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The Fiscal Multiplier of European Structural Investment Funds: Aggregate and Sectoral Effects with an Application to Slovenia

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The Fiscal Multiplier of European Structural Investment Funds: Aggregate and Sectoral Effects with an Application to Slovenia

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Abstract

In this paper, we estimate the aggregate and sectoral fiscal multipliers of EU Structural Investment (ESI) Funds and of public investment at the EU level. We complement these results with a specific application to the case of Slovenia. We first analyze aggregate data and find large and significant multipliers and strong crowding-in of private investment. Our main findings show that positive shocks to ESI Funds are followed by an increase in output that ranges from 1.2 percent on impact, to 1.8 percent after 1 year, and by an increase in private investment between 0.7 and 0.8 percent of GDP. We address country heterogeneity by dividing countries according to key characteristics that have been known to affect multipliers. In particular, we find higher multipliers in a group of CEE countries that are important recipients of European funds and are characterized by fixed exchange rate regimes and sound public investment governance (e.g. Croatia and Slovenia). We also complement the aggregate analysis by estimating the effect of different types of public investment and the effect of public investment on different sectors of the economy.

JEL Classification Numbers: E62; H30

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I. INTRODUCTION

The recent COVID-19 crisis highlighted, once again, the pivotal role of fiscal policy in assisting economies during crisis times. Decisive fiscal and monetary interventions were key in limiting the economic damage of the Great Lockdown (IMF, 2020a). Within this backdrop, there have been significant efforts made to identify which stimulus policies are most effective, as summarized by a large fiscal multiplier (see for example Hepburn et al. 2020). Notably, the ongoing cut-back in spending and private investment, especially within the certain sectors of the economy most affected by social distancing, calls for further empirical work that quantifies not only the aggregate effects of stimulus plans but also their impact at the more granular, sector-specific, levels.[2]

We contribute to this literature by estimating the role of public investments and EU Structural Investment (ESI) Funds in boosting growth, crowding-in private investment, and supporting employment, both at the aggregate and at the sectoral level, in a panel of 27 EU countries (plus the UK).[3] Using sectoral data, we emphasize the effect of ESI Funds on those economic activities that are essentials for a robust and sustained recovery from the COVID-19 crisis (such as in healthcare and in education). In addition to studying data on ESI Funds disbursements, for which information on the sectoral composition of investment is incomplete, we complement the analysis by estimating the impact of public investment in the areas of investment reported according to the Classification of the functions of government (COFOG). [4]

In the second part of our work, we account for the significant cross-country heterogeneities in multipliers. We modify the econometric framework to allow for an interaction term that singles-out the differentiated response in selected regional groups. We focus on Slovenia, as part of a group of Central and Eastern European countries that have been important recipients of ESI Funds transfers and for which theory predicts multipliers could be high because of their monetary policy regime, quality of public investment governance, labor market rigidities, or level of public debt. The group of CEE countries pooled with Slovenia is generated following a method similar to the bucket approach of Batini, Eyraud and Weber (2014).

To the best of our knowledge, this paper is the first to provide empirical evidence on the relationship between the fiscal multipliers of EU transfers, macroeconomic conditions, and the sectoral composition of investment and value added. Our first finding is that positive shocks to ESI Funds are followed by an increase in output that ranges from 1.2 percent on impact, to 1.8 percent after 1 year. Part of the response of GDP can be attributed to private investment, as we show it is crowded in by public investment. A 1 percent increase in ESI Funds' investments increases private investment by around 0.7-0.8 percent of GDP.

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[2] According to IMF (2020b), public investment has slowed down starting in the 1990s, with a reduction in public-to-private capital in all income groups. A similar trend has been observed in public investments, especially when looking at health, housing and environmental protection sectors (with exceptions in education and economic infrastructure).

[3] Fiscal shocks will tend to increase employment when the economy is below its potential level (i.e., when there is economic slack).

[4] Even though ESI Funds are also partly channeled towards financing expenditures, the bulk is devoted to investments. This is in turn what motivates us to complement the analysis of ESI Funds multipliers with a study of the multipliers of public investments.

For the CEE group that includes Slovenia, we find that a 1 percent of GDP positive shock in ESI Funds increases private investment by 1.2-1.3 percent of GDP both on impact and after 1 year, and it increases GDP by 1.3 percent of GDP on impact and by 1.6 percent after 1 year.

