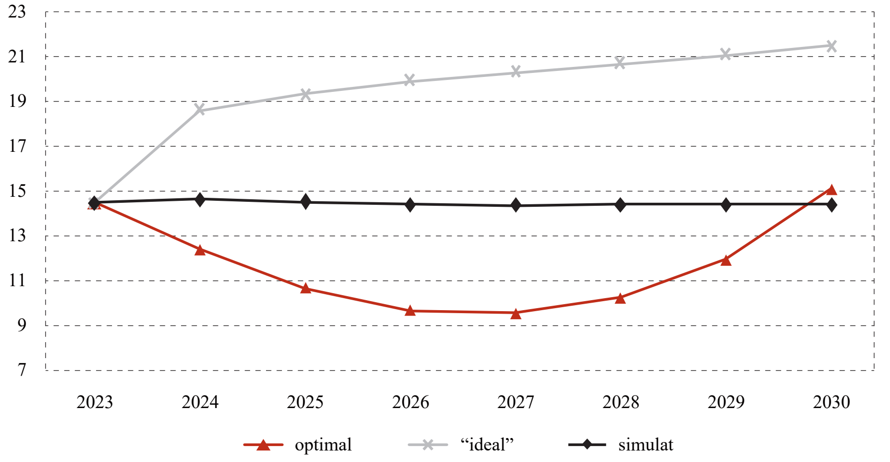
Government investment, nominal, percent of nominal GDP



Source: Authors' calculations.

Graph 10

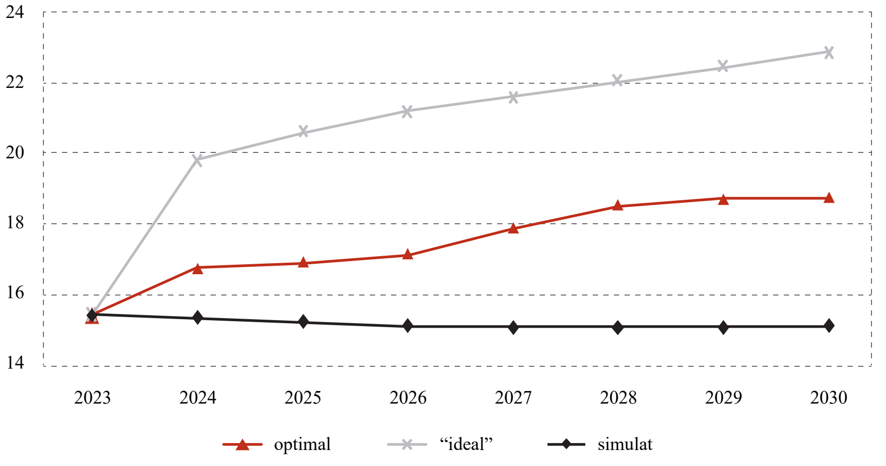
Government consumption, nominal, percent of nominal GDP



Source: Authors' calculations.

Graph 11

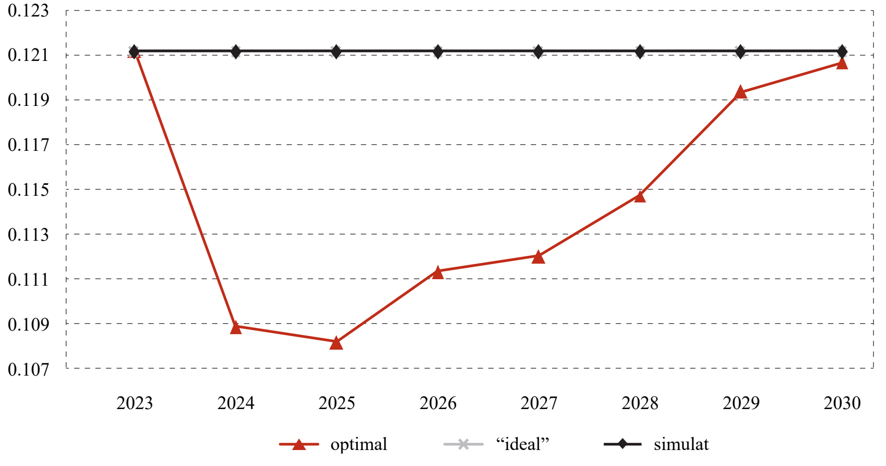
Transfers, nominal, percent of nominal GDP



Source: Authors' calculations.

Graph 12

Income tax rate, average percent of income



Source: Authors' calculations.

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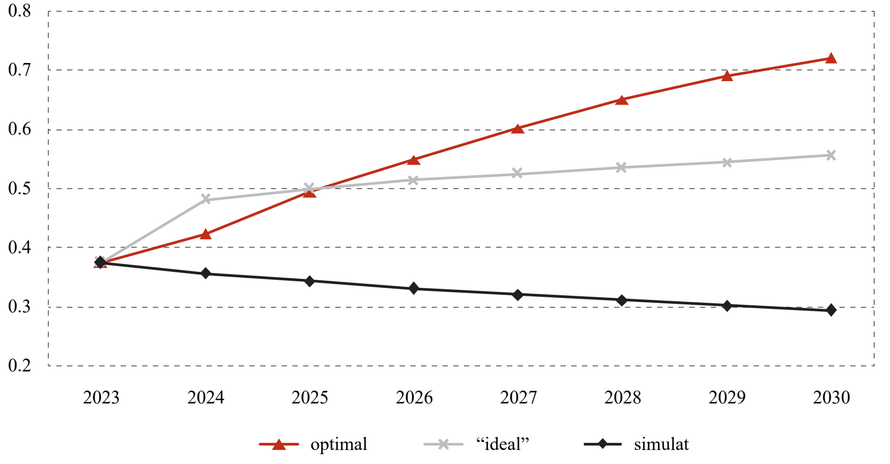
Graph 13

