How can the preferences of policy makers be operationalised in optimum control problems with macroeconometric models? A case study for Slovenian fiscal policies

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Abstract

In this paper, we use the results of a survey among Slovenian politicians in order to design an objective function for an optimal control problem with a macroeconometric model for fiscal policy in Slovenia that takes account of policy makers' preferences. The paper discusses three different scenarios in which the policy preferences revealed in interviews can be included in the objective functions of the control problems. These objective functions are then used to calculate optimal fiscal policies for the Slovenian economy until 2030. For this purpose, we utilise the macroeconometric model SLOPOL10 and the OPTCON2 algorithm. The results indicate qualitatively similar behaviour of the optimised dynamic system and a better performance (lower values of the loss due to deviation from "ideal" paths) from a ranking-based approach than from an ad-hoc assumption of policy makers' preferences. We sketch how to integrate the approach in a decision-support system for macroeconomic policy design.

Keywords: policy preferences, macroeconomics, fiscal policy, Slovenia, optimum control

1 INTRODUCTION

The optimal control framework allows the calculation of optimal policies according to predefined targets of the decision maker, usually the government of the country under consideration. This approach originates in the work of Chow (1975; 1981) and Kendrick (1981; 1988), among others. Blueschke, Weyerstrass and Neck (2016) and Neck, Blueschke and Weyerstrass (2011) are examples of such studies for the Slovenian economy. Due to a series of international (global or EU-wide) shocks as well as structural problems, especially in the banking sector (IMF, 2017), the Slovenian economy experienced a rapid increase of public debt, giving rise to an urgent need for budget stabilisation policies. However, stabilising public debt is not the single aim of policy makers in Slovenia. There are many different objectives such as growth, employment and price stability, that need to be taken care of at the same time. The optimal control framework helps the main trade-offs in an economy to be identified and enables recommendations for policy makers on how to design fiscal (and/or monetary) policies in order to approximate the given targets in the best way to be derived.

The common way of defining the objective function is to use well known and well justified setups from the literature. Often, an intertemporal objective function is formulated and optimised, subject to an empirical (econometric or other) model of the economy using optimum control techniques. In this study we go one step further and include the results of a survey of policy makers in the Slovenian government. The aim is to be able to design an objective function that is closer to the policy makers' opinions as to the importance of different targets. The final process of deriving optimal policy reactions is rather standard and similar to the methodologies presented in Neck, Blueschke and Weyerstrass (2013) and Blueschke, Weyerstrass and Neck (2016). In this paper we concentrate on the problem of how to include the policy preferences of the policy makers in the objective function. This is a problem because of the different scales of the considered targets and from non-unique ways of operationalising them.

The structure of the paper is as follows: section 2 gives a brief overview of approaches to and applications of empirically obtained objective functions for optimising policy studies. Section 3 describes the econometric model, while the optimal control framework of the study on budgetary policy is presented in section 4. In section 5, we report on the survey of policy priorities we conducted among Slovenian policy makers. Section 6 describes how we transformed the ordinal results of the survey into possible cardinal specifications of the weights of the quadratic objective function, providing some results for our policy problem. Section 7 concludes.

2 PREVIOUS WORK ON THE SPECIFICATION OF AN OBJECTIVE FUNCTION

The optimal control approach and, more generally, the optimisation approach to quantitative economic policy design consists of two elements: an empirically relevant model and an objective function to be optimised. While a large body of literature exists on modelling building and estimating economic models from empirical data, in particular, for econometric models and, more recently, on the calibration of dynamic stochastic general equilibrium and related macroeconomic models, the literature on the specification of the objective function is rather meagre. If the objective function is interpreted as a social welfare function, there is plenty of literature on social choice. However, in addition to the problem of aggregating individual preferences into an expression such as "social welfare", this kind of interpretation might only be useful for normative analyses at best and would not be very relevant for actual policy making by real politicians, particularly as they have their own ideas about "social welfare" and may also have their own preferences that are not necessarily the same as those covered by "social welfare" (however defined). For practical purposes of policy analysis and design, it is much more appropriate to interpret the objective function as an expression of the preferences of those responsible for actual policy making, as we do in this study, that is, of real politicians, whether they are acting (in their view) in society's best interests or also have partly or entirely selfish motivations.

The investigation of policy makers' preferences started in the early years of quantitative economic policy analysis and was carried out by the first Nobel laureates in economic sciences, Frisch (see Bjerkholt, 1995) and Tinbergen (1952), the fathers of the theory of quantitative economic policy. Ragnar Frisch proposed using interview techniques to quantify the preferences of decision makers and applied them so as to include the results of an interview with leading Norwegian politician (and later prime minister) Trygve Bratteli (see Bjerkholt, 1995) in his analyses using his Oslo Median Model of the Norwegian economy. Frisch (1976) contains a methodological discussion of his approach.