TABLE 1: SELECTION OF RESULTS

	EU sample		CEE sub-sample, incl. Slovenia	
	Contemp.	1Y	Contemp.	1Y
Panel 1 - ESI Funds				
Agg. GDP	1.2***	1.8**	1.3***	1.6**
Agg. Total Inv.	1.5***	1.7***	1.8***	2.1***
Agg. Private Inv.	0.8***	0.7**	1.3**	1.2**
Agg Employment	0.1	0.1	0.1	0.2
GVA Construction	0.4***	0.5***	0.4**	0.4**
GVA Manufact.	0.2*	0.4*	0.3**	0.4
GVA Retail	0.2*	0.2	0.1*	0.2
Total Inv. Education	0.1***	0.1***	0.2***	0.2***
Total Inv. Science	0.0**	0.1**	0.0	0.1**
Total Inv. Public Adm. And Defense	0.4***	0.4***	0.5***	0.4***
Total Inv. Manufacturing	0.3***	0.2	0.2	0.4*
Panel 2 - Public Inv. Environment				
Agg. GDP	2.7***	2.9**	4.0	7.0
Agg. Total Inv.	3.4***	4.0***	4.1	3.3
Agg. Private Inv.	0.5	0.5	0.6	0.6
Employment	0.5	-0.3	0.5	1.2
Panel 3 - Public Inv. Econ. Affairs				
Agg. GDP	0.7***	1.2***	1.1**	1.2*
Agg. Total Inv.	1.4***	1.1**	0.9**	0.9
Agg. Private Inv.	-0.1	0.0	-0.4	0.1
Employment	0.1	0.3	0.1	0.3
Panel 4 - Public Inv. Recreation				
Agg. GDP	2.8**	3.6	3.4**	3.3
Agg. Total Inv.	3.6***	2.9	3.4	2.9
Agg. Private Inv.	0.3	0.3	1.1	1.2
Employment	1.1*	1.9	1.2*	2.6

Source: Author's calculations.

Notes: The Table reports a selection of results associated with both ESI funds shocks (Panel 1) and public investments shocks (Panel 2 to 4). The first panel illustrates the case of ESI funds shocks on aggregate and sectoral variables, the second panel illustrates the case of a public investment shock in environmental protection on aggregate variables, the third panel illustrates the case of a public investment shock in economic affairs on aggregate variables and the fourth panel illustrates the case of a public investment shock in recreation, culture and religion on aggregate variables. All coefficients are point estimates and are therefore subject to uncertainty; statistical significance is determined at the following conventional p-values: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Our sectoral estimates show that gross value added, and private investment are more responsive in sectors that are more labor intensive. Of particular interest, given the current environment, are the estimated responses for the manufacturing, education, and public services sectors. At the EU level, we find that that an increase in ESI funds of 1 percent of GDP increases, on impact, manufacturing

investment by 0.3 percent of GDP, investment in education by 0.1 percent of GDP and investment in in public administration and defense by 0.4 percent of GDP. We also highlight the effects on research and development and environmental protection, which are key to achieving a sustainable recovery. The sectoral level analysis also reveals that, while the reaction of total employment to shocks may be statistically insignificant, employment does react strongly in certain sectors of the economy (finance, real estate, professional services).

In Table 1 we present a selection of the results from the analysis carried out in the paper that can be consulted as a quick reference behind some of our conclusions. It is important to emphasize that the values for the multipliers that are discussed throughout the paper refer to point estimates, which are subject to uncertainty. In the main text and in the tables that summarize the results, we will refer to those coefficients that are statistically different from zero as being significant. To determine statistical significance, we evaluate (and report) the associated p-values, at conventional levels.

The paper is organized as follows. In section 2, we review a selection of previous works on fiscal multipliers. In section 3, we present the econometric model and we propose an Instrumental Variable (IV) approach to identify exogenous fiscal shocks. In sections 4, 5 and 6 we present the aggregate and sectoral results. In section 7, we explain why we expect fiscal multipliers to be higher in countries with certain macroeconomic characteristics. We apply this approach to Slovenia and discuss our econometric estimates for a panel of CEE countries that includes Slovenia. Section 8 concludes.

II. LITERATURE REVIEW

Our paper adds to a growing body of work on fiscal multipliers that emphasizes the importance of disaggregated analysis and of the role that country-specific macroeconomic and financial characteristics play in shaping the response of economies to fiscal policy. Examples include Auerbach and Gorodnichenko (2012), who study sectoral multipliers using government spending disaggregated between military and non-military spending, Ilzetzki, Mendoza and Vegh (2013), who highlight that the level of economic development, the exchange rate regime, trade openness and public debt, all influence the macroeconomic response to fiscal shocks, and Espinoza, Gamboa-Arbelaez and Sy (2020), who emphasize that leverage and financial constraints affect the impact of public investment on private investment.[5] Espinoza, Gamboa-Arbelaez and Sy (2020) also find that public investments in social services and healthcare have the greatest impact on private firms' net investment, and that firms in the construction and communications sectors are relatively more responsive to public investments.

Methodologically, our work builds upon a recent stream of research that achieves identification of fiscal shocks using an Instrumental Variables (IV) approach. Chodorow-Reich et al. (2012) identify fiscal reliefs outlays using Medicaid reimbursement, Nakamura and Steinsson (2014) identify government spending shocks using variation in military procurement across U.S. states, while Shoag (2013) identifies exogenous fiscal spending shocks using state pension returns during the Great Recession. Our paper follows Kraay (2014), who instruments public spending using disbursements

[5] In particular, the authors show that public investment has a stronger crowding-in effect on private investment when firms have relatively lower leverage and are less financially constrained.

associated with official creditors' loans commitments, as reported in the World Bank Debtor Reporting System Database.

