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Impact of fiscal measures in response to the COVID-19 pandemic on small-open economies: lessons from Slovenia*

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Abstract

We assess the impact of the fiscal expansion in response to the COVID-19 pandemic on the Slovenian economy via a twofold approach. Firstly, we employ a structural VAR model in order to estimate the effects of fiscal shocks. The findings suggest a significant response of GDP, private consumption, and imports to fiscal shocks. Secondly, we simulate fiscal shocks in a three-scenario setup using a calibrated large-scale DSGE model. The outcomes of this highlight that a government consumption shock explains the lion's share of domestic fluctuations, compared to other unanticipated fiscal developments. The main transmission channel is high complementarity between private and government consumption.

Keywords: Fiscal shocks, COVID-19 crisis, Fiscal multipliers, DSGE model, VAR model

JEL Classification: C32, E32, E62

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1 Introduction

The COVID-19 pandemic represents novel challenges for the economy and policy-makers. Such an environment provides a textbook example of a large-scale countercyclical fiscal policy intervention.

We model the impact of fiscal measures on the Slovenian economy with the Euro Area and Global Economy model (the EAGLE model developed by Gomes, Jacquinot and Pisani, 2012; hereinafter: the EAGLE model). The EAGLE model, which was further extended with a big fiscal block by Clancy, Jacquinot and Lozej (2016) has some appealing features which are relevant for small open economy within a monetary union such as Slovenia. First, in the EAGLE model, government spending consists partly of imported goods. This gives the feature that government spending has a lower multiplier as a result of higher import expenditures. Second, the EAGLE model splits government spending between consumption and investment goods. Third, the EAGLE model allows for the complementarities between private and government consumption. The last two features allow us to analyse the effects of such complementarities on the size of government consumption multipliers.

We analyse the effects of several fiscal shocks on the Slovenian economy. In particular, we disentangle the source of fiscal variation into (1) government investments, (2) government consumption, (3) direct taxes, (4) indirect taxes, and (5) social benefits. The focus on fiscal measures is motivated by the fact that these are the main instruments used by the Slovenian national authorities to monitor and shape the trajectory of the business cycle. Slovenian monetary policy is under the full control of the European Central Bank.

A short contextualisation may justify why we focus on measures of the fiscal policy. Since independence, Slovenia has experienced two important fiscal interventions: first following the Great Financial Crisis (henceforth: GFC) and the second during the sovereign crisis in 2012, when a recession hit the euro area. While the former event constituted a positive fiscal shock, it should not be interpreted as the ad hoc government response to the crisis.

The fact is that the fiscal plan was already in place before the outbreak of the crisis.[1] In the second case, in 2012, fiscal policy responded to the domestic contraction by limiting the public deficit by implementing restrictive reforms such as the adopting of the Fiscal Balance Act (ZUJF) labour reform. Today, differently to the GFC and recession in 2012, the fiscal policy is intentionally reacting counter-cyclically by increasing the public debt and deficit to offset the negative shock of the COVID-19 crisis on the Slovene economy.

We check the robustness of our theoretical results by estimating a small-scale VAR model following Blanchard and Perotti (2002). We identify the shocks to fiscal policy and the response of taxes and spending to activity by using institutional information about the tax and transfer systems.

We provide two main contributions. First, we theoretically disentangle the impact of the latest fiscal stimulus packages on the Slovenian economy by simulating a 3-scenarios of the fiscal package in the calibrated EAGLE model.[2] Second, we present the empirical results of the small-scale VAR model.

Our results show that government consumption has a stronger and more persistent effect on the domestic business cycle than other fiscal variables. In particular, with a large scale DSGE model, we find that fiscal spending multiplier on impact equals 1.3. Cumulative spending multiplier increases to 1.4 in the first year, and levels-off at 1.3 after three years. In the EAGLE model, the bigger proportion of the non-tradable sector is composed of services that are provided by the government sector. Therefore, the effect of the fiscal stimulus on the non-tradable sector is larger than on the tradable sector. The fiscal stimulus positively affects private consumption and imports, while having an almost insignificant effect on investments and exports. The reason behind this result is that government consumption and investments stimulate aggregate demand and consist mostly of imported goods.

[1] Especially the substantial wage increase of the public sector in the so-called Virant's wage reform in 2008.

[2] The basic EAGLE model was developed by Gomes, Jacquinot and Pisani (2012).

Our theoretical results are confirmed with a small-scale VAR model. The main transmission channel of the fiscal stimulus on the Slovenian output is high complementarity between private and government consumption. This result was first established by Clancy, Jacquinot and Lozej (2016) with the DSGE model, which was calibrated for the Slovenian and Irish economies. Results of the SVAR model in Jemec, Strojan Kastelec and Delakorda (2011) can be interpreted as meaning that such complementarities are important in Slovenia.

Finally, we find that the fiscal stimulus increases the nominal variables with a lower magnitude which is longer-lasting than for the real variables. The government subsidies to households and firms, and the direct fiscal stimulus, increase wages for several quarters.

The paper is structured as follows. Section 2 reviews the literature. Section 3 presents the fiscal packages in scenarios with different lengths of the COVID-19 lock-down. Section 4 calibrates the EAGLE model. Section 5 estimates the SVAR model. Section 6 compares fiscal multipliers implied by the models. Section 7 concludes.

2 Literature Review

In this section, we provide a short literature review. The strand of literature covering the effects of fiscal shocks on business cycles is wide. Favero and Karamysheva (2015) provide a survey of different estimates of fiscal multipliers in order to try to understand their heterogeneity and provide a general framework that allows comparing the identification and specification choices made by the different authors[3] in understanding the heterogeneity of results. Caldara and Kamps (2008), for example, take a US example and assess the effects of fiscal policy shocks by using vector autoregressive models. They show that, controlling for differences in specification of the reduced-form model, all identification approaches yield qualitatively and quantitatively very similar results as regards government spending

[3]For example: Baxter and King (1993); Christiano, Eichenbaum and Rebelo (2011); De Long and Summers (2012).

shocks as real GDP, real private consumption and real wages all significantly increase, while private employment does not react. In the case of tax shocks, the estimated effects range from non-distortionary to strongly distortionary. Caggiano et al. (2015) study the state-dependent fiscal multipliers of the US economy. They report that the median effects of fiscal shocks in periods of contraction are larger than in periods of expansion. However, once we account for the standard errors, the confidence intervals imply the absence of non-linearities. This is the opposite of the findings of Auerbach and Gorodnichenko (2012, 2013). The results of Caggiano et al. (2015) differ because they impose stricter conditions on the transitionary phase between the expansion and contraction periods.

Cugnasca and Rother (2015) investigate the impact of fiscal consolidation on economic growth in the European Union. They find that the size of the fiscal multiplier varies significantly under different states of the business cycle, the degree of openness to trade, the composition of the fiscal adjustment, and the presence of a stressed credit market. Only a few consolidation episodes yield multipliers above one. Favero and Giavazzi (2012) include structural shocks identified via the narrative method in fiscal VAR models, by first showing that narrative shocks are orthogonal to the relevant information set a fiscal VAR and then derive impulse responses to these shocks. Something similar was done by Mertens and Ravn (2014).

Kilponen et al. (2015) estimate output multipliers for alternative fiscal instruments by simulating 15 structural models within the Euro Area. They find that country-specific short-run fiscal multipliers are smaller than one in absolute value. Temporary reductions in government consumption are typically associated with larger (short-run) effects on GDP than temporary increases in tax rates. The difference becomes more pronounced when the economy is financially distressed.

Gornicka et al. (2018) set up a natural quasi-experiment to model the behavior of the fiscal multiplier during the GFC and European sovereign debt crisis (SDC) in the European Union. They find that fiscal multipliers increased over time, from about 1/4 to about 2/3. They do not find evidence that ex-post fiscal multipliers have been substantially above 1.

More recently, Alloza et al. (2020) assessed the spillovers of national fiscal policies to other countries within the Euro Area. They find (cumulative) domestic spending multipliers are slightly lower than one, while average cumulative output response in one euro area country to a trade-weighted increase in government spending in other euro area countries equals roughly 0.4. However, domestic multipliers and cross-country spillovers are heterogeneous among Euro Area countries. Additionally, they find that the reaction of interest rates to fiscal expansions is an important determinant of the magnitude of the spillovers.

Most of the literature studies the effects of fiscal shocks on large scale economies. Nevertheless, some of studies incorporated the estimation of fiscal shocks on small open economies. Ravn and Spange (2014) study the empirical effects of fiscal policy in the case of Denmark since the adoption of a fixed exchange rate policy in 1982. They show that fiscal stimulus has a larger impact on economic activity in the very short run, with a government spending multiplier of 1.1 on impact. They also show that the effects of fiscal stimulus are short-lived in the case of Denmark, with the effect on output becoming insignificant after around two years. Deskar-Škrbić, Šimović and Ćorić (2014) and Deskar-Škrbić and Šimović (2017) use the structural VAR model to study the dynamic effects of fiscal shocks on the economic activity of the private sector in small open economies such as Croatia. Since Croatia is a small open transition economy, they assume that shocks of foreign origin can also have notable effects on its performance. Therefore, they extend the Blanchard-Perotti identification method by introducing variables that represent external demand shocks. They show that government spending has a positive and statistically significant effect on private aggregate demand and private consumption, and that the net indirect taxes can have a negative and statistically significant effect on private consumption and private investment.