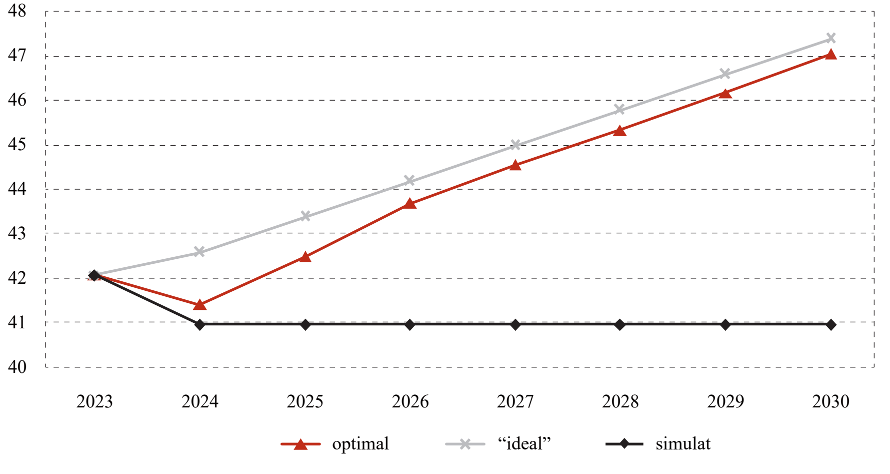
Government expenditures for R&D, nominal, percent of nominal GDP



Source: Authors' calculations.

Graph 14

Human capital investment variable: persons with tertiary education as percent of active working population



Source: Authors' calculations.

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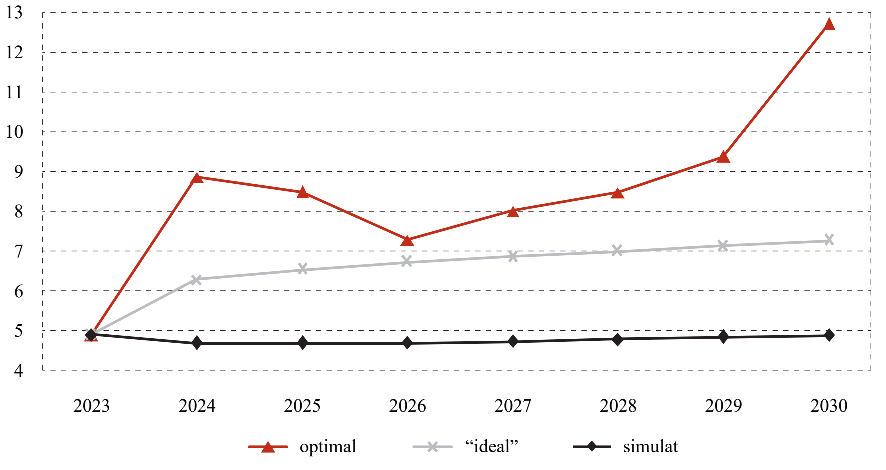
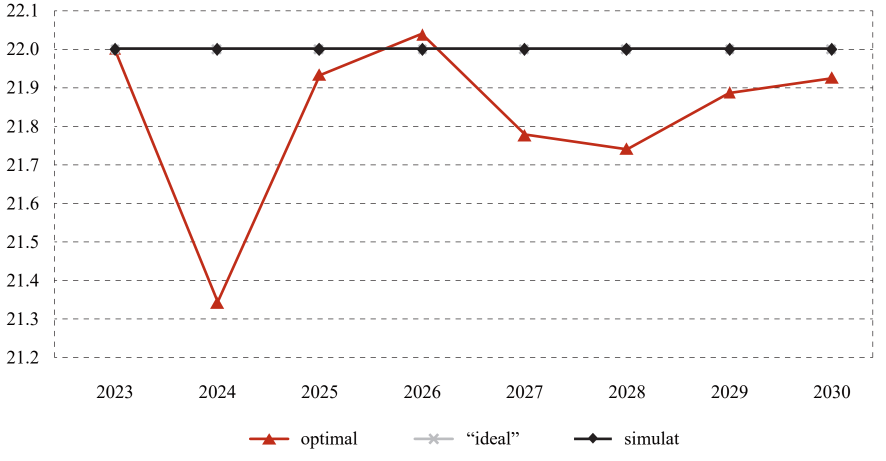
Graph 15
Remaining government revenues



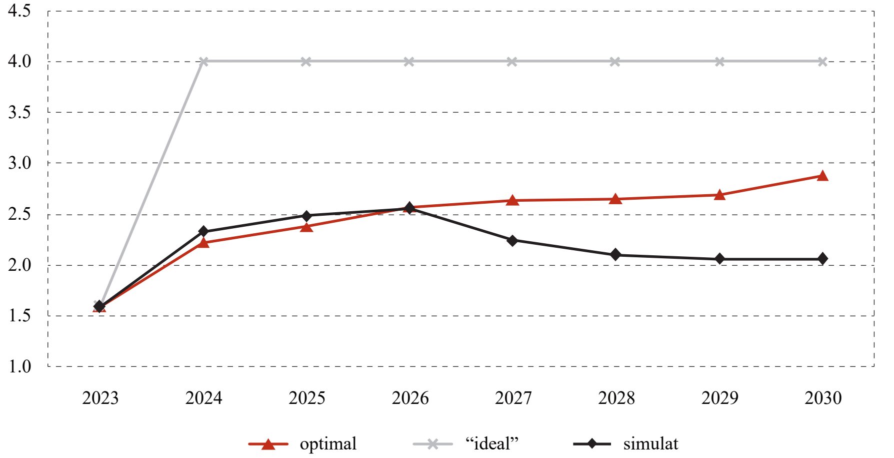
Source: Authors' calculations.