Our work is also related to a stream of research that analyzes the role of European Funds in promoting economic convergence, growth and employment (Hagen and Mohl, 2008; Hagen and Mohl, 2009; Hagen and Mohl, 2010; Beugelsdijk and Eijffinger, 2005). Among the main contributions, Becker, Egger and Von Ehrlich (2010) apply a regression-discontinuity design to regional data and find that, while European funds contribute to per-capita GDP growth, there is no significant effect on employment, unless spillovers effects across regions are also accounted for. Becker, Egger and Von Ehrlich (2012) address a similar research question, using a generalized propensity score methodology, which allows them to account for the intensity of regional transfers, and in turn to estimate an "optimal transfer intensity" as a function of target regional GDP.[6]

An important finding of this literature is the importance of the initial level of economic development for the effect of EU transfers. Becker, Egger and Von Ehrlich (2013) allow for heterogeneous treatment effects in an otherwise standard regression discontinuity setup and conclude that only in regions where there is sufficient human capital, and enough institutional quality, transfer programs do increase growth. This finding is consistent with the spatial panel data analysis of Breidenbach, Mitze and Schmidt (2016), who suggest that the estimated negative effects of transfers on regional growth might arise from structural and technological backwardness of some recipient regions. Ederveen, De Groot and Nahuis (2006), who also rely on a panel setup, reach similar conclusions.

A notable addition to the research agenda is the work of Hagen and Mohl (2009), where the focus of analysis is the impact of EU funds on public investments and primary budget balances, instead of income growth. Interestingly, the authors argue that EU funds do not cause an increase in public investment, which in turn suggests a crowding-out of nationally funded investments.

Our paper also contributes to the literature on fiscal policy in Slovenia and CEE countries. Cuaresma, Eller and Mehrotra (2011), estimate fiscal multipliers for Slovenia with a SVAR (using quarterly data that ranges from 1996 to 2009), and following the identification of Blanchard and Perotti (2002) (BP thereafter). The authors find multipliers insignificantly different from 0 for both spending and tax shocks. In another work on Slovenia, Jemec and Dalekorda (2013) follow the same SVAR methodology (using data that ranges from 1995 to 2010) and find a positive impact spending multiplier of 0.3 on impact, and a negative impact tax multiplier equal to -0.1. In an extension, the authors also estimate the responses of private consumption and investment and find a contemporaneous spending (tax) multiplier equal to 0.4 (-0.0) in the case of private consumption, and equal to 1.4 (-0.2) in the case of investments. Finally, Deskar-Škrbić and Šimović (2015) also estimate a SVAR following the BP identification; for the case of Slovenia, the authors find a negative impact fiscal impact multiplier equal to -0.1 for the case of an increase in government expenditures and equal to -0.3 for the case of an increase in net taxes.

Finally, our paper is closest to Coelho (2019), who analyzes the response of output and employment to EU funds, at the regional level, over the period 2000-2013. Coelho (2019) identifies the causal

[6] Interestingly, the authors find that regions with a transfer intensity above 1.3% of GDP could give up EU transfers without suffering a significant decline in their per capita income growth rate.

effect of EU funds using an IV approach where EU expenditures are instrumented by previously committed EU funds. Coelho (2019) finds large multipliers, averaging 1.7 on impact in the poorest regions, and with a cumulative effect reaching 4 after three years, although she does not find statistically significant effects on employment.[7]

III. FISCAL MULTIPLIERS: AN IV APPROACH

In this section we introduce the econometric model we use to estimate fiscal multipliers, following an instrumental variable approach. We study the impact of ESI Funds, first on aggregate GDP, (aggregate) private investment, total investment, and employment, then on sectoral Gross Value Added (GVA), sectoral private investment, sectoral total investment, and sectoral employment.[8,9,10] The sectoral estimations are important to understand the sectoral effect of a fiscal stimulus, especially since different economic sectors have been hit differently by the COVID-19 crisis. We also study the role of public investments by area of investment (say, a shock to public investments in the health sector) on aggregate GDP, total investment and private investment. All of our estimations are based on a panel of 28 countries (27 EU plus the UK), using annual data going, approximately, from 1994 (depending on country-specific availability) to 2018. ESI funds disbursements are computed summing disbursement data from major EU Structural Investment funds. More details on ESI Funds are available in Appendix A. We discuss below the main challenges associated with identification of exogenous fiscal shocks and propose an identification strategy. Next, we specify the econometric model and present the main results.