Turning to the Slovenian economy, Clancy, Jacquinot and Lozej (2016) develop a "fiscal" version of the EAGLE model to study the effects of fiscal shocks in Ireland and Slovenia as typical representatives of small open economies. Among several important contributions, they find that complementarities between private and government consumption

play an important role in transmitting the stimulus to the economy. However, when such complementarities are high, government consumption expenditure reductions can lead to substantial output losses. When complementarities between private and government consumption are low, a reduction of government consumption may be a preferred option to minimize output loss during fiscal consolidation.

Jemec, Strojan Kastelec and Delakorda (2011) follow Blanchard and Perotti (2002) and estimate a small-scale VAR model on Slovenian data. They find that positive government spending shocks have a positive immediate effect on output, private consumption, and investment. We can interpret their results as showing that high complementarity between private and government consumption seems to be important for the transmission of fiscal stimulus to the Slovenian economy.

3 Fiscal Packages

Fiscal policy measures are intended to directly – through increased government spending, investment, and tax relief – support the domestic demand and thereby temporarily moderate the decline in economic activity. In the longer term, however, the purpose of the measures is to primarily prevent corporate bankruptcies and redundancies and preserve production capacity. Specific to the COVID-19 situation, some measures are directly aimed at ensuring the sustainability of the health care system and to redistribute government funding to support research to discover the cure for the disease.

Fiscal measures can be direct and indirect. Direct measures primarily consist of subsidies to companies, equity contributions to businesses, tax reliefs, and unemployment cash benefits to households and the self-employed and are in the form of direct help to safeguard the long-term sustainability of the healthcare system. These are the measures that are the main focus of this paper. The second part of the measures is indirect aid. These are mainly aimed to help companies obtain new loans and solve their liquidity problems. Mostly they are in the form of loan guarantees.

The Slovenian government introduced a set of measures worth around EUR 1 billion on the 9th of March 2020. These measures were primarily aimed at providing liquidity to companies facing difficulties in settling their liabilities due to a lack of revenue. They consisted mostly of new SID Bank credit lines, assets of the Slovenian Enterprise Fund, and loan reschedules by the Regional Development Fund. State guarantees and the possibility of deferring taxes were also envisaged. Hence, the first set of measures primarily involved indirect measures.

With the worsening of the situation, the government prepared the Act on Emergency Measures to Curb the COVID-19 Epidemic and Mitigate its Implications for Citizens and the Economy, which was approved by the National Assembly on the 2nd of April. The additional adopted measures were estimated at EUR 2 billion (4 % of GDP). The measures consisted primarily of *direct* financial aid to preserve jobs.

Among the measures to preserve jobs, the most important was the reimbursement of workers' compensation for temporary waiting for work and exemption from contributions, while maintaining the insurance rights and the benefits of social security funds. For employees who work, the contribution to the pension and disability insurance was paid by the Republic of Slovenia. Self-employed persons who were unable to carry out their activities or able to only on a substantially reduced basis due to the crisis were eligible for exceptional assistance in the form of a monthly basic income of EUR 350 for March and EUR 700 for April and May 2020. The compensation for sick leave during the pandemic was covered by the Health Insurance Institute and not by the employer. Corporates were relieved of advance payment of personal income tax on income from the performance of business activities and advance payment of corporate income tax. Payment deadlines for payments to private suppliers from public funds were reduced to eight days.

Additionally, the second package included measures to improve corporate liquidity, measures to assist agriculture and measures to improve people's social status.

Based on the publicly available information and the official macroeconomic projections of

Banka Slovenije from 2020, we have prepared three possible scenarios on how big will the *actual* fiscal takeaway be given the length of the COVID-19 lock-down. We have rescaled the estimated amounts of the fiscal takeaway in three scenarios and merged the categories into (1) Government Subsidies, (2) Social Benefits, (3) Government Wages, (4) Holiday Vouchers, (5) Taxes and (6) Expenditures for Protection Equipment. Only the shocks to government subsidies, social benefits and government wages in scenario 3 last more than one quarter. Shocks to taxes and expenditures for protection equipment last only for one quarter in all scenarios. Table 1 presents the rescaled shocks.

Table 1: Normalised shocks to nominal GDP EUR 48 billion (in p.p.)

	Scenario 1	Scenario 2	Scenario 3	
Category	Q1	Q1	Q1	Q2
Government subsidies	1.9	2.6	2.6	0.9
Social benefits	0.7	0.8	0.8	0.1
Government wages	0.3	0.3	0.3	0.1
Holiday vouchers*	(0.5)	(0.5)	(0.6)	–
Taxes	0.2	0.2	0.2	–
Expenditures for protection equipment	0.2	0.3	0.4	–
Sum**	**3.3**	**4.4**	**4.5**	**1.1**

Sources: Authors' calculations, Banka Slovenije (2020), Agency of the Republic of Slovenia for Commodity Reserves. *Note*: * For the holiday vouchers, we assume that the takeaway will take place in Q2 and Q3 from the first fiscal shocks taking place. ** Without holiday vouchers.

4 The SVAR model

We estimated a small-scale VAR model to assess the size of the fiscal multipliers in Slovenia. Using the SVAR model, we perform a robustness check for the EAGLE model estimates of the impacts of fiscal shocks. The model comprises the set of four endogenous variables, namely government expenditure (G), government revenues (T), private expenditure (C) and the trade balance (TB).[1] The inclusion of the trade balance is crucial as Slovenia is a small open economy and we need to account for the possibility of the outflow of fiscal expenditure through the imported goods. The quarterly time horizon spans from 1999Q1 to 2022Q2.

The estimated reduced form VAR model has the following form:[2]

$$Y_t = \sum_{i=1}^{p} \Phi_i Y_{t-i} + \beta X_t + u_t \tag{1}$$

where, Y_t is a vector of endogenous variables in period t, X_t is a vector of exogenous variables at t and u_t represents reduced form errors of the model, assumed to be i.i.d. $WN(0, \Sigma_u)$, $\Sigma_u = \mathbb{E}(u_t u_t')$. In the set of exogenous variables we include a deterministic trend, a constant, dummy variable for a crisis period and the foreign demand constructed as the weighted average of GDP of main trading partners.[3] With inclusion of the foreign demand we control for the exogenous developments which drive the domestic economic cycle and cannot be affected by domestic fiscal policies (following the small open economy assumption).

[1] Government expenditure is calculated as a logarithm of the sum of government consumption and government investment. Similarly, private expenditure is calculated as a logarithm of the sum of private investment and private consumption, while trade balance is a logarithm of the ratio between export and import. The series of taxes is calculated as the logarithm of the sum of direct taxes, indirect taxes and net social security contributions.

[2] We conducted the specification test to assess the appropriate lag order of the model. Different information criteria suggest the use of 1 to 6 lags in the reduced form VAR model. We decided to include four lags to include one year and to mute the problem of serial autocorrelation of residuals.

[3] The dummy variable for the crisis period attains a value of one for quarters with negative growth rates of real GDP.

4.1 Identification of structural shocks

In the identification of structural shocks we follow the general approach of Blanchard and Perotti (2002) with adjustments for small open economies in the spirit of Ravn and Spange (2014), Beetsma, Giuliodori and Klaassen (2006), Deskar-Škrbić and Šimović (2017), and others. To identify the orthogonal shocks and recover the effects of orthogonal structural shocks in government revenues and spending, we can write the identification equations as:

$$Au_t = B\varepsilon_t \tag{2}$$

where $u_t = (u_t^g, u_t^t, u_t^c, u_t^{tb})'$ is a vector of reduced form disturbances, $\varepsilon_t = (\varepsilon_t^g, \varepsilon_t^t, \varepsilon_t^c, \varepsilon_t^{tb})'$ is a vector of structural shocks and matrices A and B represent structural parameters. We can rewrite equation (2) as:

$$\begin{bmatrix} 1 & 0 & -a_{1,3} & -a_{1,4} \\ -a_{2,1} & 1 & -a_{2,3} & -a_{2,4} \\ -a_{3,1} & -a_{3,2} & 1 & 0 \\ -a_{4,1} & 0 & -a_{4,3} & 1 \end{bmatrix} \begin{bmatrix} u_t^g \\ u_t^t \\ u_t^c \\ u_t^{tb} \end{bmatrix} = \begin{bmatrix} b_{1,1} & 0 & 0 & 0 \\ b_{2,1} & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^g \\ \varepsilon_t^t \\ \varepsilon_t^c \\ \varepsilon_t^{tb} \end{bmatrix} \tag{3}$$