The tradition founded by Frisch did not find many followers. Johansen (1974) was one of them; other work in this direction, combining Frisch's approach with that of Tinbergen, was done with Dutch political parties in the Netherlands in the 1980s (Merkies, 2002) and for the USA in Swank's (1990) PhD dissertation, which was closer to the revealed-preferences approach of Friedlaender (1973). More recent work in this direction includes Krause and Méndez (2005), Aguiar and Martins (2005) and Best (2017). Methodological contributions to various ways of constructing objective functions for macroeconomic policy making are covered in the volumes edited by Tangian and Gruber (1997; 2002). In this paper, we want to contribute to the literature initiated by Ragnar Frisch and combine his idea of using interviews with the optimal control approach to economic policy design by means of a real-world example from Slovenia.

3 THE ECONOMETRIC MODEL

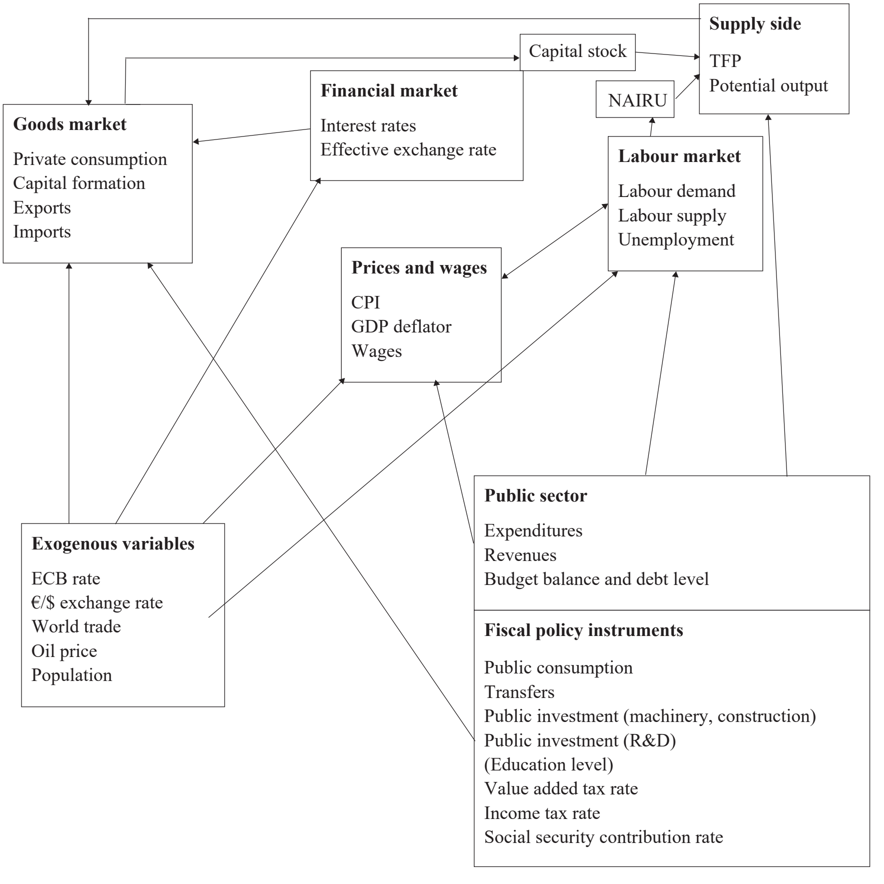
In this study we use the SLOPOL10 model, a medium-sized macroeconometric model of the small open economy of Slovenia. In the version used here, SLOPOL10 (SLOvenian economic POLicy model, version no. 10) consists of 75 equations, 23 of which are behavioural equations and 52 identities. In addition to the 75 endogenous variables, the model contains 41 exogenous variables. The estimation of the behavioural equations used the software program EViews, with quarterly data for the periods 1995Q1 to 2015Q4. Almost all behavioural equations are specified in error correction form. The model should allow for forecasts and policy simulations for the near future. Statistical tests performed for the past showed that the model exhibits acceptable quality for policy makers to use it for determining optimal policies. Improvements in the light of new data were made later when updating the model for these purposes due to the COVID-19 pandemic (which could not be foreseen when this study started in 2017, of course); see Weyerstrass et al. (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. The model combines Keynesian (with rigidities of wages and prices) 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. In the following, we describe the key model equations verbally. Graph 1 is a diagram of the building blocks of the model. A detailed description of the version used here can be found in Weyerstrass et al. (2018).