Graph 16
Value added tax rate



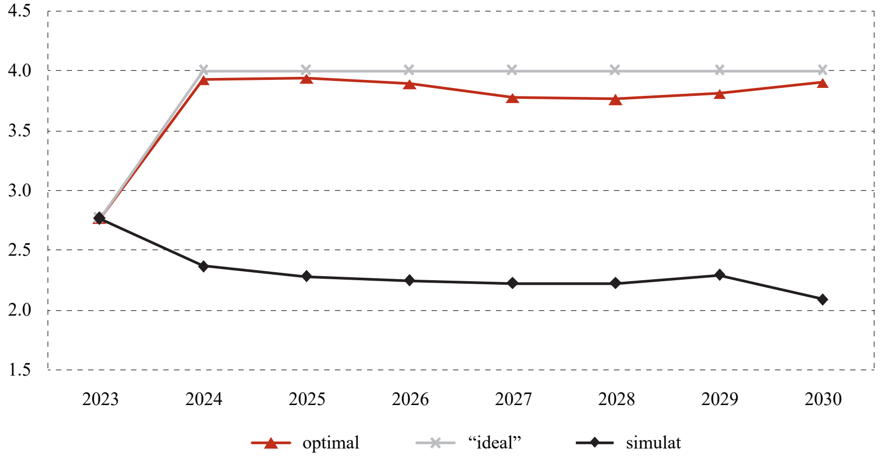
Source: Authors' calculations.

Graph 17
Growth rate of real GDP, percent



Source: Authors' calculations.

Graph 18
Growth rate of real potential GDP, percent



Source: Authors' calculations.

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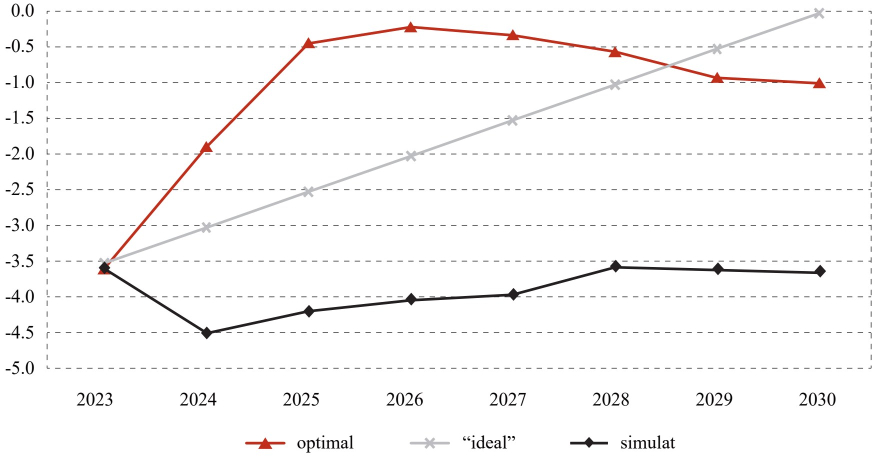
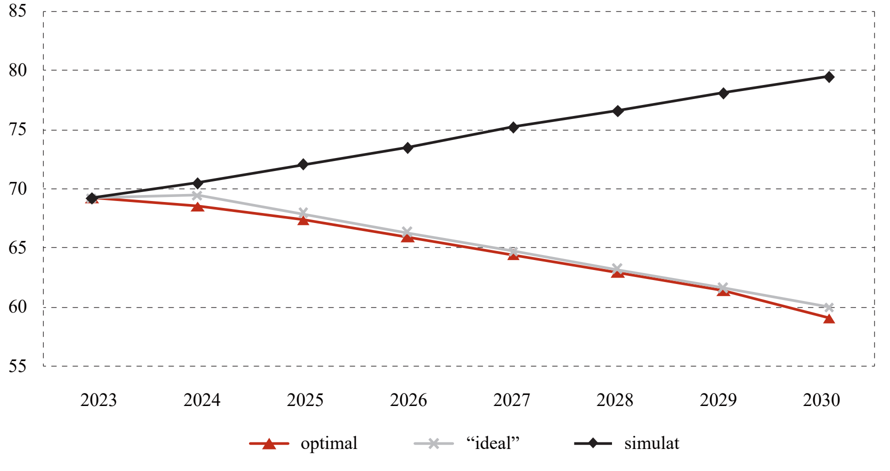
Graph 19
Budget balance, nominal, percent of nominal GDP