The identification process is composed of the following steps:

- We initiated the identification with the automatic stabilisers, defined as the elasticity of government expenditures (γ^g) to changes in the output. We follow the estimates of Price, Dang and Botev (2015) to identify the changes of government expenditures to changes in the output gap.[4] As the elasticities are defined with respect to the changes in output, we need to calculate the respective coefficients vis-à -vis subcomponents

[4]Elasticity of government expenditure relative to changes in the output gap is rather limited, estimated at -0.0712 in the case of Slovenia.

of the GDP according to the expenditure method.[5] [6]

$$u_t^g = \gamma^g u_t^{GDP} + \varepsilon_t^g \tag{4}$$

$$u_t^g = \gamma^g (u_t^g (G/GDP) + u_t^c (C/GDP) + u_t^{tb} (M/GDP)) + \varepsilon_t^g \tag{5}$$

$$u_t^g = \mu\gamma^g u_t^c (C/GDP) + \mu\gamma^g u_t^{tb} (M/GDP) + \mu\varepsilon_t^g \tag{6}$$

From the calculation presented above we can see that $b_{1,1} = \mu$, $a_{1,3} = \mu\gamma^g(C/GDP)$, and $a_{1,4} = \mu\gamma^g(M/GDP)$.

- Similarly, we identified parameters $a_{2,1}$, $a_{2,3}$, $a_{2,4}$ by relying on institutional information about tax programmes, well documented in Price, Dang and Botev (2015), Jemec et al. (2011), and Burriel et al. (2009). The detailed process of parameter estimation is described in Appendix B.

- Estimated automatic stabilisers allow us to calculate the cyclically adjusted reduced-form disturbances $u_t^{g,CA}$ and $u_t^{t,CA}$.

$$u_t^{g,CA} = u_t^g - a_{1,3} u_t^c - a_{1,4} u_t^{tb} \tag{7}$$

$$u_t^{t,CA} = u_t^t - a_{2,1} u_t^g - a_{2,3} u_t^c - a_{2,4} u_t^{tb} \tag{8}$$

Cyclically adjusted reduced form errors are no longer correlated with the subcomponents of GDP and we can use them for estimating the coefficient $b_{2,1}$ with the OLS.

- Furthermore, we use the cyclically adjusted errors as instruments in the estimation of the parameters $a_{3,1}$ and $a_{3,2}$. By inclusion of the foreign demand indicator an exogenous variable in the reduced form VAR model, we control for the export component included in the trade balance. Explicit modeling of the import within the

[5] $u_t^{GDP} \approx u_t^c (C/GDP) + u_t^g (G/GDP) + u_t^{tb} (M/GDP)$
This equation follows the assumption that $(M/GDP) \approx (X/GDP)$, which holds based on historical data. M denotes the real import and X denotes the real export. Note that it is necessary to account for weights of subcomponents of the GDP because of logarithmic transformation of variables in the VAR model.

[6] $\mu \equiv 1/(1 - \gamma^g (G/GDP))$

model controls for the international trade transmission channel in case of the policy actions. Automatic responses of import to changes in government and private expenditures are calibrated by accounting for the import intensities of subcomponents of GDP. We follow Radovan (2022) in accounting for direct import elasticities for the case of Slovenia, which are reflected in the parameters $a_{4,1}$ and $a_{4,3}$.

4.2 Impulse response functions

With the small-scale VAR model, we calculate the impulse response functions and assess the size of fiscal multipliers for Slovenia. In order to make our results comparable to the ones of the EAGLE model we express government expenditure shocks and government revenue shocks in terms of 1 percent of GDP.[7] The purpose of the paper is to show not only the direct impulse response functions from the VAR model but also the cumulative elasticities of GDP to the government expenditure and government revenue multiplier that can be directly compared to the cumulative impulse responses from the EAGLE model.

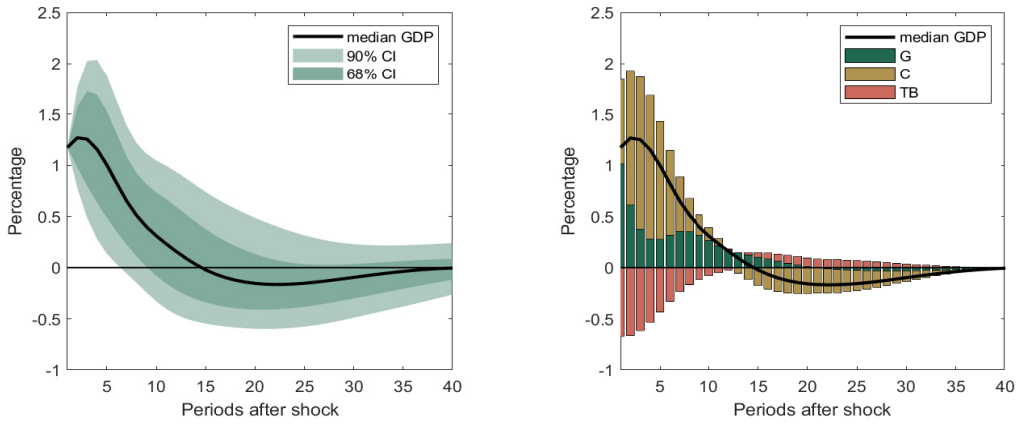
4.2.1 Government expenditure shock

The response of the GDP to a government expenditure shock is presented in Figure 1. Government expenditure shock (1% of GDP) increases the GDP on impact by 1.17% and the effect remains positive and statistically significant for a period of six quarters. On the right hand side of Figure 1, we see the decomposition of the effect on GDP. Government expenditure response to the own shock is transitory as the effect fades out after approximately three quarters, but the response of private expenditure is stronger and lasts approximately three years. As expected, we see that a significant share of contribution to GDP outflows through the foreign trade channel as Slovenia imports a

[7]This effectively means that we rescale government spending shocks by a factor of 4.3, which is an inverse of a share of government expenditure in total GDP. In the case of government revenues we rescale its shocks by a factor of 4. Both estimates are assessed by historical averages.

significant share of the finally consumed and invested goods and services. The outflow through the foreign trade therefore decreases the impact multiplier by approximately 0.7 p.p.. Results are broadly in line with the EAGLE model as the response stands somewhere between the government consumption shock and the government investment shock.

Figure 1: The response of real GDP to a positive government expenditure shock (1% of GDP)

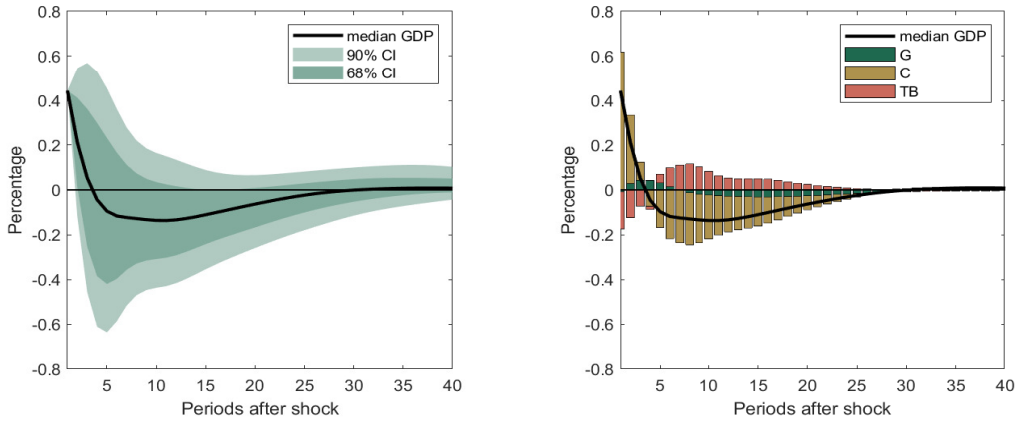


Source: Authors' calculations. *Note*: 90% and 68% confidence intervals are estimated by the nonparametric bootstrap with 10,000 replications. Quarterly impulse response functions are smoothed by the restriction on the annual impulse response which remain intact.

4.2.2 Government revenues shock

Negative government revenues shock (1% of the GDP tax reduction) increases GDP on impact by approximately 0.44%. The main driver of the positive effect is the private expenditure, which on impact contributes approximately 0.6 p.p. to the GDP growth on the impact. The positive impact is however once again offset by the negative response of the trade balance. The response of GDP to the changes in the government revenues is insignificant already in the second quarter after the impact. This result is also consistent with Jemec et al. (2011).

Figure 2: The response of real GDP to a negative government revenues shock (1% of GDP)



Source: Authors' calculations. *Note*: 90% and 68% confidence intervals are estimated by the nonparametric bootstrap with 10000 replications. Quarterly impulse response functions are smoothed by the restriction on the annual impulse response which remain intact.