As is well known, the analysis of the effects of fiscal policy requires, for the correct estimation of the parameters of interest, identifying exogenous policy actions (see Ódor, 2017). In our context, this requires ensuring that shocks to ESI Funds disbursements are not correlated with other macroeconomic news and shocks, and that the resulting estimated effects are not contaminated by other policy changes, such as monetary policy. As an example, consider the case of a negative shock that affects the implementation of the projects in the borrowing country receiving ESI Funds; this translates into an unexpected negative effect on disbursements, which endogenously react to the contemporaneous shock.[11]

We adopt the identification strategy proposed by Kraay (2014), where fiscal shocks are identified using public loans and grants. Kraay (2014) notes that official creditors' funds that are approved (committed) in a given year are not related to anticipated future macroeconomic shocks, and that subsequent disbursements on those same, previously approved, loans do not react to contemporaneous macroeconomic shocks. While the first assumption is easily satisfied by looking at

[7] Coelho (2019) argues that the estimated large cumulative effect can be fully explained by increased compensation of currently employed workers, rather than investment, or changes, in employment levels.

[8] Total investment refers to the economy-wide gross fixed capital formation, while public investment refers to general government gross fixed capital formation; we compute private investment as the difference between aggregate total investment and aggregate public investment.

[9] For simplicity, in the following, we will interchangeably refer to ESI funds disbursements as fiscal policy.

[10] Employment is calculated as the sum of employed people, with age going from 15 to 64 years.

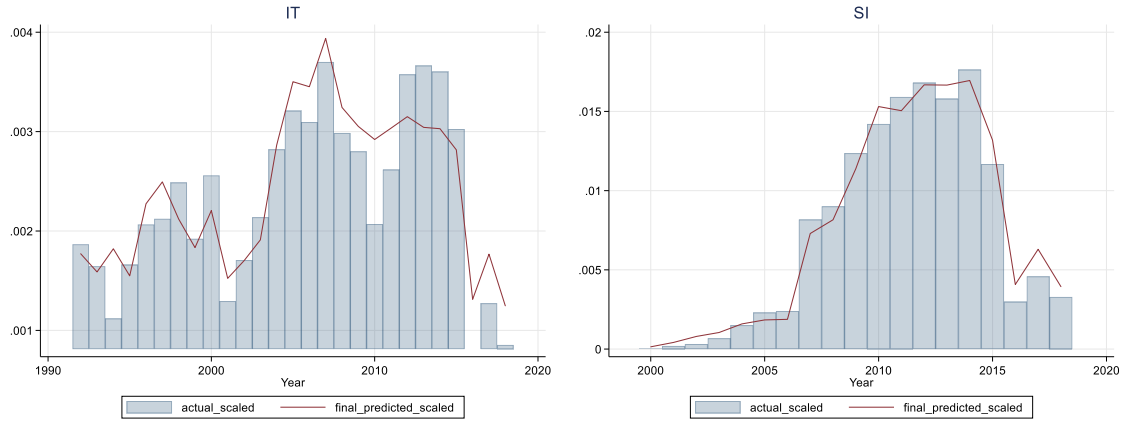
[11] Alternatively, examples of a positive shock include the cases of a country joining the EU or adopting the Euro; in both events the shock leads to an unexpected (endogenous) increase in disbursements.

planned total disbursements, the second assumption is inherently less plausible; for instance, actual disbursements, being spread out over several years following the initial commitment, might remain endogenous, hence still potentially giving rise to reverse causality. This concern is particularly relevant in the context of the proposed model where ESI funds are disbursed only after local borrowers chose to undertake a (previously approved) project. As a solution, Kraay (2014) defines a predicted loan disbursement profile, which is computed as a function of the cross-section of loans with similar creditor, decade and region, but excluding the loan in question. The resulting series is then used to distribute over time the initial loan commitment. This series is, by construction, exogenous to domestic shocks, therefore allowing for proper identification.

We follow here a similar approach, by distinguishing ESI Funds disbursement data, depending on their programs of reference and the status of the recipient region (only some regions are qualified to have access to some of the funds, depending on their initial, pre-programming period, GDP per capita), so as to construct exogenous predicted disbursement series. We leave to Appendix B.1 the details on the technical steps behind the construction of this predicted disbursement series.

How does the computed predicted disbursement series for ESI funds look like? In Figure 1 below we report the results for the cases of Italy and Slovenia. We show both a bar chart that depicts, in each bar, the actual sum of disbursements per year, together with the final predicted disbursement profile (overlayed solid line). For both countries, there is a strong correlation between fluctuations in actual ESI funds disbursements and predicted series, which is key for the success of the adopted identification strategy.

FIGURE 1: DISBURSEMENTS ON FUNDS FROM EU: ITALY AND SLOVENIA



Source: Author's calculations.
Note: The figure shows the actual disbursement on funds from the EU for Italy and Slovenia. The height of each bar shows total payments for each year. The solid line reports predicted disbursements, as described in the main text. All values are scaled by (lagged) GDP.