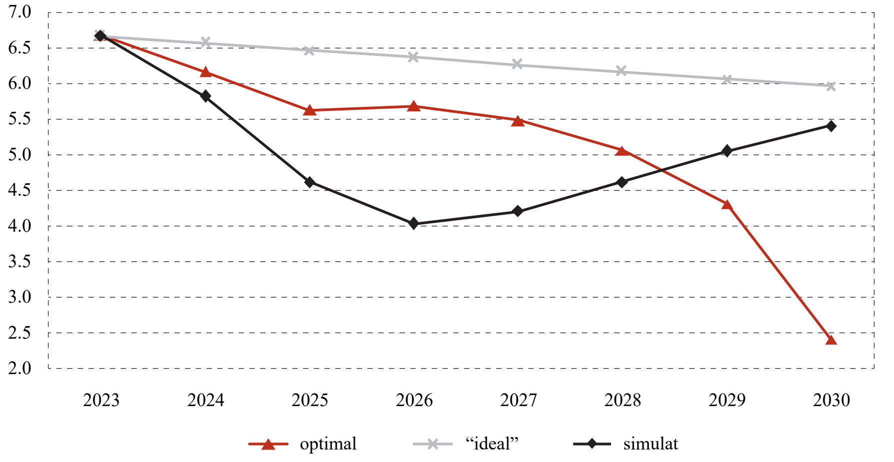
Source: Authors' calculations.

Graph 20
Public debt level in relation to GDP, nominal, percent



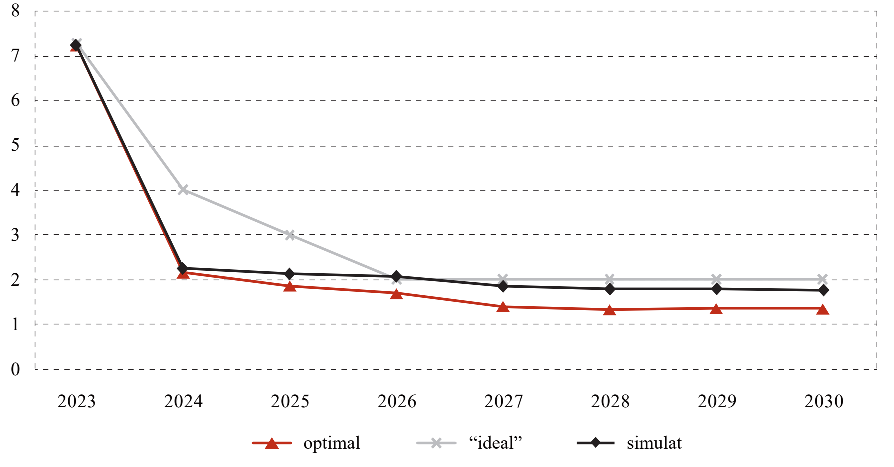
Source: Authors' calculations.

Graph 21
Current account, nominal, percent of nominal GDP



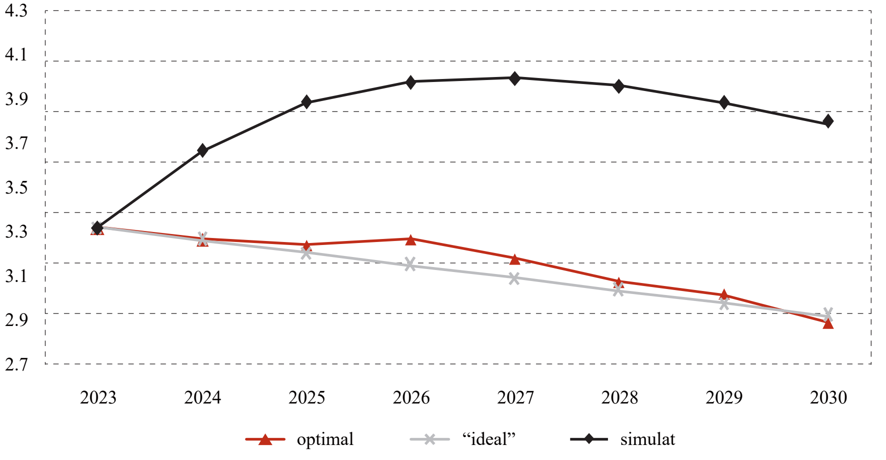
Source: Authors' calculations.

Graph 22
Inflation rate



Source: Authors' calculations.

Graph 23
Unemployment rate



Source: Authors' calculations.

In the baseline scenario, the optimization calls for a fiscal policy mix that is decidedly different for those instruments that affect real output and real potential output directly and indirectly (for instance, through the labour market) and for those instruments that have only direct effects on output or none at all. The former act in an expansionary manner compared to the uncontrolled simulation, increasing expenditures and reducing taxes to keep output and its components (especially private investment and consumption) closer to their "ideal" paths, while the latter act in a pro-cyclical way in order to keep the budget deficit and public debt on paths closer to their "ideal" ones. Alternative "ideal" paths for the budget variables show an even more pronounced highly restrictive tendency for public consumption, which serves to finance the expansionary course of income taxes, social security contributions and public investment.

For the baseline scenario shown here, this can be seen when the paths of government investment (graph 9) are contrasted with government consumption (graph 10): the optimal path of government investment is lower than its "ideal" but higher than the simulated path (the path without optimization) while government consumption is lower than the "ideal" and even the simulated values. The reason for this is the stronger effect of investment on real GDP, both directly and through its effect on potential GDP. The optimal policies call for increases in transfers (graph 11) to increase private consumption as well as a reduction in the income tax rate (graph 12) and a similar but weaker reduction in the social security contributions rate because these latter instruments have a direct expansionary (supply side) effect on labour supply by reducing the tax wedge and thereby increasing employment and output.