4.2.3 Cumulative domestic spending multiplier

To obtain the cumulative elasticity of GDP to the isolated government intervention we follow Alloza et al. (2020). Cumulative elasticity is therefore calculated as a division of the cumulative response of GDP and the response of the relevant government intervention variable to its own shock. In order to measure the pure effect of a fiscal variable, we calculated the cumulative counterfactual impulse responses. In Table 2 we report the cumulative multipliers for the three-year period. Cumulative impulse responses estimated in this section can be compared to the cumulative impulse response functions from the EAGLE model.

Table 2: Cumulative domestic fiscal multipliers in the small scale VAR model

	On impact	First Year	Second Year	Third Year
Government expenditure shock	1.17	1.51	1.59	1.52
Government revenues shock	0.44	0.42	0.21	0.07

Source: Authors' calculations.

5 The calibrated large-scale DSGE model

We estimate the effects of different fiscal measures on the Slovenian (domestic) economy by calibrating a large-scale DSGE model. The cumulative domestic spending multipliers can be calculated by checking the impulse response functions (IRFs) of a structural model.

5.1 The EAGLE model

To assess the effect of the fiscal package on the economy in a rich modelling environment, we calibrate the EAGLE model on Slovenian data as developed by Clancy, Jacquinot and Lozej (2016).[4] The EAGLE model consists of four regions in the world economy, two of which constitute a monetary union (in our case Slovenia and the rest of the Euro Area). Apart from monetary policy regimes and some parameter values, each region covered in the EAGLE model is modelled symmetrically.

An important aspect of the model is that the regions are linked with each other through a bilateral trade relationship and their participation in international financial (bond) markets. The linkages between regions provide a wide range of macroeconomic interdependencies and spillovers present in the Euro Area. There are two types of households, which are differentiated by their ability to participate in asset markets. Labour markets are monopolistically competitive allowing households to be the wage setters for the differentiated labour services they supply to firms. This implies nominal rigidities in the labour and goods market. Wage rigidities are modelled following Calvo (1983).

On the production side, an intermediate sector produces tradable[5] and nontradable goods which are produced by monopolistically competitive firms. Prices of differentiated intermediate goods are also subject to the Calvo-type scheme with indexation. The final goods sector is subject to perfectly competitive firms that aggregate different varieties

[4]For the theoretical derivation of the model in detail see Gomes, Jacquinot and Pisani (2012) and Clancy, Jacquinot and Lozej (2016).

[5]Tradable intermediate goods are subject to international trade, with export prices denominated in the importing country's currency (local currency pricing assumption).

of domestic nontradable, tradable, and imported goods (Clancy, Jacquinot and Lozej, 2016).[6]

The reason why we use the EAGLE model with the fiscal extension is that it allows for government spending to partly consist of imported goods. To simulate the reality of small open economies a significant proportion of goods consumed or invested by the government should be imported (Clancy, Jacquinot and Lozej, 2016).

Therefore, the fiscal multipliers of government spending are lower as a result of increasing import expenditure. Government spending is additionally divided into government consumption and government investment. In this respect, Clancy, Jacquinot and Lozej (2016) assume that the government consumption expenditure is wasteful, but they also impose additional assumptions.

The additional assumption, made by Coenen, Straub and Trabandt (2012) allows for complementarities between private and government consumption. The latter feature of the model enables us to study the effects of such complementarities on both the size of government consumption multipliers and the spillovers of government spending shocks in their main trading partners.

The third assumption, made by Leeper, Walker and Yang (2010), allows government investment to contribute to public capital. This means that when public capital increases, the productivity of private capital also increases, and marginal costs of firms decrease. Consequently, the economy experiences an improvement in external competitiveness and attracts additional private investment. The current account improves and output increases.

On the other side, the government generates revenue by imposing proportional and lump-sum taxes.[7] Transfers and lump-sum taxes are not evenly distributed across the two modelled types of households. Those households that have full access to asset markets

[6]Aggregation of imports into a homogeneous import good is subject to adjustment costs whenever a country's trade structure changes.

[7]The government generates revenue also through seigniorage that is earned on outstanding money

are receiving fewer transfers and pay more taxes in per-capita terms (Gomes, Jacquinot and Pisani, 2012; Clancy, Jacquinot and Lozej, 2016). Fiscal debt that is accrued by a particular government is held in the form of government bonds. The debt level of a region is subject to a long-term target debt level that is in line with the Maastricht Treaty. The target debt level is achieved through a smooth adjustment process in lump-sum taxes (Clancy, Jacquinot and Lozej, 2016).

5.2 Results of the EAGLE model

The main results of the paper are the estimated effects of the fiscal policy package on the key national economic variables, depending on the three different scenarios of the actual takeaway. The latter is shown in greater detail in Table 1 and mainly depends on the length of the economic lock-down.

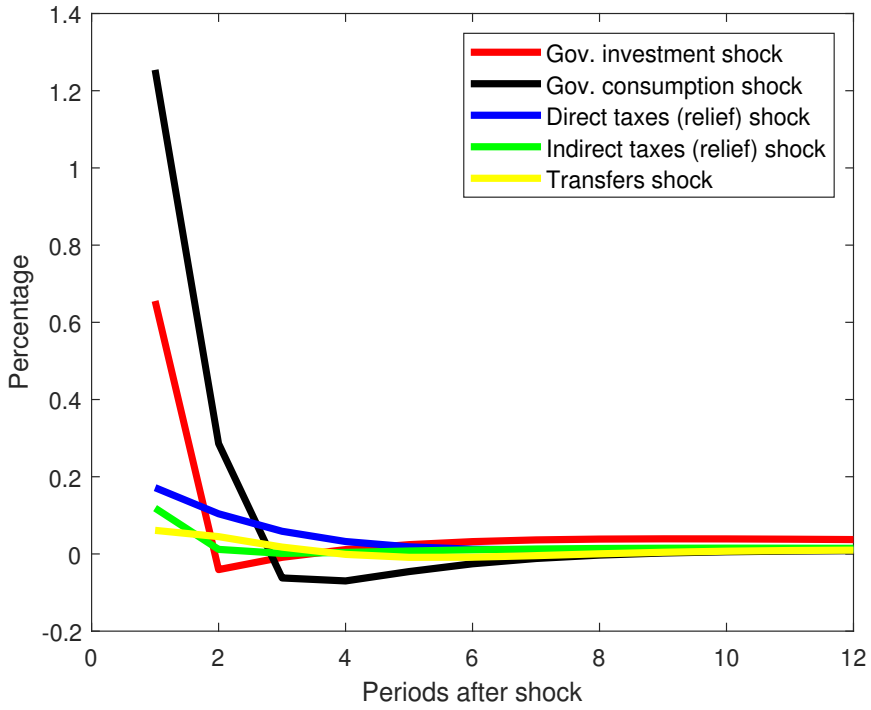
The EAGLE model is calibrated to the case of Slovenia, which predominantly and economically operates within the Euro Area. This means that shocks that stem from the Euro Area region have a larger impact on the Slovenian economy than shocks originating from the US or the rest of the world. On the other hand, since Slovenia is a typical small open economy, shocks that originate from its economy have no significant effect on large regions. In comparison to Clancy, Jacquinot and Lozej (2016), the major calibration difference involves the new parameter recalibration of the exogenous processes in the fiscal block of the model. First, we assume that fiscal packages are a strict one-off event that has no persistence in fiscal variables (investments, consumption, transfers/benefits, and taxes). Consequently, we set the persistence parameters in the fiscal exogenous processes to zero. Second, the size and the structure of the fiscal shocks are suited to the size and structure of the fiscal packages explained in Section 3.

The effects of different fiscal variables on the macroeconomic variables differ. Figure 3 shows the impulse responses of the GDP variable to shocks to different fiscal variables,

holdings (Clancy, Jacquinot and Lozej, 2016), but this feature is not key in our paper.

which are rescaled to 1% of GDP. The idea here is to show the differences in the effects of fiscal variables. Based on Figure 1, it is evident that government consumption and investments have the largest effect on the economy and thus have the largest multiplier. Direct tax relief has a significantly lower effect, while indirect taxes and social contributions have an even lower effect on the economy.

Figure 3: The impulse response of GDP to shocks to different fiscal variables scaled to 1% of GDP



Source: Authors' calculations. *Note*: The chart in Figure 3 depicts a p.p. response of the GDP variable to different types of fiscal variable shocks scaled to 1% of GDP.

We translate the figures from Table 1 that show the fiscal stimulus package (i.e. government subsidies, social benefits, government wages, holiday vouchers, taxes and expenditures for protection equipment) to the theoretical model fiscal variables specified in EAGLE (Table 3). We treat government subsidies as a combination of household and firms (pay-roll tax rates and social contributions) shocks. Half of the subsidies are meant to stimulate firms, while the other half are intended to stimulate the household segment. With respect to social benefits, we treat them as a fiscal authority's transfers shock. Hol-

iday vouchers, add-ons to government wages and expenditures for protection equipment are treated as the government consumption shock, while taxes are treated as additional pay-roll tax rate, social contributions (transfers) and wage tax shocks.