The supply side incorporates neoclassical features. Potential output is determined by a Cobb-Douglas production function with constant returns to scale. It depends on trend employment, capital stock and autonomous technical progress. Trend employment is defined as the labour force minus natural unemployment, the latter being defined via the non-accelerating inflation rate of unemployment (NAIRU). NAIRU, which approximates structural unemployment, is estimated by applying the Hodrick-Prescott (HP) filter to the actual unemployment rate. For forecasts and simulations, the structural unemployment rate is then extrapolated with an autoregressive (AR) process. Capital stock enters the determination of potential

GDP not with its trend but with its actual level. Technical progress is determined as follows: Firstly, ex-post total factor productivity (TFP) is calculated as the Solow residual. Secondly, the trend of technical progress is determined by applying the HP filter in a procedure similar to NAIRU. The trend of the TFP is explained in a behavioural equation with the share of people with tertiary education in the labour force, the real investment ratio and lagged real government spending on research and development (R&D) as explanatory variables.

Graph 1
SLOPOL10 building blocks



On the demand side, the consumption of private households depends on current disposable income and on the long-term real interest rate. Real gross fixed capital formation is influenced by the change in real disposable income and by the user cost of capital, the latter being equal to the real interest rate plus the depreciation rate of capital stock. Changes in inventories are exogenous. Real exports of goods and services are a function of the real exchange rate and foreign demand for Slovenian goods and services, with foreign demand being approximated by the volume of world trade. Real imports of goods and services depend on domestic final demand and on the real exchange rate.

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On the labour market, the labour demand of companies (actual employment) is modelled via the employment rates of two age groups (15 to 64 years, 65 years and above), i.e. employment as a share of the relevant age group in the total population. Both employment rates depend positively on real GDP and negatively on the real net wage and the wedge between the gross and the net wage. Labour supply is modelled via the share of the labour force of the two age groups in the total population. Labour supply depends positively on the real net wage and, like employment, negatively on the wedge between the gross and the net wage.

In the wage-price system, gross wages, the harmonised index of consumer prices (HICP) for Slovenia and various deflators are the endogenous variables. The gross wage rate depends on the price level, labour productivity and the unemployment rate. The consumer price index depends, via the consumption deflator, on domestic (unit labour costs and the capacity utilisation rate) and international (approximated by the import deflator) factors. The investment and the export deflators are influenced by domestic (approximated by unit labour costs) and imported (the import deflator) cost elements. The import deflator depends on the oil price in euro as a proxy for international raw material prices.

On the money market, the short-term interest rate has a link to its euro area counterpart to capture Slovenia's euro area membership. The long-term euro area interest rate is a regressor in the equation determining the long-term interest rate in Slovenia, which is also linked to the short-term rate and contains the debt-to-GDP ratio. The foreign exchange market is modelled by the real effective exchange rate against a group of 41 countries. As Slovenia has only been a euro area member state since 2007, for the period before that, the bilateral exchange rate between the Slovenian tolar and the euro is the explanatory variable in the real effective exchange rate equation; furthermore, the exchange rate between the euro and the US dollar and the domestic inflation rate are regressors.

In the government sector of the model, the most important expenditure and revenue items of the Slovenian budget in the model are: social security contributions by employees and by companies, income and profit tax payments, value added tax revenues and other direct and indirect taxes; all of them depend on institutional factors as well as on GDP and its components. Interest payments on public debt depend on the lagged debt level and on the long-term interest rate. Public consumption and transfer payments to private households as well as the remaining public expenditures and revenues are exogenous. By definition, the budget balance is the difference between total government revenues and expenditures. The public debt level is extrapolated using the budget balance equation. The model is closed by a number of identities and definition equations.

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 government expenditures have a strong effect on GDP while government revenues (through tax rates) affect the labour market and employment strongly. The side effects on public debt originate directly from the policy variables and indirectly from nominal GDP. Long-run effects lead to convergence of the model to a balanced growth path, with real GDP and its components growing at approximately the same rate and nominal GDP and its components at the same rate plus an inflation rate of 2%, with only limited effects on public debt. This long-term path, adapted for the exogenous disturbances that actually occurred, is calculated for the period under consideration. We regard it as an "ideal" path from the viewpoint of the policy makers because it shows the growth performance of the Slovenian economy under actual exogenous shocks without strong oscillations of target variables that is attainable by prudent choice of fiscal policy according to the model.

4 AN OPTIMAL CONTROL FRAMEWORK FOR BUDGET STABILISATION POLICY IN SLOVENIA

In order to obtain optimal trajectories of the fiscal policy instruments, we run several optimal control exercises using the OPTCON2 algorithm (Blueschke-Nikolaeva, Blueschke and Neck, 2012; Blueschke, Blueschke-Nikolaeva and Neck, 2021). Solving an optimum control problem implies finding certain paths of control variables which minimise an objective function involving deviations of the values of the politically relevant variables from some pre-specified target paths. As usual in economic policy applications, we assume a quadratic objective function. The problem is described as follows:

$$\min J = \sum_{t=1}^{T} L_t\left(x_t, u_t\right) \tag{1}$$

$$L_t\left(x_t, u_t\right) = \frac{1}{2}\begin{pmatrix} x_t - \tilde{x}_t \\ u_t - \tilde{u}_t \end{pmatrix}' W_t \begin{pmatrix} x_t - \tilde{x}_t \\ u_t - \tilde{u}_t \end{pmatrix} \tag{2}$$

Here x_t is an n-dimensional vector of state variables that describes the state of the economic system at time t; u_t is an m-dimensional vector of control (policy instrument) variables; $\tilde{x}_t \in R^n$ and $\tilde{u}_t \in R^m$ are given "ideal" levels of the state and control variables respectively. W_t is a matrix specifying the relative weights of the state and control variables in the objective function.