The econometric model used to estimate the fiscal multipliers is as follows:

$$\frac{\Delta Y_{i,t+h}}{GDP_{i,t-1}} = \alpha_i + t_t + \beta \frac{\Delta X_{i,t}}{GDP_{i,t-1}} + \boldsymbol{\rho}' \boldsymbol{V}_{i,t} + \epsilon_{i,t+h} \qquad \textbf{\textit{Eq. 1}}$$

where $\Delta Y_{i,t+h}$ represents the yearly change in the outcome variable of country i between time $t-1$ and time $t+h$ (i.e., GDP, Investments, etc.); α_i, t_t are country and time fixed effects, $\Delta X_{i,t}$ denotes the yearly change in the fiscal variable of interest (either public investment or ESI Funds disbursements). $GDP_{i,t-1}$ refers to (deflated) GDP.[12] Finally, $\boldsymbol{V}_{i,t}$ is a vector of control variables, which we further discuss in Appendix B.2.[13]

IV. AGGREGATE MULTIPLIERS

In this section we present the results for the aggregate multipliers associated with ESI Funds disbursements on GDP, total investment, private investment and employment.

Table 4 reports the contemporaneous (Panel 1) and 1-year (Panel 2) multipliers estimated by 2 Stages Least Squares (2SLS), using the ESI funds predicted disbursements series as an instrument for actual ESI funds disbursements. The OLS estimates that use actual ESI funds disbursements as an explanatory variable are also presented to allow for comparison. In all specifications, p-values are computed using robust standard errors clustered at the country level. In addition, Figure 2 displays the scatter plots corresponding to the relationship between actual and predicted disbursements (top panel) and for the case of actual disbursements and GDP, total investments and private investments (bottom panels).

Focusing on the 2SLS method, the model suggests that when ESI funds disbursements increase by an amount equal to 1 percent of GDP, the average effect for EU countries is that GDP increases by 1.2 percent on impact, and cumulatively by 1.8 percent after 1 year (both values are significant at the 1 and 5 percent confidence threshold, respectively).[14] These multipliers are in line with the existing literature; as an example, Born, Juessen and Muller (2013) estimate a GDP multiplier to government spending equal to approximately 2 (after 1 year) in fixed exchange rate economies, and equal to 1 in flexible exchange rate economies (after 1 year). Our results are reassuringly sitting within the range defined by these two bounds, as we would expect given the sample of countries at hand (in the EU, 22 countries have adopted the euro or are pegging to the euro, and 5 countries follow a float or managed float exchange rate regime). The results also reveal a downward bias associated with the OLS approach, possibly resulting from the countercyclicality of ESI funds payments.

Turning to the effect on investment, we find that when ESI funds disbursements increase by an amount equal to 1 percent of GDP, total (respectively private) investment increases by 1.5 percent of GDP (0.8 percent of GDP) on impact, and cumulatively by 1.7 percent of GDP (0.7 percent of GDP) after 1 year. Both investments multipliers are also highly significant (either at the 1 percent or 5 percent significance level).

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[12] In the case of the employment multiplier the dependent variable is instead given by $\frac{\Delta Y_{i,t+h}}{Y_{i,t-1}}$; in this case the estimated β coefficient captures the percentage change in employment associated with a ESI funds disbursements increase equal to 1 percent of GDP.

[13] Each variable is expressed in constant euros, using the overall GDP deflator. Data comes from Eurostat, with few exceptions in the case of control variables.

[14] In this and subsequent discussions we always refer to the point estimates of the multipliers; each estimated multiplier is naturally subject to different degrees of uncertainty, depending on the associated standard errors. In the text we will generally emphasize the statistical significance (or lack thereof) of our findings. This uncertainty should be taken into account when using these numbers for policymaking purposes.

We also estimate the effect of ESI funds on employment. We find that, when ESI funds disbursements increase by 1 percent of GDP, employment increases by 0.1 percent on impact and by 0.1 percent cumulatively, after 1 year (although in both cases the coefficient is statistically insignificant). This result is consistent with previous literature, such as Mohl and Hagen (2010), Becker, Egger and Ehrlich (2010) and Coelho (2019). Coelho (2019), who also finds statistically insignificant effects on unemployment, suggests that the core mechanism of the fiscal multiplier resides in increases in compensation of employees, rather than in changes in employment levels.[15]

V. SECTORAL MULTIPLIERS

In this section we turn to a disaggregated analysis of multipliers and study the impact of fiscal shocks in ESI Funds disbursements on Gross Value Added (GVA), Total Investment and employment, at a sectoral level.[16] As for the case of aggregate multipliers, we adopt a 2SLS approach and instrument ESI Funds disbursements with the associated predicted disbursement series. We cannot include the effects on private investment, since the data on public investment by area, which is necessary to derive the series of sectoral private investments, follows the COFOG classification and is thus not consistent with the economic classification (NACE Rev.2; see Table 1) that is used to split investment across economic sectors.