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A particularly interesting assignment of policy variables to the goal of boosting actual and potential GDP can be seen from the optimal path of government expenditures for R&D (graph 13) and for the human capital variable (graph 14). These instruments are known from growth theory to drive output higher through their supply-side effects. Our results show that these instruments are also very effective in the short run and should therefore be used to lead the economy towards full capacity utilization when stabilizing the economy in the short run. It is optimal to increase government expenditures for R&D in a smooth expansion path from its initial share of less than 0.4 percent of GDP to nearly twice that share in 2030, even surpassing their "ideal" values in the later periods due to their strong effects on both actual and potential GDP. The human capital variable, which is hampered by the long-run pandemic effects at the beginning, should also increase immediately afterwards to reach its "ideal" value of 47 percent of the population with tertiary education by 2030.

The remaining government revenues, which have no direct effect on non-budgetary variables, are increased much above their "ideal" values to contribute to the consolidation of the government budget (graph 15). On the other hand, the value added tax (VAT) rate, is used in a more countercyclical, mostly expansionary way, being reduced by up to 1.5 percentage points, thereby boosting private consumption, which is an important target according to the politicians' preferences (graph 16). It is interesting to note that, in spite of their own high weights, the income tax rate, the social security contribution rate and the VAT rate are used more actively than expected.

The combined effect of this policy mix can be seen from the variables primarily targeted by fiscal policy in this simulation. Real GDP growth (graph 17) increases only slowly to less than 3 percent in 2030 while the growth rate of potential output (graph 18) approaches its "ideal" value nearly immediately, although its weight is smaller since policy makers did not designate it a target variable. Conversely, the restrictive design of the instruments that are less effective for output leads to a budget deficit (graph 19) that is much smaller than in the simulation and leads quickly to a nearly balanced government budget, staying below 1 percent of GDP over the last six years. This drives government debt to its final "ideal" value, even below the EU SGP target of 60 percent of GDP, along a path that is nearly identical to the "ideal" one (graph 20). This policy also reduces imports more than in the uncontrolled simulation, leading to a slower reduction in the current account surplus except for the last two periods (graph 21).

One of the trade-offs most debated in macroeconomic policy is that between GDP growth (and unemployment) on the one hand and the fiscal variables public budget deficit and public debt on the other hand. Policies aimed at increasing growth and reducing unemployment in recessions have led to increases in government deficit and debt beyond sustainable values in many European countries and were critical in the European sovereign debt crisis in the 2010s. In view of this, at first sight it

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is astonishing that here this trade-off does not seem to be present. Although real GDP growth is only modestly increased to less than over one percentage point below its "ideal" value of 4 percent by optimizing the objective function, the "ideal" debt is virtually reached in every period, which is achieved by reducing the deficit strongly in the first few periods – a "cold turkey" fiscal policy (shock therapy), without undesirable side effects on targets such as unemployment, for instance. When looking at the contributions of GDP growth and public debt to the value of the objective function, one can see that they are 2789.65 for growth and 2,318.50 for debt in the noncontrolled solution and 1718.36 for growth and only 3.09 for debt in the optimal solution, meaning that it is by far easier to control public debt than GDP. The optimal policy therefore drives debt to its "ideal" path, using some of those expenditures and taxes which have little or no effect on GDP, and then uses its more effective policy instruments to achieve better paths for the non-fiscal variables.

The famous Phillips curve trade-off between inflation and unemployment does not seem to be present in Slovenia. This is mainly due to the behaviour of the inflation rate, which is only marginally affected by fiscal policy but nearly fully determined by exogenous factors, especially the Euro Area wide monetary policy of the European Central Bank (graph 22). The unemployment rate, on the other hand, is strongly influenced by the fiscal policy mix suggested by the optimal policy design: it moves along a path that is nearly identical to the "ideal" one, despite the only slow increase in GDP growth and the resulting output gap (graph 23). A modest increase in GDP growth is sufficient to drive the unemployment rate along its desired values, which effect is supported by the supply side orientation of the policy mix.

Next, we consider the optimal policies when confronted with short-term recessions or booms from the demand or the supply side. This is illustrated by comparing optimal fiscal policies in the five scenarios (graphs 24-30). It turns out that for the instruments aiming at increasing the productive capacity of the economy, the optimal paths are very close to those for the baseline scenario. This is true especially for the relatively expansionary design of government investment, government expenditures for R&D and the human capital variable. In contrast, financing these expenditures by reducing government consumption and some taxes is done in a similar procyclical way as in the baseline scenario: restrictive in recessions, less so in booms.

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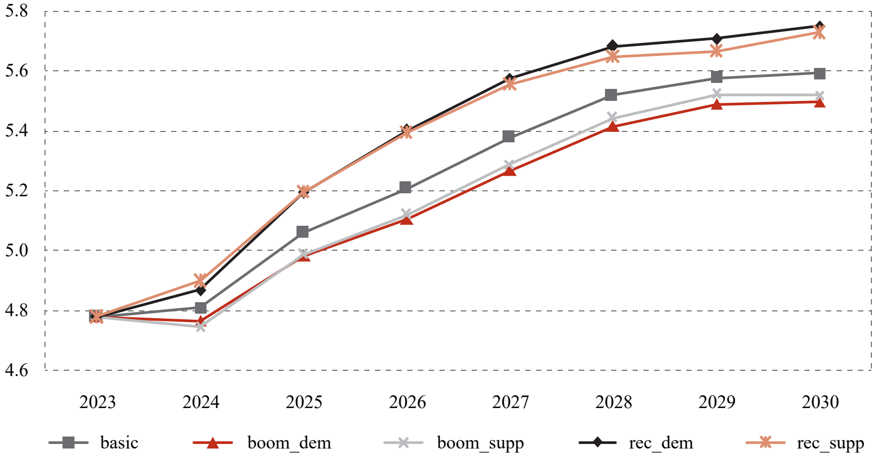
Graph 24