The optimisation is restricted by the dynamics of the system given in the form of a system of nonlinear difference equations:

$$x_t = f\left(x_{t-1}, x_t, u_t, \theta, z_t\right) + \varepsilon_t, \qquad t = 1, \ldots, T \tag{3}$$

where θ is a p-dimensional vector of estimated parameters and z_t denotes a vector of exogenous non-controlled variables. In this study, the dynamic system f is the SLOPOL10 model. The dynamic system (3) and the objective function (1) with (2) define a multivariable nonlinear-quadratic optimum control problem to be solved.

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The policy maker in this optimal control experiment is the government of Slovenia, which we assume, in 2017, could have calculated the optimal trajectories of fiscal policy instruments for the period 2018 to 2030. As we are not interested in the details of that exercise apart from comparisons of the time paths of the variables, we will denote the time index by 0 (for the initial historical period 2017), 1 …, 13. There are nine control variables (fiscal policy instruments): government consumption, transfers, government investments, public expenditure for research and development, the average personal income tax rate, the proportion of the active working population with tertiary education, the average social security contribution rate, remaining government revenues and the value added tax rate.

The definition of the objective function (2) and the corresponding choice of the weights *W* is the topic addressed in this study. As it is not possible and not reasonable to include all 75 endogenous (state) variables as target variables in the SLOPOL10 model, we have to choose an appropriate set of objective variables (evaluated control and state variables), taking account of the policy preferences collected from the policy makers.

5 POLICY PREFERENCES SURVEY

We conducted the survey on policy preferences in order to reveal the economic indicators deemed important in the process of policymaking. The main method used was the Delphi method, which has been used for similar forecasting purposes (e.g. Society of Actuaries, 2005; Rowe and Wright, 1999). The Delphi method was reviewed extensively in Hill and Fowles (1975), Linstone and Turoff (1975), Lock (1987), Parente and Anderson-Parente (1987), Stewart (1987) and Rowe, Wright and Bolger (1991). It was developed in the 1950s by workers at the RAND Corporation while involved in a U.S. Air Force sponsored project. More generally, the technique is a procedure to "obtain the most reliable consensus of opinion of a group of experts […] by a series of intensive questionnaires interspersed with controlled opinion feedback" (Dalkey and Helmer, 1963).

The design of our questionnaire drew on previous literature on the importance of macroeconomic aggregates for the Slovenian economy (Žižmond, 1997; Weyerstrass, Haber and Neck, 2001; Kajzer et al., 2006) as well as on the design of the macroeconometric model SLOPOL10 and previous optimisations with the OPTCON2 algorithm. It started with an introduction to the survey, the purpose of the research and instructions for the participants as well as clarifications regarding the handling of the data and the anonymisation of the responses. The main part of the questionnaire was divided into eight sections covering the macroeconomic indicators of interest.

The eight categories included in the questionnaire were GDP growth, unemployment rate, inflation rate, state budget level, trade balance, share of public debt in GDP, private consumption level and share of investment in GDP. We asked all of the participants to estimate the importance of each category for gauging the condition of the Slovenian economy by awarding the most important category 10 points (marks) and less important targets fewer points down to the least important. They

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had to provide such estimates separately for 2016, 2017, 2018 and 2021. Each category also had a final open-ended question on the respondents' opinions on and justifications of the importance of the category for the Slovenian economy.

The survey was conducted between 6 June 2017 and 5 July 2017. Our sample consisted of relevant budget experts and political decision makers. For the budget experts, we addressed the six relevant members of staff at the Budget Directorate of the Ministry of Finance of the Republic of Slovenia. For the political decision makers, we approached the eight parliamentary groups in the National Assembly of the Republic of Slovenia at that time representing all of the elected political parties and the two national minorities. Thus, 14 questionnaires were distributed in all. The questionnaire was sent by e-mail, with a follow-up phone call. We received eight filled-in questionnaires by the end of the survey period. The primary data were collected in accordance with the ethical research standards on data collection and anonymisation laid down by the Research Ethics Committee of the School of Economics and Business at the University of Ljubljana.

Our expectations were that more "broad" categories like GDP growth, unemployment rate, state budget level and share of public debt in GDP would be paid more attention than the inflation rate, for example, as they were also the most vulnerable during the financial crisis in Slovenia (see Verbič et al., 2016). The level of GDP dropped significantly during the crisis, in two waves, firstly as a consequence of the crisis and secondly following the adopted austerity measures. The level of unemployment also increased significantly, particularly affecting younger people. Political reasons (changes of government, PR and media activities, policy measures, etc.) were among the main reasons why the spreads of Slovenian government bonds and, consequently, the cost of debt soared.