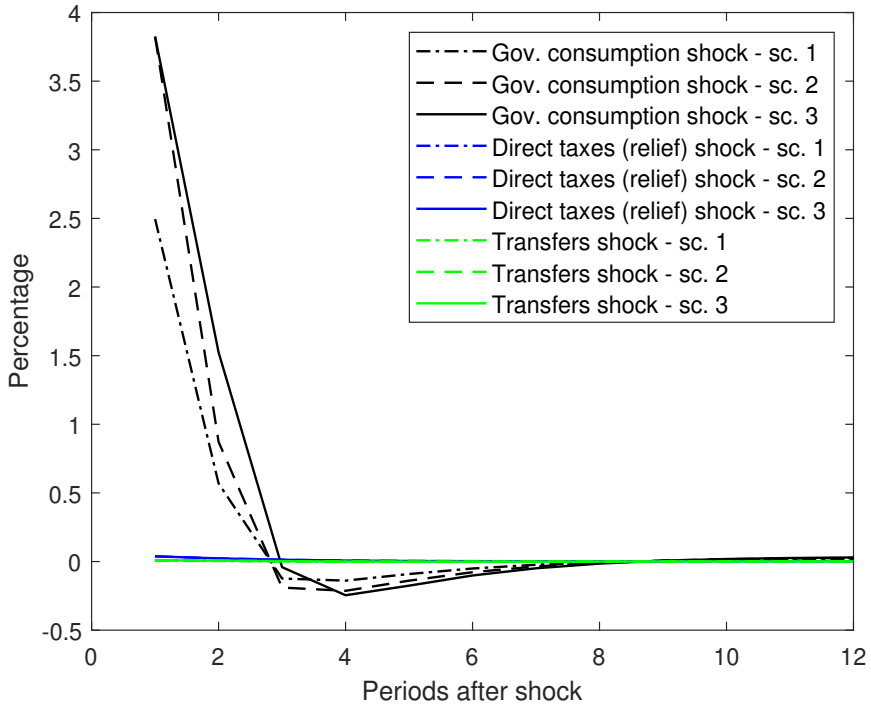
Table 3: Modelled and type of shocks in EAGLE

Category	Scenario 1 Q1	Scenario 2 Q1	Scenario 3 Q1	Scenario 3 Q2	Type of shock
Government subsidies	0.030188	0.041032	0.041032	0.014190	$\varepsilon_{\tau_h^W}$
	0.030188	0.041032	0.041032	0.014190	$\varepsilon_{\tau_f^W}$
Social benefits	0.007223	0.00749	0.00749	0.001482	ε_{tr}
Government wages	0.003101	0.003101	0.003101	0.001222	ε_{τ^C}
Holiday vouchers	0.004543	0.004543	0.006436	–	ε_{τ^C}
Taxes	0.002051	0.001974	0.001974	–	$\varepsilon_{\tau_h^W}$
	0.001875	0.001804	0.001804	–	$\varepsilon_{\tau_f^W}$
	0.001741	0.00167	0.00167	–	ε_{τ^N}
Expenditures for protection equipment	0.001854	0.003125	0.003833	–	ε_{τ^C}

Source: Authors' calculations.

Then, based on Figure 3 and the fiscal shock sizes from Table 3, we provide the impulse responses of GDP to shocks to different fiscal variables to the translated size of the fiscal stimulus package, which is shown in Figure 4. It is evident, that the government spending takes on the most of the effect on GDP, as direct taxes and transfers due to their lower multiplier effect and their small overall size in the fiscal stimulus package have a limited effect on GDP.

Figure 4: The impulse response of GDP to shocks to different fiscal variables based on figures from Table 1



Source: Authors' calculations. *Note*: The chart in Figure 4 depicts a p.p. response of the GDP variable to different types of fiscal variable shocks.

Further on, in Figure 5, we can see that the proposed fiscal stimulus (again, the size of the effects depends on the scenarios) has a positive effect on the Slovenian economy. The immediate fiscal stimulus shock affects the GDP the most at the beginning (in period 1). The peak responses vary from 1.1 to 1.6 p.p. depending on the scenario.[8] Since we assume the one-off type of shocks with zero persistence parameters the dynamics of most real variables quickly decrease back to the steady-state after 4 to 5 quarters.[9]

From Figure 5 it is also clear that the effect of the fiscal stimulus on the non-tradable sector is larger than on the tradable sector. The bigger proportion of the non-tradable

[8]The yearly effects of the fiscal stimulus packages depending on the scenario differ from 2.5 to 4.1% of GDP in line with the projection for the Slovenian economy (Banka Slovenije, 2020). In the second year, mostly due to the zero persistence assumption of the fiscal shocks, the effects of the fiscal stimulus packages disappear.

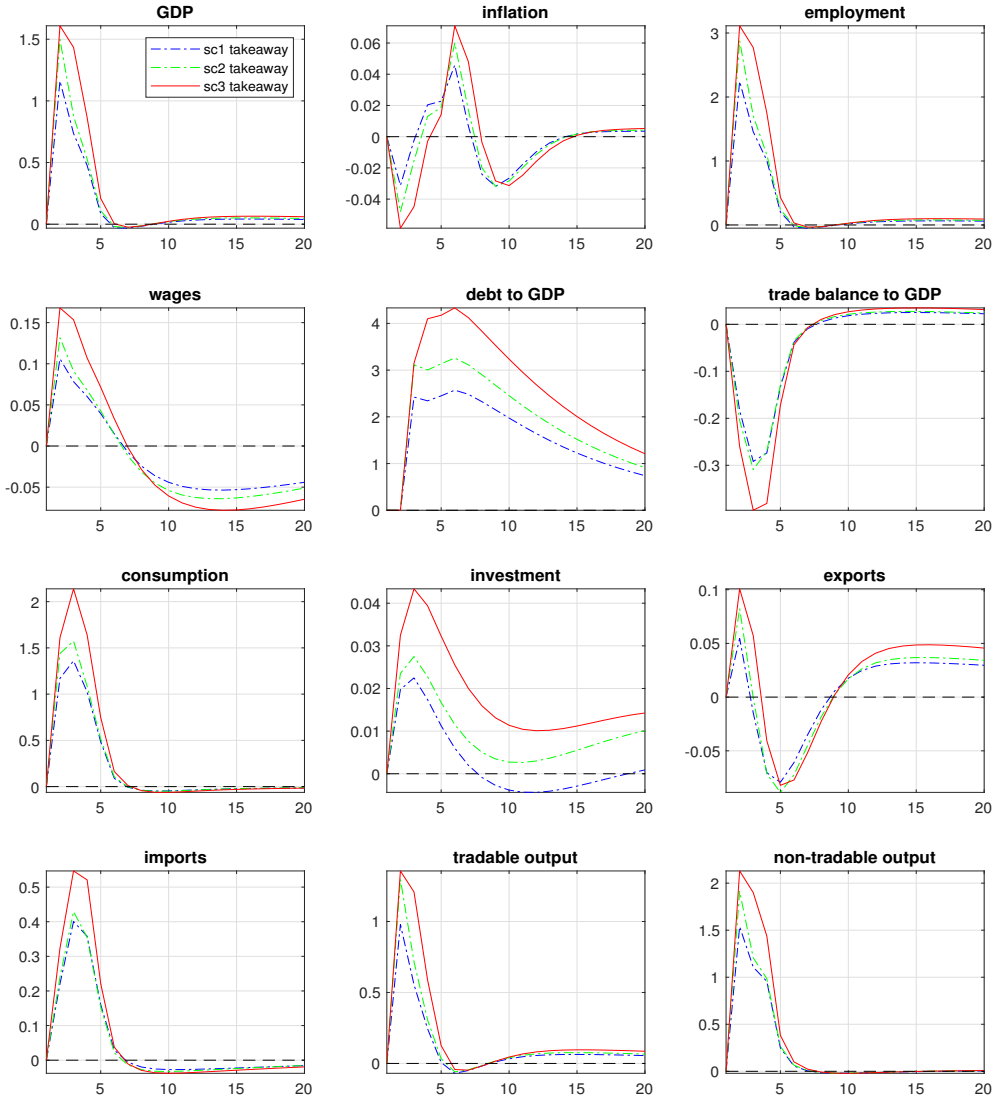
[9]For robustness check, we calculate the fiscal multiplier from the DSGE model. The size of the fiscal multiplier from the DSGE model is in line with the multiplier obtained from the SVAR model above and with the literature, such as Bayer et al. (2020), who estimated the fiscal transfer multiplier.

sector is composed of services that are provided by the government sector. Sectors such as manufacturing, storage, and transporting which fall under the tradable sector, are affected less by the increase in government spending.