In addition to reporting sectoral fiscal multipliers for each selected economic sector, we also re-construct an aggregate multiplier as the sum of the multipliers across sectors (this is possible since all multipliers are expressed in units of aggregate GDP); this exercise complements the estimation of the aggregate multipliers, done in section IV above, and is motivated so as to allow for a cross-check of the aggregate results presented in Table 4; formally, we infer an aggregate multiplier as follows:

$$Agg\ Mult = \sum_{j} \widehat{Multiplier_j} \qquad \textbf{Eq. 2}$$

where $\widehat{Multiplier_j}$ denotes the estimated multiplier in sector j.

A. Crowding-in of Investment

Table 5 (Panel 1) presents the results for total investment. On impact, we find significant multipliers in the following sectors: Manufacturing (C), Utilities (D and E), Professional, Scientific and Technical Activities (M), Administrative and support services (N), Public Administration and Defense (O) and Education (P). The strongest contemporaneous effects are in Manufacturing (C), Utilities (D) and Public Administration and Defense (O). For instance, a 1 percent of GDP increase in ESI funds boosts investment in the Manufacturing sector by 0.3 percent of (aggregate) GDP. After one year, the effects become insignificant for the cases of manufacturing and Administrative and Support Services.

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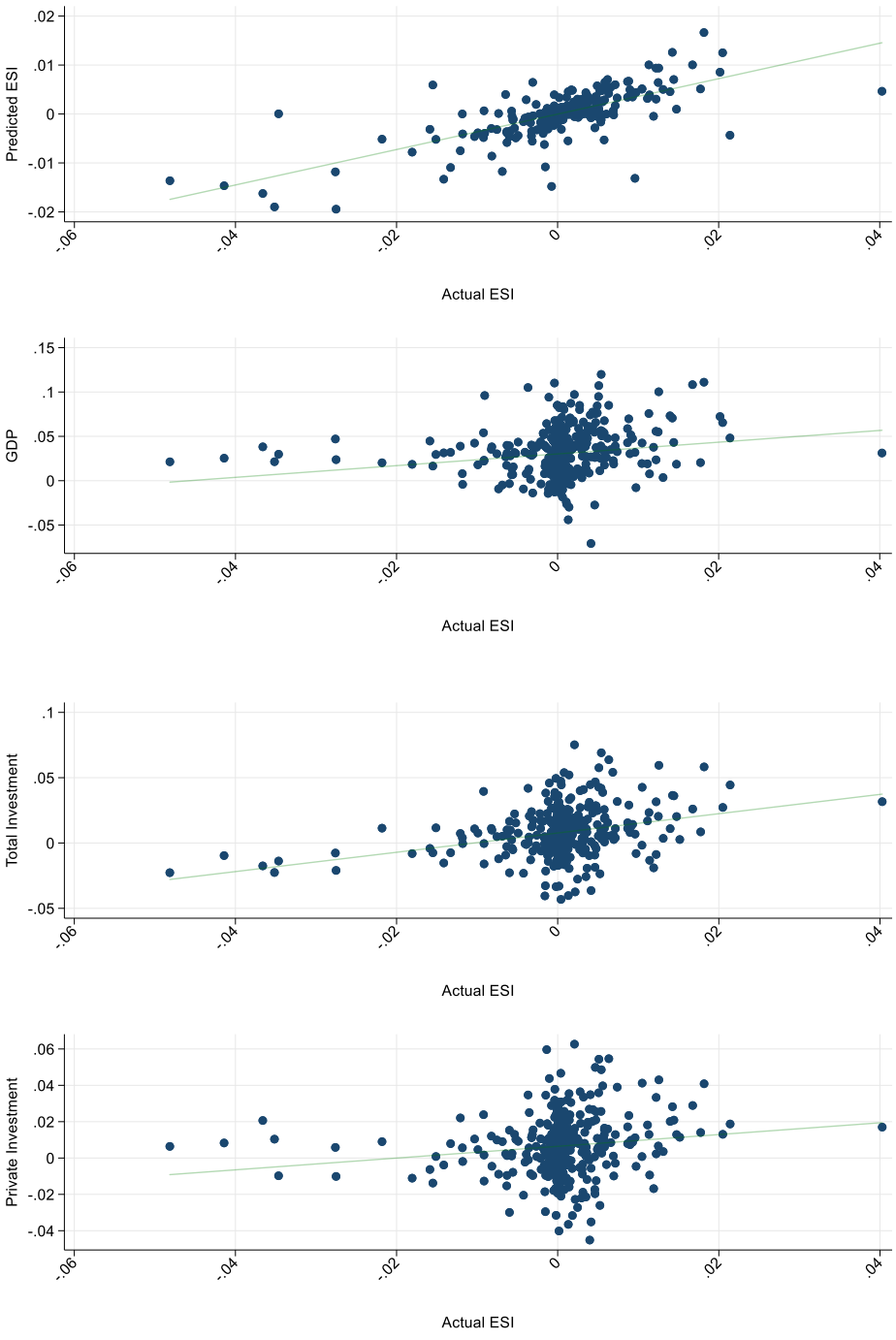
[15] Coelho (2019) finds an exception when looking at Objective 1 regions after 2006; for this sub-sample the author finds large and significant multipliers. A recent work by Gabriel, Klein and Pessoa (2020) also finds a large, positive and significant effects when looking at employment in the EU, following a public spending shock.