The results of the survey are summarised in table 1. The marks shown are the mean values of those the respondents gave to the variables. This aggregation of individual marks converts the ordinal ranking into a cardinal one, which is the simplest way of operationalising the importance of each category.

Table 1

The revealed policy preferences

Rank	Target	Mark (1-10)
1	GDP growth	9.5
2	Ratio of public debt to GDP	8.8
3	Trade balance	8.6
4	Unemployment rate	8.5
5	Private consumption level	8.5
6	Share of investment in GDP	8.3
7	State budget level	7.0
8	Inflation rate	6.9

Source: Authors' own calculations.

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The data on policy preferences were collected in 2017, when Slovenia had a left-wing government. However, the survey targeted all of the parliamentary groups in the National Assembly of the Republic of Slovenia, not only those in the government. In addition, the relevant budget experts were surveyed, representing, in principle, the professional layer of government administration. For future research, we could additionally differentiate between the policy preferences of left-wing and right-wing political parties and then simulate specifically the policies of left-wing and right-wing governments.

6 DEALING WITH THE OBSERVED POLICY PREFERENCES

Based on the results of the survey, we selected eight "major" state variables to enter in the objective function (2), namely the growth rate of GDP (*GRGDPR*), the unemployment rate (*UR*), the inflation rate (*INFL*), the budget balance ratio to GDP (*BAL*), the debt level ratio to GDP (*DEBT*), the current account balance ratio to GDP (*CAGDP*), real private consumption (*CR*) and real private investment (*PRINVR*).

As the model and control variables consider the supply side of the economy as well, it is necessary to include certain corresponding variables in order to allow for an optimal solution for the entire model and to avoid strong oscillations of the time paths of the major target variables. We added three variables from the supply side to enter the objective function (2), namely the level of real GDP (*GDPR*), the growth rate of potential GDP (*GRYPOT*) and the level of potential GDP (*YPOT*). In order to take it into account that these variables were not named by the politicians, they had significantly lower weights and are called "minor" target variables. As a starting point we attach to each of these "minor" variables a weight of 1 in the matrix *W*. The next step is to attach corresponding weights to the major variables based on the observed preferences as given in table 1. To this end we define four different optimisation scenarios as summarised in table 2.

TABLE 2
Scenarios including the revealed policy preferences

	BAL	CAGDP	CR	DEBT	GDPR	GRGDPR	GRYPOT	INFL	INVR	UR	YPOT
sc0	1	1	1	1	1	1	1	1	1	1	1
sc1	2	2	2	2	2	1	2	1	2	2	1
sc2	7	8.6	8.5	8.8	1	9.5	1	6.9	8.3	8.5	1
sc3	3	7	5	8	1	9	1	2	4	6	1

Source: Authors' own calculations.

Scenario 0 (sc0) is regarded as a baseline solution where all targets have the same weight. Of course, all the weights are normalised according to the time-series characteristics of the variables. Scenario sc1 is the simplest way of including the observed information, that is, by defining just two groups: "minor" variables with a weight of 1 and "major" ones with a weight of 2. In this case the ranking of the targets as expressed by the politicians was ignored and simple inclusion in the decision-making process is crucial. In sc2, the numbers from the right column of table 1 are taken one-to-one and converted into the objective function. Finally, sc3 takes advantage of the rank order in a different form and converts it into a weighting matrix by increasing the weights by one for each target from the bottom to the top of table 1. Thus, *INFL* gets a weight of 2, as it is least in the ranking. The second last variable, *BAL*, gets the weight 3 and so on. The most important target, *GRGDPR*, gets the highest weight 9.

In addition, we assume "ideal" paths for all of the target 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 in section 3 above.

Using the specified targets and weights, we are able to carry out the optimal control exercise and to calculate optimal fiscal policies. In this study we are not interested in the optimal paths themselves; instead, the focus is on the effects caused by the different ways of including observed policy preferences. Table 3 summarises the objective function values for each path of the considered state variables. In order to make the objective values comparable, the weighting matrix from the baseline scenario is used to evaluate the optimal paths. In addition to these individual targets, table 4 includes the sums of the objective function values over all states (sum_*J*_states), all controls (sum_*J*_controls) and the total sum of the objective function (sum_*J*_all). These show the contributions of the aggregated deviations of the states, the controls and the two combined from the "ideal" paths to the total loss in the scenario concerned.