The fiscal stimulus positively affects private consumption and imports, while having an almost insignificant effect on investments and exports. The economic rationale here is that government consumption and investments stimulate aggregate demand and consist mostly of imported goods. On the other hand, private investments and exports are less affected. Higher imports and lower exports worsen the Slovenian balance of trade.

Finally, in Figure 5 we plot the evolution of inflation and real wage variables. The fiscal stimulus increases wages through several quarters. The wages increase due to government subsidies to households and firms and as a result of the direct stimulus. On the other hand, the effect of fiscal stimulus on inflation is negligible.

Figure 5: The impulse response of the main macroeconomic variables to fiscal packages in three scenarios



Source: Authors' calculations. *Note*: The charts in Figure 5 depict a p.p. response of the main macroeconomic variables to fiscal packages shocks.

5.3 Different calibrations of the EAGLE model

We also test different calibration versions of the EAGLE model. In the baseline EAGLE model we allow for complementarity between government consumption and private con-

sumption. This assumption follows Coenen, Straub and Trabandt (2012) and Leeper, Walker and Yang (2009) and introduces government consumption in the utility function in a non-separable manner. The CES-aggregate of government and private consumption is therefore defined by the following equation:[10]

$$\tilde{C}_t = \left[\nu_{CCES}\left(C_t\right)^{\frac{\mu_{CCES}-1}{\mu_{CCES}}} + \left(1-\nu_{CCES}\right)\left(G_{C,t}\right)^{\frac{\mu_{CCES}-1}{\mu_{CCES}}}\right]^{\frac{\mu_{CCES}}{\mu_{CCES}-1}} \tag{9}$$

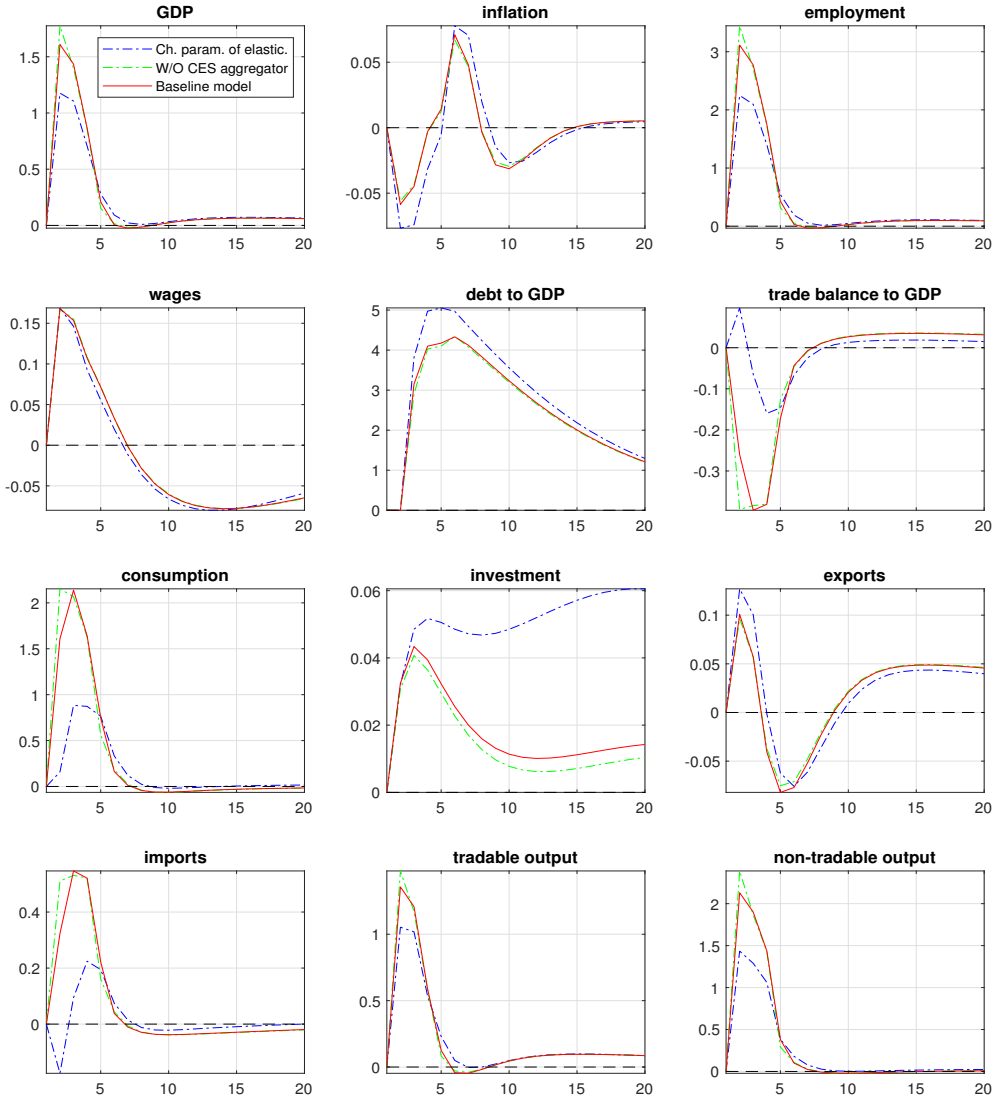
The degree of complementarity is set by the elasticity of substitution parameter μ_{CCES}, which in the baseline model is set at 0.20, while the parameter ν_{CCES} defines the share of private consumption in total consumption (set at 0.75).

For the sake of robustness check and sensitivity analysis, we assume different cases. In the first case set the elasticity of substitution parameter μ_{CCES} to 0.50, thus increasing the complementarity of government good with respect to private good. In the second case, we change the specified CES consumption equation for each type of household by eliminating the government consumption from the CES consumption equation, thus relaxing the assumption of Coenen, Straub and Trabandt (2012) and Leeper, Walker and Yang (2009). This way we treat the government consumption and private consumption separately, so that there is no direct tie of government consumption to private consumption (or total consumption).

We show both cases together with the baseline case model with the scenario 3 takeaway in the following figure (Figure 6). We see that the higher complementarity of both type of goods affects the overall effect of the fiscal stimulus on the economy. Even more if we treat both types of goods separately (i.e. relaxing the assumption of Coenen, Straub and Trabandt, 2012 and Leeper, Walker and Yang, 2009), the model displays the strongest effect on the main macroeconomic variables.

[10]See the EAGLE's extended fiscal sector of Clancy, Jacquinot and Lozej (2016) in the appendix for more detail.

Figure 6: The impulse response of the main macroeconomic variables to the 3rd scenario takeaway with different parameter values



Source: Authors' calculations. *Note*: The charts in Figure 6 depict a p.p. response of the main macroeconomic variables to fiscal packages shocks.

6 Comparison of the fiscal multipliers

In the end, we check and compare the estimated cumulative domestic spending multipliers in the structural VAR model and the calibrated EAGLE model. Table 4 presents the multipliers. We can see that the multipliers align close to each other, and are, in economic magnitudes, close to those in Jemec, Strojan Kastelec and Delakorda (2011). The effect of the fiscal stimulus becomes insignificant and returns to the steady-state after four quarters in the case of the EAGLE model. For the SVAR model, we can observe that the cumulative multiplier reaches its peak only after a two-year period and reaches the values of the EAGLE model in the medium run.

Table 4: Cumulative domestic fiscal multipliers in the small-scale VAR and EAGLE models

	Government expenditure		Government revenue	
	SVAR	EAGLE	SVAR	EAGLE
On Impact	1.2	1.3	0.4	0.1
First year	1.5	1.4	0.4	0.2
Second year	1.6	1.3	0.2	0.3
Third year	1.5	1.3	0.1	0.3

Source: Authors' calculations.

7 Conclusions

This paper lists the fiscal stimulus measures which were implemented by the Slovenian government and assesses the impact of the fiscal stimulus amid the COVID-19 pandemic on the domestic economy. We estimate the impact of the fiscal policy via two approaches, i.e. a theoretical and an empirical approach. The EAGLE model and a structural VAR model are used to this end. We find strong evidence that the fiscal stimulus affects GDP, private consumption, and import-related variables, while it has only a small effect on private investments and exports. The fiscal stimulus pushes inflation and real wages up slightly. Government subsidies to households and firms, as well as the direct fiscal

stimulus, increase wages across several quarters. We show that the fiscal stimulus increases the nominal variables with a lower magnitude, despite with a stronger persistence with respect to real variables.

In the EAGLE model, we have three features that help us understand how the fiscal stimulus transmits to the Slovenian economy. First, the model allows government spending to partly consist of imported goods. Higher import expenditures lower the multiplier of government spending. Second, the model splits government spending between consumption and investment goods. Third, the model allows for complementarities between private and government consumption.

We find that the main transmission channel of the fiscal stimulus on Slovenian output is through high complementarities between private and government consumption which is in line with the findings of Clancy, Jacquinot and Lozej (2016). We can reach the same conclusions based on the results of the SVAR model in Jemec, Strojan Kastelec and Delakorda (2011).