[16] Notice that since the independent variable denotes a shock to total ESI Funds, the estimated coefficient captures the total impact of the shock on the dependent variable of interest.

FIGURE 2: SCATTERPLOTS FOR AGGREGATE RESULTS



Source: Author's calculations.
Note: This graph shows the relationship between actual ESI funds and predicted ESI funds (top panel) and the relationship between GDP, total investment, private investment and actual ESI disbursements (bottom 3 panels). All variables are scaled by lagged GDP and expressed in first differences.

However, the coefficients associated with Agriculture (A), Real Estate (L), Human Health (Q) and Arts and entertainment (R), all become significant. These results are of relevance to the current challenges

associated with the COVID-19 crisis, because the Health sector is at the core of the fight against the crisis, and the Arts, entertainment and recreation (R) sector has been one of the sectors most affected by social distancing. Finally, when summing the different sectoral multipliers, we find a total, contemporaneous, multiplier equal to 1.1 and a total one-year multiplier equal to 1.6. Reassuringly, these values are in line with our previous aggregate estimates.

In order to compare the relative strength of ESI Funds multipliers in promoting investment across sectors, we normalize the multipliers by the size of investment, to obtain coefficients akin to a semi-elasticity, i.e., we compute for each sector j the following metric:

$$e_j = \widehat{Multiplier_j} \times \left(\frac{\overline{Tot.\ Inv_j}}{\overline{GDP}} \right)^{-1}$$

where $\overline{Tot.Inv_j}$ denotes the average value of total investments undertaken in sector j, computed over the full sample, and $\overline{GDP}$ denotes the average value of GDP, computed over the full sample. The above metric quantifies the impact of an ESI Funds shock on total investments in sector j, expressed as a share of the (average) value of investments.[17]

These semi-elasticities are reported in Table 6 (Panel 1). Sectors with high multipliers tend to have large semi-elasticities: for instance, an increase of ESI Funds disbursements equal to 1 percent of GDP leads to a contemporaneous increase in manufacturing investment corresponding to 8.4 percent of (average) manufacturing investment, to a contemporaneous increase in electricity investments corresponding to 21.0 percent of the value of (average) electricity investment and to a contemporaneous increase in Public Administration and Defense investments corresponding to 26.4 percent of the value of investments in that same sector. Interestingly, we also find that in the cases of Water supply and Education the relative increase in investment is significant, despite relatively low multipliers.

Overall, our results highlight significant crowding-in effects for investments in sectors that are labor intensive (such as, education and manufacturing). These results give support to the Keynesian notion that fiscal stimulus packages should target labor-intensive sectors, the reason being that output can increase only if aggregate demand for goods and services increases, which can only happen when this increase demand for goods and services is backed by an increase in the aggregate demand for labor. Our results are also aligned with recent model simulations: for example, Alonso (2017) develops a heterogeneous agents New Keynesian model to show that government purchases of labor-intensive consumption good are almost five times more effective at raising GDP than purchases of capital-intensive goods. While our above results apply to total investments rather than GDP, it is easy to map changes in income to changes in investment using the accelerator principle in the theory of investment (See Knox, 1952).

In Figure 3 below we show a scatter plot of the point estimates of contemporaneous and 1 year sectoral total investments multipliers and a measure of labor intensity, computed as the ratio of total

[17] We perform a similar analysis for the case of GVA, using the average value of total GVA undertaken in sector j.

sectoral employment to total sectoral GVA.[18] Figure 3 offers some suggestive evidence of the relationship between the size of the multiplier and the degree of labor intensity.

B. Effect on Gross Value Added (Sectoral Fiscal Multiplier)

Table 5 (Panel 2) presents our results when the dependent variable is sectoral GVA.[19] We find that in most sectors the estimated impacts are insignificant. But a few exceptions are worth mentioning. For the agricultural sector, we estimate a contemporaneous and 1-year multipliers equal to 0.1 and 0.2, respectively (both significant at the 10 percent significance level). The agricultural sector (A) is an important recipient of ESIF funds, which explains this result. The contemporaneous multiplier on GVA in the manufacturing is strong, equal to 0.2, followed by a 1-year multiplier equal to 0.4 (both significant at the 10 percent level). The construction sector (F) also appears to be sensitive to fiscal shocks. We find large contemporaneous and 1-year multipliers equal to 0.4 and 0.5, respectively (both significant at the 1 percent level). The impact multiplier for the Wholesale and Retail trade sector (G) is also high, at 0.2 (significant at the 10 percent level). The sum of the sectoral multipliers is equal to 0.9 on impact and to 1.0 after a year. Especially for the former, the value is comparable to the multipliers estimated on aggregate GDP.