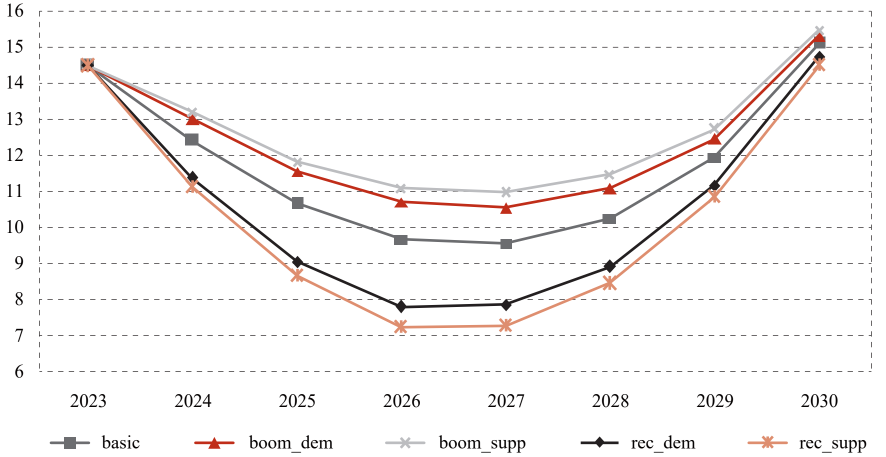
Government investment, nominal, percent of GDP



Source: Authors' calculations.

Graph 25

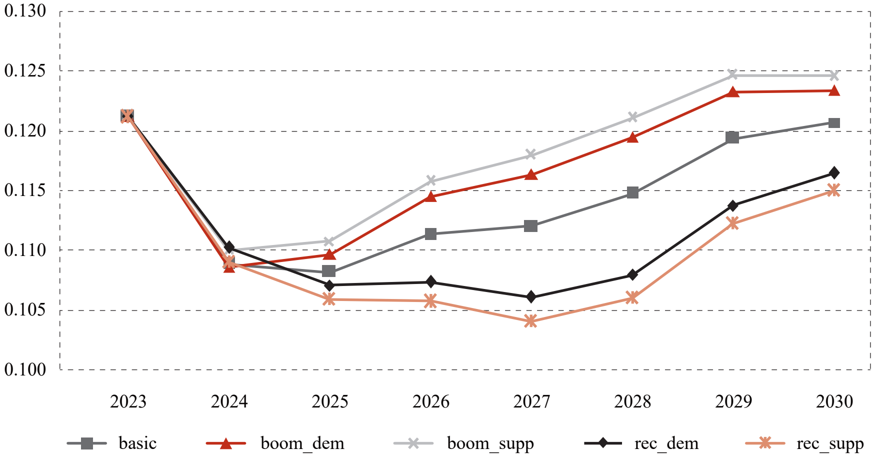
Government consumption, nominal, percent of GDP



Source: Authors' calculations.

Graph 26

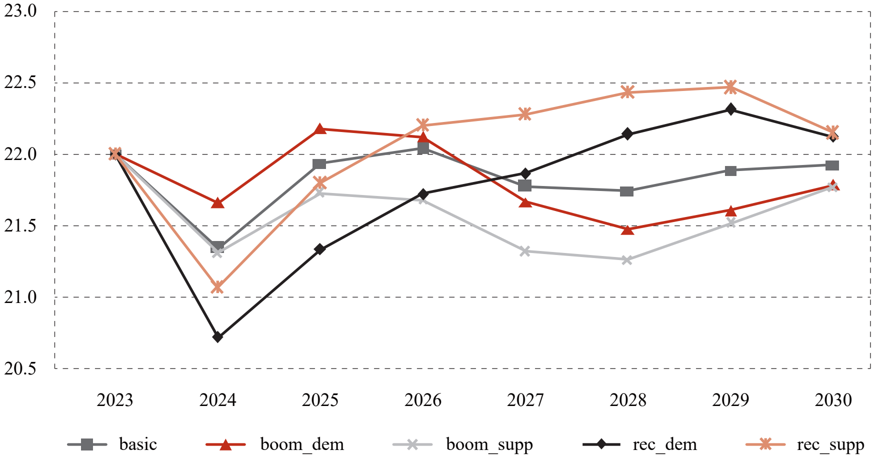
Income tax rate, average percent of income



Source: Authors' calculations.