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Appendices

7.1 Appendix A: Diagnostics, Inference and Robustness checks of the SVAR model

7.1.1 A.1 Diagnostics

- **Lag selection**

  Information criteria proposed different number of lags in the reduced form VAR model. The restriction for the maximal lag order was set to 12. We decided to include 4 lags in the baseline model. However, we performed the robustness check with other lag orders proposed by the information criteria. The results are presented in Appendix A.3.

Table 5: Lag selection criteria

AIC(n)	HQ(n)	SC(n)	FPE(n)
6	1	1	3

Source: Authors' calculations.

- **Asymptotic Portmanteau test of residual autocorrelation** cannot reject the null hypothesis of no serial autocorrelation.

- **Multivariate ARCH-LM tests** reject the absence of heteroscedasticity at the sec-

Table 6: Portmanteau Test (asymptotic)

Chi-squared	df	p-value
156.84	144	0.2194

Source: Authors' calculations.

ond and third lag but the test becomes insignificant when tested for the conditional multivariate heteroscedasticity up to 4 lags.

Table 7: Multivariate ARCH-LM tests

	Chi-squared	p-value
lag 1	121.81	0.07
lag 2	249.03	0.01
lag 3	348.96	0.03
lag 4	427.26	0.17
lag 5	528.29	0.18
lag 6	607.83	0.4
lag 7	704.46	0.45
lag 8	806.44	0.43

Source: Authors' calculations.

- **Multivariate Jarque-Bera test** of normality of residuals concludes that the distribution of residuals is not normal. The test however is inconclusive for partial test of skewness and Kurtosis. Consequently, our confidence intervals are estimated by the bootstrap.

Table 8: Multivariate Jarque-Bera test

JB-Test (multivariate)		
Chi-squared	df	p-value
16.157	8	0.04
Skewness only (multivariate)		
Chi-squared	df	p-value
7.7264	4	0.10
Kurtosis only (multivariate)		
Chi-squared	df	p-value
8.4307	4	0.08

Source: Authors' calculations.

- **OLS-CUSUM test** shows that there are no notable structural changes in the data.

7.1.2 A.2 Inference

VAR coefficients

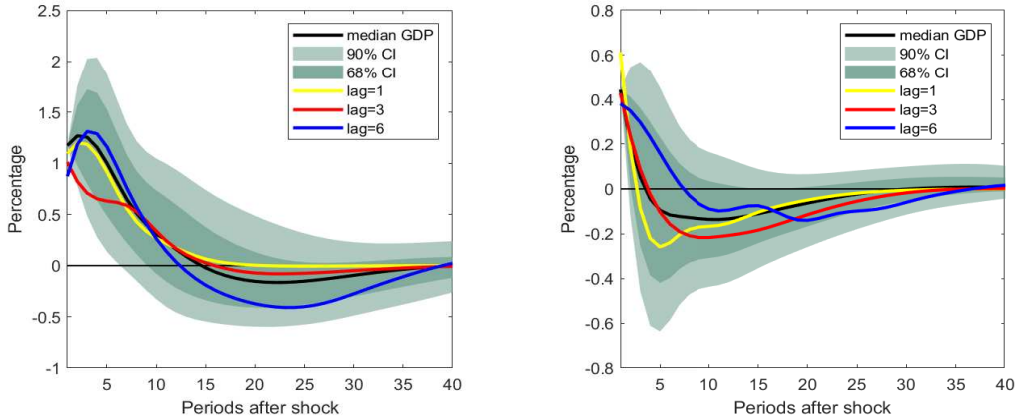
Table 9: VAR coefficients

	GCOR	TAXR	PCOR	TB
G.l1	0.600 ***	-0.101	0.002	-0.103
T.l1	0.016	0.515 **	0.123	-0.078
C.l1	0.108	0.071	0.277 *	-0.238 *
TB.l1	-0.151	-0.182	-0.478 **	0.397 **
G.l2	0.21	0.394.	0.125	-0.078
T.l2	-0.06	-0.042	-0.213.	0.113
C.l2	-0.157	0.226	0.305 *	-0.092
TB.l2	-0.098	-0.013	-0.018	-0.122
G.l3	-0.208	-0.293	0.134	0.1
T.l3	0.05	0.251.	0.250 *	-0.095
C.l3	0.074	-0.192	-0.144	0.106
TB.l3	0.214 .	-0.038	-0.096	0.181.
G.l4	0.215	-0.249	-0.291.	-0.013
T.l4	0.009	-0.09	-0.071	-0.007
C.l4	0.096	0.06	0.161	0.111
TB.l4	-0.071	-0.043	0.123	0.035
const	0.222	3.345 **	3.138 **	2.228 **
trend	0	0	0	0.001 .
FD	0.023	0.269 **	0.253 ***	0.113 *
D	-0.007	-0.039 ***	-0.025 *	0.01
Adj, R-sq.	0.972	0.886	0.941	0.939
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Source: Authors' calculations.

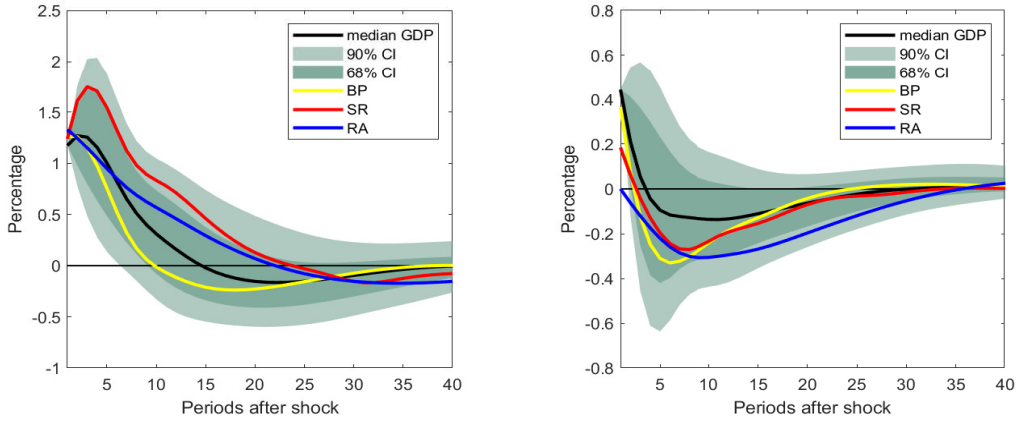
7.1.3 A.3 Robustness checks

Figure 7: The robustness of the response of real GDP to different lag specifications (1% of GDP)



Source: Authors' calculations. *Note*: 90% and 68% confidence intervals are estimated by the nonparametric bootstrap with 10000 replications. Quarterly impulse response functions are smoothed by the restriction on the annual impulse response which remain intact.

Figure 8: The robustness of the response of real GDP to different identification strategies (1% of GDP)



Source: Authors' calculations. *Note*: 90% and 68% confidence intervals are estimated by the nonparametric bootstrap with 10000 replications. Quarterly impulse response functions are smoothed by the restriction on the annual impulse response which remain intact.

Comparison of the impulse response functions shown in Figure 7 confirms that our results are robust to different orders of the VAR model. Furthermore, we examined the impulse

response functions of GDP to the government expenditure and government revenues shock identified by different strategies. We followed Caldara and Kamps (2008) in identification of the fiscal policy shocks by the recursive approach (RA), sign restriction (SR) and the identification of Blanchard and Perotti (2002) approach (BP). We compared results of different identification strategies with our baseline specification. The impulse response functions obtained by different identification strategies are shown in the Figure 8.

The recursive approach (RA) of identification implies the causal ordering of variables. We ordered government expenditure first, private expenditure second, trade balance third and government revenues last. Government expenditure is not contemporaneously affected by the shocks to other variables in the system. Trade balance and private expenditure are not contemporaneously affected by changes in the government revenues while they react immediately to the change in government expenditure.

The Blanchard and Perotti (2002) approach (BP) is very similar to the one used in our analysis, with the exception that in includes the GDP directly in the VAR model, potentially affecting the results as the trade balance is not modelled directly within the VAR model. we can see, however, that the impulse responses of GDP are extremely similar to the estimation with our model. It is worth noting that we kept the exogenous part of the VAR model the same as in the baseline approach.

The sign restrictions approach (SR) utilises the shape of the impulse response function to identify structural shocks. In this case, the number of structural shocks is not necessarily equal to the number of variables in the VAR model. We identify two structural shocks, namely the government expenditure shock and the government revenues shock. [11] The government expenditure shock is identified by the requirement that the government expenditure increases together with private expenditure, while the trade balance decreases. The government revenues shock is identified by the requirement that the positive response of taxes is accompanied by the negative response of the private expenditure and a posi-

[11]Business cycle shock is meant to control for the situations when the private expenditure increases together with the trade balance and taxes. Identification of the business cycle shock and its orthogonality to the fiscal shocks controls for the global trade, which is an important factor for the small open economies.

tive response of the trade balance. The impulse response functions of the GDP to both discretionary fiscal shocks are broadly in line with the baseline approach.