Table 3
*Objective function values for individual target state variables**

	BAL	CAGDP	CR	DEBT	GDPR	GRGDPR	GRYPOT	INFL	INVR	UR	YPOT
sc0	6.7	13.7	1.7	1.9	2.8	11.2	12.6	22.8	1.6	9.7	2.3
sc1	5.4	12.9	1.6	1.5	2.7	10.2	10.5	21.4	1.4	7.9	1.9
sc2	3.2	10.3	1.3	0.7	2.2	7.1	7.2	18.3	0.9	4.1	0.8
sc3	5.7	11.3	1.3	0.6	2.2	6.5	10.6	22.2	1.3	4.4	1.7

** A lower value means less deviation from the "ideal" path.*
Source: Authors' own calculations.

Table 4
*Aggregated objective function values**

	sum_*J*_states	sum_*J*_controls	sum_*J*_all
sc0	87.0	54.7	141.7
sc1	77.4	67.4	144.8
sc2	56.2	144.8	201.1
sc3	67.8	107.7	175.4

** With weights from sc0, thus, sc0 produces the best results.*
Source: Authors' own calculations.

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We can conclude from tables 3 and 4 that scenarios with weights derived from the revealed preferences (sc2 and sc3) lead to a better performance (lower values of sum_J_states) of the most important state variables than in sc1. This is only possible at the cost of a more active use of the control variables, however, leading to higher overall objective function values. Scenario 2 is the one with the largest deviations of the controls from the baseline as it accords the highest importance to the selected major target variables. However, taking the large losses by the controls (summarised by sum_J_controls) into account and the fact that the choice of the weights is rather ad hoc, taken directly from the data collection process, it is questionable whether sc2 is a good strategy. Furthermore, scenario 1 seems to be too similar to the baseline solution, which may mean that the revealed preferences are not taken into account properly. In contrast, scenario 3 seems to be a good compromise between paying enough attention to the observed preferences and not requiring too much action, which is quite often considered to be undesirable. In this scenario, the summarised objective function value (sum_J_all) increases "only" by less than 25% above its baseline value (sc0).

More information can be obtained from a detailed inspection of the results. Graphs 2-7 show the time paths of the deviations of some key target variables (graphs 2-6) and one instrument variable (graph 7) from their assumed "ideal" paths (which were not changed in the optimisation experiments). They show that the paths of the (endogenous) target variables are mostly close to their "ideal" paths while the reverse is true for the instrument variables (graph 7; similar for the other instruments) resulting from the optimisation runs. In particular, the public-debt-to-GDP ratio (graph 4) is always closer to its "ideal" path in the scenarios using the policy preferences from our procedure (scenarios 1-3), although the budget balance is further away from its "ideal" path. These results show that a more active (countercyclical) use of fiscal policy instruments can lead to improvements in terms of the revealed objectives of the policy makers without intolerable side effects on public deficit and debt. In addition, other simulations have shown that a better combination of the instruments with a more active use of government investment and a more restrictive use of government consumption leads to a more favourable outcome in terms of the trade-off between GDP growth and fiscal stability (see Weyerstrass et al., 2020; Neck et al., 2021).

The results in graphs 2-7 support the insights from the objective function values. In all scenarios we can observe qualitatively similar paths to the optimal results from the baseline scenario. The impact of the inclusion procedure is rather restricted to the level of activity of using the policy instruments. The additional losses for the control variables in scenarios 2 and 3 are due to the larger deviations from their given "ideal" values than in the baseline scenario.

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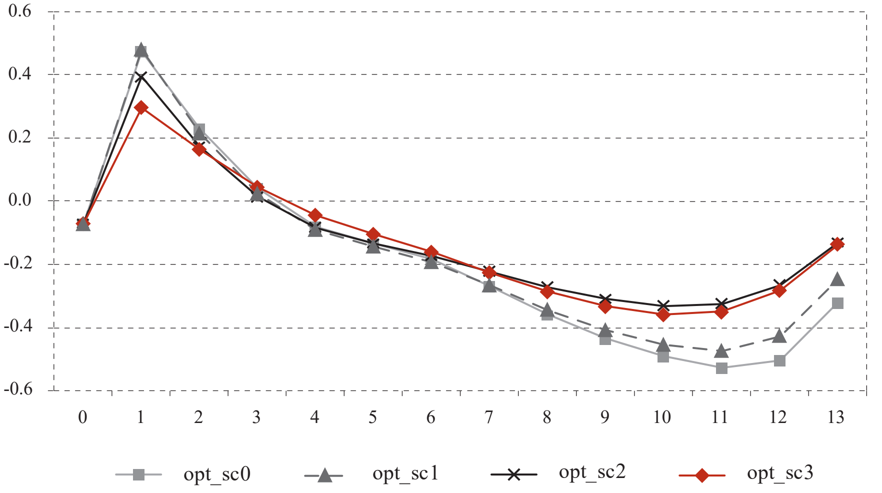
Graph 2