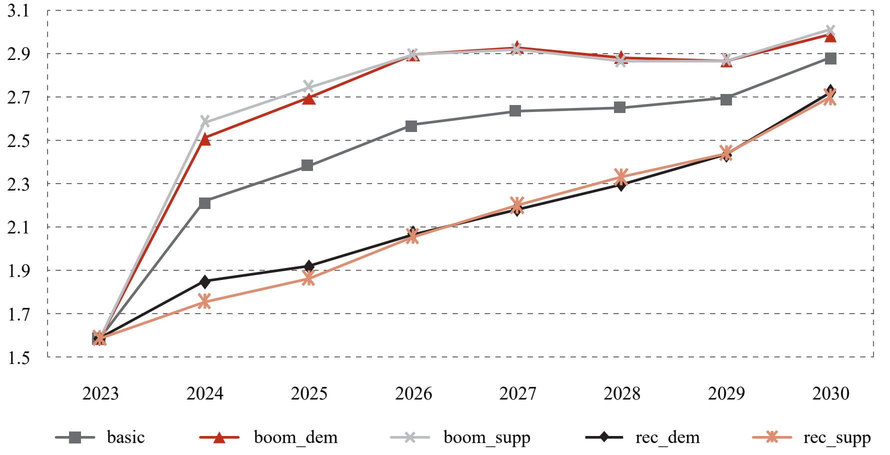
Graph 27

Value added tax rate



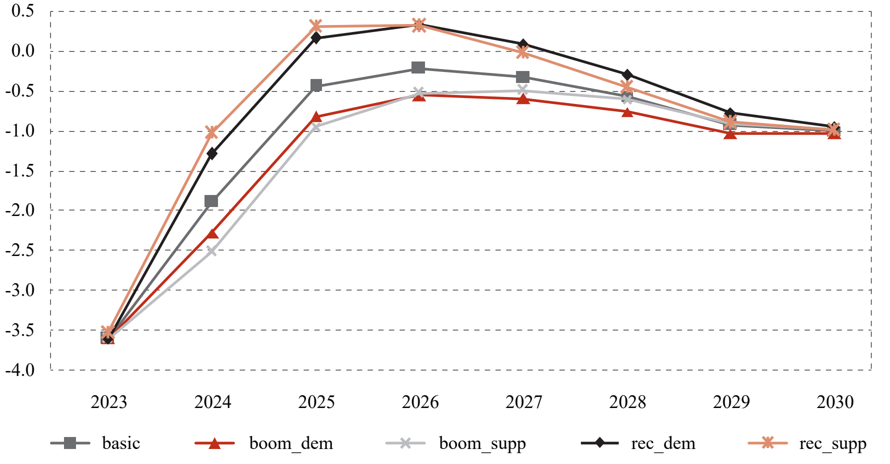
Source: Authors' calculations.

Graph 28
Growth rate of real GDP, percent



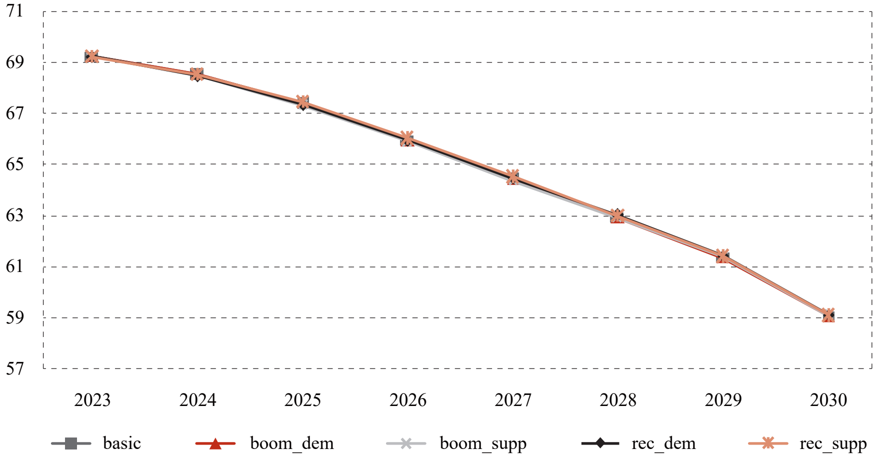
Source: Authors' calculations.

Graph 29
Government budgetary surplus, percent of GDP



Source: Authors' calculations.

Graph 30
Public debt level in relation to GDP, nominal, percent



Source: Authors' calculations.

This is shown in graph 24 for government investment, in graph 25 for government consumption and in graphs 26 and 27 for two categories of taxes. While government investment as a strong countercyclical policy instrument is higher in the recession and lower in the boom than in the baseline scenario, the contrary is true for government consumption. The two tax rates also differ in their reaction to business cycle shocks: income tax rates (graph 26), which already behave countercyclically in the baseline scenario, do so more intensively in recessions (becoming lower than in the baseline scenario) and booms (becoming higher). The VAT rate (graph 27) in the two recession scenarios behaves countercyclical in the first half of the optimization period and procyclical in the second, thus turning from an orientation towards output and private consumption to one addressing public debt and deficits. In the boom scenarios, its orientation is less clear and expresses its contribution to both output and the public budget. The remaining tax revenues, which do not affect aggregate demand and output, actively contribute to financing the increases in government expenditures and reductions in income tax.

Graph 28 shows the results of the policy mix in the different scenarios for the main target variable growth rate of real GDP. This, as well as the growth rate of potential output, exhibits behaviour qualitatively similar to that in the baseline scenario but the effects of the recessions and the booms are closer to the respective uncontrolled simulations than to the "ideal" paths. This means that only part of the seemingly additional stabilization need is fulfilled by optimal fiscal policy. The reason for this is, again, the trade-off between output stabilization and budgetary prudence. Graph 29 shows that in all scenarios, the government budget deficit behaves in a way similar to that in the baseline scenario. In particular, irrespective of the shocks investigated here, the optimal policy calls for a strong reduction of the budget deficit as soon as at the beginning of the planning period. This results in a path of government

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debt that in all scenarios is nearly identical to the "ideal" one, which results from the ease of obtaining this path with the optimal assignment of the different fiscal instruments (graph 30). Thus, to secure fiscal sustainability, it is optimal to design countercyclical policy actions with moderation, using only those instruments with more than immediate effects on output and employment, especially supply-side oriented measures such as reductions of direct taxes and increases in expenditures boosting actual and potential output.