7.2 Appendix B: Estimation of net taxes elasticities

The estimation of net taxes elasticities follows the well established approach, where the elasticity of the collected tax vis-à-vis the tax base is established on the basis of the tax legislation and the elasticity of tax base with respect to different activity measures is estimated with a linear regression. For the setup of taxes with respect to their tax base, we followed the procedure of Jemec, Strojan Kastelec and Delakorda (2011) by letting the elasticity of proportional taxes to unity, higher than one for progressive taxes and lower than one for regressive taxes. Sensitivities of tax bases to the output were estimated via linear regressions.

Personal income tax accounts for 5.4% of GDP or 14.5% of government revenues. Similar to other European countries, the personal income tax is progressive and therefore we set the elasticity with respect to tax base ($\vartheta_{tdirh,w}$) at 1.5 as suggested by Jemec, Strojan Kastelec and Delakorda (2011) and Bouthevillain et al. (2001). The GDP subcomponent elasticities of personal income tax are computed as follows:

$$\vartheta_{tdirh,c} = (\vartheta_{tdirh,w}\vartheta_{w,emp} + 1)\vartheta_{emp,c}$$

$$\vartheta_{tdirh,g} = (\vartheta_{tdirh,w}\vartheta_{w,emp} + 1)\vartheta_{emp,g}$$

$$\vartheta_{tdirh,tb} = (\vartheta_{tdirh,w}\vartheta_{w,emp} + 1)\vartheta_{emp,tb}$$

We estimated the employment elasticity of the real wage ($\vartheta_{w,emp}$) as 0.0 which is in line with Jemec, Strojan Kastelec and Delakorda (2011). The relation between real wages and employment turns out insignificant after controlling for the real output, which is an underlying driver of both real wages and employment. Estimation of elasticities of

employment with respect to the changes in output components is carried out by the means of instrumental variables (IV) and is in line with the literature.

The IV estimation of $\vartheta_{emp,c}$ uses the private expenditure component that is corrected for the effect of the wage bill. Higher employment would increase disposable income and hence private expenditure. The contemporaneous relation has to be muted to find the elasticity of employment to the change in private expenditure. We estimated the adjusted private expenditure as a residual of the effect of the real wage bill on private expenditure. Then, we used the adjusted private expenditure as an instrument in the estimation of $\vartheta_{emp,c}$.

Similarly, government expenditure is contemporaneously affected by employment in the government sector. Therefore, we subtract the government sector wage bill from the government expenditure and use the resulting series as an instrument in the estimation of $\vartheta_{emp,g}$.

Aggregating our estimates to the $\vartheta_{emp,GDP}$ we get to the value of approximately 0.42, which is in line with Burriel et al. (2009) EU estimate of 0.39.

Table 10: Estimated elasticities related to the personal income tax

Elasticity	$\vartheta_{emp,c}$	$\vartheta_{emp,g}$	$\vartheta_{emp,tb}$	$\vartheta_{tdirh,c}$	$\vartheta_{tdirh,g}$	$\vartheta_{tdirh,tb}$	$\vartheta_{w,emp}$
Value	0.37	0.22	0.10	0.37	0.22	0.10	0.00
p-value	0.00	0.00	0.00	/	/	/	0.00

Note: missing p-values (denoted by /) mean that the number is calculated from other estimated elasticities according to equations stated before.
Source: Authors' calculations.

Corporate income tax represents on average 1.8% of GDP, which translates to roughly 4.9% of government revenues throughout the period of analysis. As the corporate income tax is levied at a single rate, we set the elasticity of corporate income tax to the tax base ($\vartheta_{tdirc,gos}$) to 1 in order to avoid potentially complex estimation involving different

We found no successful draws once we already control for the business cycle by including the foreign demand in the reduced form VAR model. This finding suggests that our baseline specification sufficiently controls for the global business cycle.

tax allowances during the period. Our assessment of the elasticity is also consistent with Jemec, Strojan Kastelec and Delakorda (2011) and Burriel et al. (2009). We again follow up by estimation of remaining elasticities of gross operating surplus to changes in the output subcomponents ($\vartheta_{gos,c}$, $\vartheta_{gos,g}$, $\vartheta_{gos,tb}$) to obtain final elasticities ($\vartheta_{tdirc,c}$, $\vartheta_{tdirc,g}$, $\vartheta_{tdirc,tb}$).

$$\vartheta_{tdirc,c} = \vartheta_{tdirc,gos}\vartheta_{gos,c} = \vartheta_{gos,c}$$

$$\vartheta_{tdirc,g} = \vartheta_{tdirc,gos}\vartheta_{gos,g} = \vartheta_{gos,g}$$

$$\vartheta_{tdirc,tb} = \vartheta_{tdirc,gos}\vartheta_{gos,tb} = \vartheta_{gos,tb}$$

Table 11: Estimated elasticities related to the corporate income tax

Elasticity	$\vartheta_{gos,c}$	$\vartheta_{gos,g}$	$\vartheta_{gos,tb}$	$\vartheta_{tdirc,c}$	$\vartheta_{tdirc,g}$	$\vartheta_{tdirc,tb}$
Value	1.19	1.09	0.00	1.19	1.09	0.00
p-value	0.00	0.00	/	/	/	/

Note: missing p-values (denoted by /) mean that the number is calculated from other estimated elasticities according to equations stated before.
Source: Authors' calculations.

Social security contributions are an important component of government revenues, representing 15.6% of GDP or 41.6% of government revenues. Social security contributions are paid as a fixed percentage of the salary and there is no ceiling for the contribution. We set the elasticity of social security contributions to the tax base ($\vartheta_{ssc,w}$) to 1. Other elasticities were already estimated under personal income tax. Thus we can proceed to calculate the elasticities of social security contributions to changes in the output components as follows:

$$\vartheta_{ssc,c} = (\vartheta_{ssc,w}\vartheta_{w,emp} + 1)\vartheta_{emp,c}$$

$$\vartheta_{ssc,g} = (\vartheta_{ssc,w}\vartheta_{w,emp} + 1)\vartheta_{emp,g}$$

$$\vartheta_{ssc,tb} = (\vartheta_{ssc,w}\vartheta_{w,emp} + 1)\vartheta_{emp,tb}$$

Table 12: Elasticities related to the social security contributions

Elasticity	$\vartheta_{ssc,c}$	$\vartheta_{ssc,g}$	$\vartheta_{ssc,tb}$
Value	0.37	0.22	0.10

Source: Authors' calculations.

Indirect taxes represent a similarly important share of government revenues (39%). In line with other studies, we set private expenditure as a tax base for indirect taxes with the elasticity of the indirect taxes to changes of the tax base ($\vartheta_{tind,cons}$) settled at 1. The elasticity of private consumption to a change in private expenditure ($\vartheta_{cons,c}$) was estimated to be around 1.07, due to positive impacts on private investment. The remainder of the identification is the estimate of the elasticity of private expenditure to changes in government expenditure ($\vartheta_{cons,g}$) and the domestic trade balance ($\vartheta_{cons,tb}$). The response of private expenditure to changes in government expenditure is already included in the model through the private expenditure equation. Furthermore, we assume that the $\vartheta_{c,tb}$ is zero, consistent with the assumption that imports are driven by the domestic demand and not vice versa.

Table 13: Estimated elasticity of government revenues to changes in GDP subcomponents

Government revenues	**Share in total government revenues**	$\vartheta_{i,c}$	$\vartheta_{i,g}$	$\vartheta_{i,tb}$
Personal income tax	14.50%	0.37	0.22	0.10
Corporate income tax	4.90%	1.19	1.09	0.00
Social security contributions	41.60%	0.37	0.22	0.10
Indirect taxes	39%	1.07	0.00	0.00
TOTAL	**100%**	**0.68**	**0.18**	**0.06**

Source: Authors' calculations.

In Table B4, we can see the resulting elasticities of different government revenues to changes in the GDP subcomponents. Identified elasticities based on the taxation system in Slovenia give us the estimates of parameters $a_{2,1} = 0.18$, $a_{2,3} = 0.75$ and $a_{2,4} = 0.06$. Summation of these coefficients give as an approximation of the elasticity of government revenues to change in GDP ($\vartheta_{t,GDP}$) under the assumption that all components simulta-

neously increase by 1%. The elasticity of government revenues to change in GDP ($\vartheta_{t,GDP}$) in this case evaluates at around 0.92, which is in line with other estimates for Slovenia: Price, Dang and Botev (2015) and Jemec, Strojan Kastelec and Delakorda (2011) estimated elasticities of 0.99 and 0.87 respectively. The estimate however remains below estimates for the EU: Burriel et al. (2009) estimated the elasticity at 1.54.