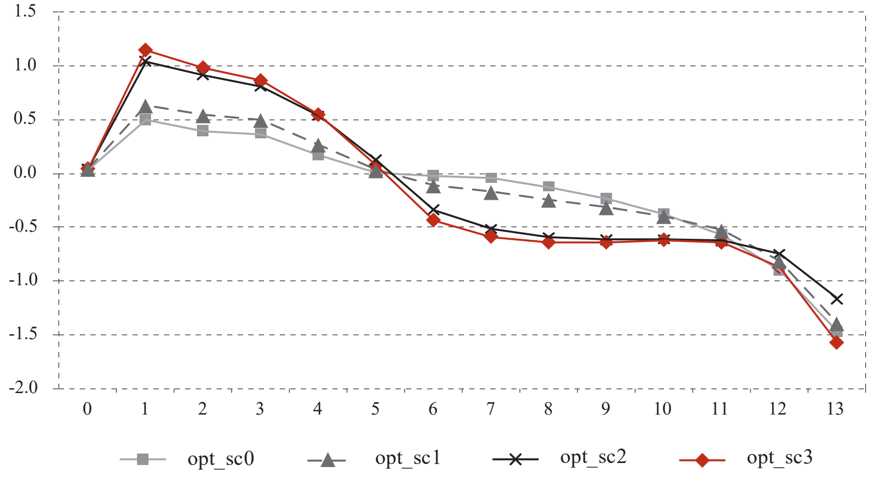
Growth rate of GDP, %



Source: Authors' own calculations.

Graph 3

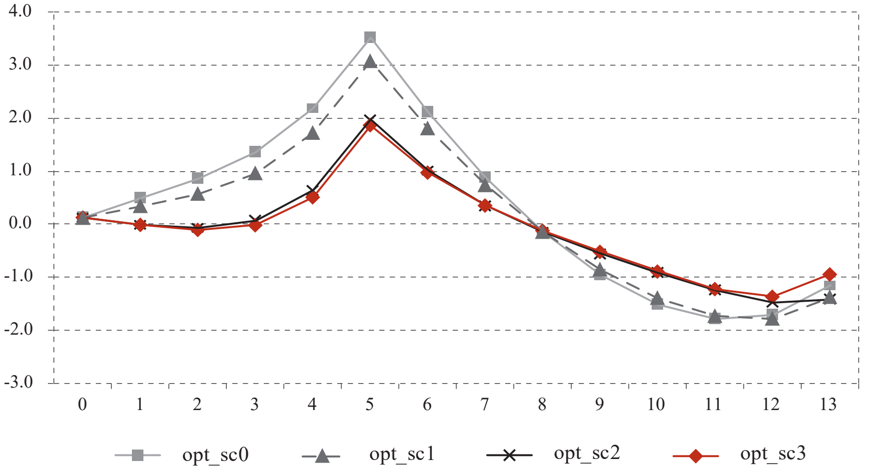
Budget balance ratio to GDP, % of GDP



Source: Authors' own calculations.

Graph 4

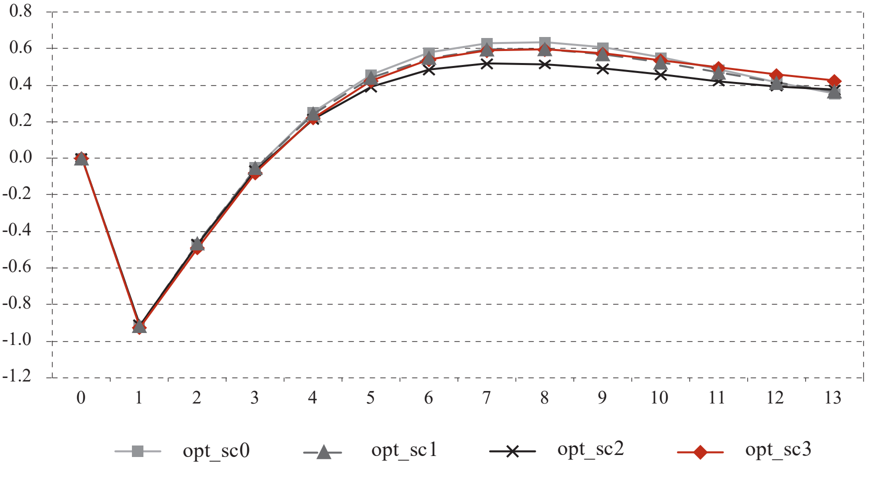
Public debt, % of GDP



Source: Authors' own calculations.