As a policy conclusion, the optimization experiment suggests combining the fiscal policy instruments in a different way in view of the trade-off between output and the sustainability of public finances. According to the SLOPOL12 model, Slovenian fiscal policy makers can be advised to divert a large amount of its budget from consumptive expenditures to physical and human capital, while reducing income taxes and social security contributions, to obtain smooth growth with favourable effects on the state budget and debt. The task of budget consolidation should be accomplished as early as possible.

5 CONCLUSIONS

In this paper, we determined optimal fiscal policies for the next few years for Slovenia under alternative assumptions about global development. We used the macroeconometric model SLOPOL12 and assumed an intertemporal objective function for Slovenian policy makers containing output, unemployment, inflation, the budget deficit, public debt, and the current account as its main arguments. Using the OPTCON2 algorithm, approximately optimal policies were calculated under different scenarios, modelling modest global shocks. This serves to obtain information about trade-offs for Slovenian fiscal policy makers and advisable policy measures over the next few years under different conditions of the global economy. For an analysis of major global shocks (such as the COVID-19 shock or further geopolitical tensions), a different framework must be adopted.

The most important results of this study are:

1) Fiscal policy can, in the absence of a national monetary instrument, perform the task of stabilizing the economy to a certain extent by using some of its instruments in a Keynesian way to deal with recessions and booms in a qualitatively symmetric way to exert an influence on target variables such as GDP growth and unemployment, but not inflation.
2) There is a trade-off between output stabilization and the sustainability of budgetary policy, where the latter aim can be dealt with by the fiscal instruments very effectively, but at the price of a relatively low effectiveness of optimal fiscal policy with respect to GDP and its components in the short run.
3) Reactions of fiscal policy on negative (recession) and positive (boom) shocks should be dealt with in a moderate way and, at least for the shocks investigated here, without deviating much from the optimal policy course without these shocks.

4) Assigning policy instruments with supply side effects on potential output, real GDP and employment (such as income taxes, social security contributions, and public investment, especially in physical and human capital) to the task of output stabilization (countercyclical policies) and other policy instruments (such as public consumption) to budgetary consolidation (procyclical policies) turned out to produce the optimal policy design. This is a relevant new insight as Keynesian policy prescription often miss the importance of supply side instruments also for short run stabilization policies.

A more comprehensive analysis would systematically consider variations in all of the parameters of the objective function. Previous work in this direction by Weyerstrass and Neck (2002) showed that the variation most relevant for the results was the weights and the "ideal" paths so these elements of the optimization problem should be the main focus of such an investigation. This could be followed by presentation of the results to policy makers to obtain their views about the desirability of the resulting scenarios. For this purpose, not only actual policy makers but also their advisors and other experts (and possibly a representative sample of voters) should participate in an interactive process in which the results of their stated preferences are demonstrated and the simulations are adapted accordingly. This would include presenting the results to the respondents in several rounds to obtain their views on the different scenarios. The ultimate aim of such an iterated interaction between modellers and policy makers could be a decision support system for actual policy decisions relating to current or future fiscal policy.

Disclosure statement
The authors have no conflicts of interest to declare.

REFERENCES

1. Alogoskoufis, G., 2019. *Dynamic Macroeconomics.* Cambridge: MIT Press.
2. Blueschke, D. [et al.], 2024. How can the preferences of policy makers be operationalised in optimum control problems with macroeconomic models? A case study for Slovenian fiscal policies. *Public Sector Economics,* 48(2), pp. 151-168. https://doi.org/10.3326/pse.48.2.2
3. Blueschke, D., Blueschke-Nikolaeva, V. and Neck, R., 2021. Approximately optimal control of nonlinear dynamic stochastic problems with learning: the OPTCON algorithm. *Algorithms,* 14(6), 181. https://doi.org/10.3390/a14060181
4. Blueschke-Nikolaeva, V., Blueschke, D. and Neck, R., 2012. Optimal control of nonlinear dynamic econometric models: an algorithm and an application. *Computational Statistics and Data Analysis,* 56(11), pp. 3230-3240. https://doi.org/10.1016/j.csda.2010.10.030
5. Chow, G. C., 1975. *Analysis and Control of Dynamic Economic Systems.* New York: John Wiley.
6. Chow, G. C., 1981. *Econometric Analysis by Control Methods*. New York: John Wiley.
7. IMAD, 2024. *Spring forecast of economic trends spring 2024.* Ljubljana: Institute of Macroeconomic Analysis and Development.
8. Kendrick, D. A., 1981. *Stochastic Control for Economic Models*. New York: McGraw-Hill.
9. Kendrick, D. A., 1988. *Feedback: A New Framework for Macroeconomic Policy*. Boston: Kluwer.
10. Weyerstrass, K. [et al.], 2018. SLOPOL10: A Macroeconometric Model for Slovenia. *Economic and Business Review,* 20(2), pp. 269-302. https://doi.org/10.15458/85451.62
11. Weyerstrass, K. and Neck, R., 2002. Towards an objective function for Slovenian fiscal policy-making: a heuristic approach. In: A. S. Tangian and J. Gruber, eds. *Lecture Notes in Economics and Mathematical Systems,* pp. 366-389. https://doi.org/10.1007/978-3-642-56038-5_19