Graph 5

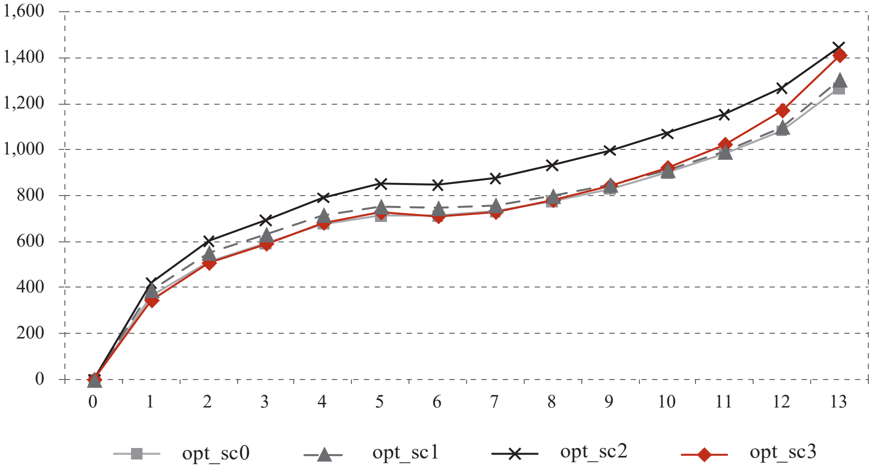
Inflation rate, %



Source: Authors' own calculations.

Graph 6

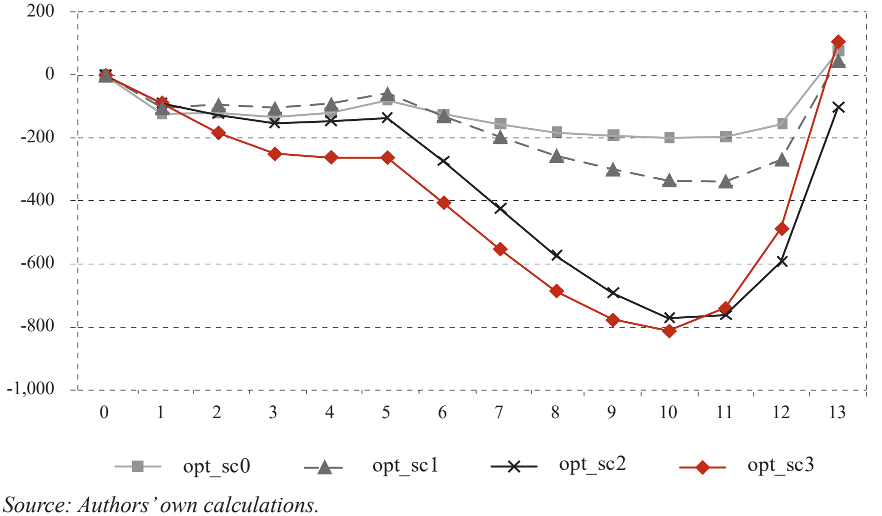
Government investment, mn. euro



Source: Authors' own calculations.

Graph 7

Government consumption, mn. euro



Source: Authors' own calculations.

A more comprehensive analysis would also consider variations in the assumed "ideal" paths of the objective variables and other parameters of the objective function. Previous work in this direction was done for Austria by Neck and Karbuz (1997) and Weyerstrass and Neck (2002). It showed that the variation most relevant for the results was the weights and not the planning horizon or the discount factor; hence we did not consider these elements of the objective function here. Changing the "ideal" paths of the objective variables was not investigated here either because demanding evaluations of such alternatives would have asked too

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much of the policy makers in view of their time constraints. In a more comprehensive analysis, this exercise would have to be included, although for this purpose, not only actual policy makers but also their advisors and other experts (and possibly a representative sample of voters) would have to participate in an interactive process in which they would be shown the results of their stated preferences and the simulations would be adapted accordingly.

The next step would be to do a systematic analysis of all of these variations and their results and to present them to the policy makers in second and further rounds to obtain their views on the different scenarios. The ultimate aim of such an iterated interaction between the modellers and the policy makers is a decision-support system for actual policy decisions relating to current or future fiscal policy. This will be a task for future research, requiring a much larger project, ideally over a longer time horizon.

7 CONCLUSIONS

In this paper, we use the results of a survey among politicians in Slovenia to find an objective function for an optimal policy problem that is closer to what policy makers in this country really want. We show different ways of incorporating the observed data in an objective function and revealing the impact of these procedures on the minimal losses resulting from optimum control scenarios for fiscal policy design. The results indicate qualitatively similar behaviour for the optimal trajectories. A slightly better performance of a ranking procedure incorporating policy preferences can be observed, in particular with respect to the trade-off between economic growth and the sustainability of budgetary policy. The main contribution of this paper is a modest step towards developing a tool supporting policy makers in their decisions about how to design fiscal policy with respect to macroeconomic targets. The preferences of policy makers are often not very explicit and asking them to reveal them at least in an ordinal manner may be the only way to extract some information from them. We showed that there are several possibilities by which such incomplete information can be converted into input for use in an optimisation procedure with optimum control techniques. For this purpose, we concentrated on the weights of the instruments and the targets in the objective function of the policy makers and gave only a few hints on other elements of such an optimisation problem. Further research will have to extend the analysis in the direction of creating a comprehensive decision-support system for macroeconomic policy decisions.

Disclosure statement

All authors declare that they have no conflicts of interest.

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