C. Effect on Employment

Table 7 presents the effect of ESI funds on employment. Unfortunately, the available data only allows a partial breakdown across sectors (for instance employment is only available with the following NACE categories breakdown: A, B-E, F, G-J, K-N, O-U.[20] Even though the results point to positive effects of ESI funds on employment, in general the effects are not statistically significant results. The few exceptions are in the sectors K-N, where we find a contemporaneous and 1 year percentage increase equal to 1.3 percent and 2.8 percent, respectively (in both cases the significance is at the 5 percent level); and in the case of the O-U sector where we find a contemporaneous negative impact equal to -0.6 percent (but with only a 10 percent level significance). [21]

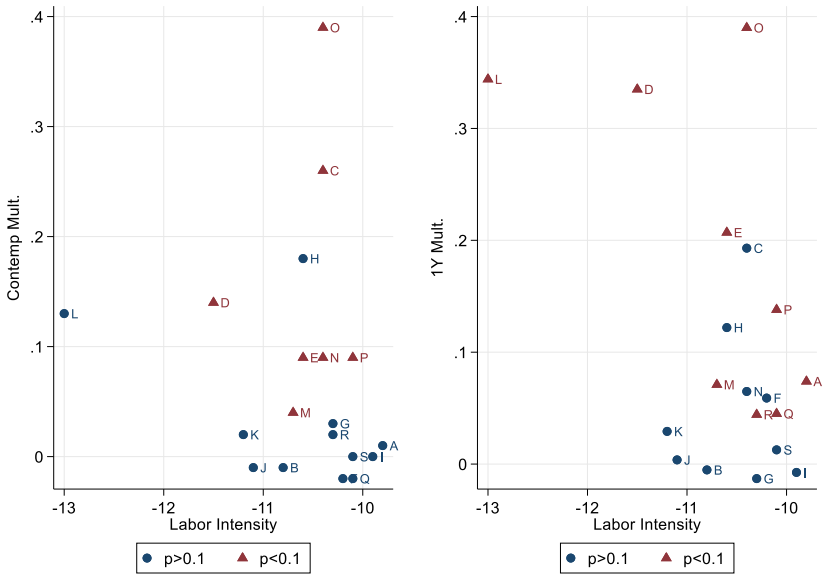
[18] We compute the ratio for each sector by taking the sectoral (NACE Rev.2) average of GVA and employment, starting in 2008. Available data on sectoral employment before 2008 follows a different classification (NACE Rev.1), which cannot be swiftly merged with the subsequent classification (NACE Rev. 2).

[19] In table 6 (Panel 2) we also report the associated semi-elasticities, as done for the case of investments.

[20] Fully disaggregated data consistent with NACE Rev. 2 is only available starting in 2008; for the preceding years, fully disaggregated data is only available following the NACE Rev. 1 classification. In principle, these two series could be combined to achieve a coherent time series of employment. We leave this further step to future work.

[21] Sector K-N is the sum of Financial and insurance activities; Real estate activities; professional, scientific, technical, administration and support activities. Sector O-U is the sum of public administration, defense, education, human health and social work activities, other services.

FIGURE 3: INVESTMENT MULTIPLIERS AND LABOR INTENSITY



Source: Author's calculations.

Note: The Figure shows the scatter plot of point estimates of the multipliers and the (log) ratio of sectoral employment to sectoral gross value added. Triangles highlight the sectoral multipliers that are at least significant at the 10% level (p value <0.1). In terms of NACE Rev.2 nomenclature, A = "Agriculture, forestry and fish.", B = "Mining and quarrying", C = "Manufacturing", D = "Electricity, gas, steam and air conditioning supply", E = "Water supply; sewerage, waste management and remediation", F = "Construction", G = "Wholesale and retail trade; repair of motor vehicles and motorcycles", H = "Transportation and storage", I = "Accommodation and food service activities", J = "Information and communication", K = "Financial and insurance activities", L = "Real estate activities", M = "Professional, scientific and technical activities", N = "Administrative and support service activities", O = "Public administration and defense; compulsory social security", P = "Education", Q "Human health and social work activities", R = "Arts, entertainment and recreation", S = "other Service activities".

VI. THE MULTIPLIER OF DIFFERENT TYPES OF PUBLIC INVESTMENT

We now turn to estimating the effect of different *types* of public investments on aggregate GDP, aggregate total investment, aggregate private investment, and employment. The different types of public investment are classified according to the COFOG99 classification (see Table 2). In this exercise, we cannot use an instrumental variable approach to account for endogeneity of public investments. However, to the extent that changes in sectoral public investment are driven by changes in sectoral economic conditions, they are less likely to respond endogenously to aggregate shocks to GDP and investments, meaning that the bias associated with the OLS methodology is less relevant. As a result, the properties of the OLS estimator are more likely to be satisfied. Nevertheless, we urge some caution in interpreting and using these estimates.

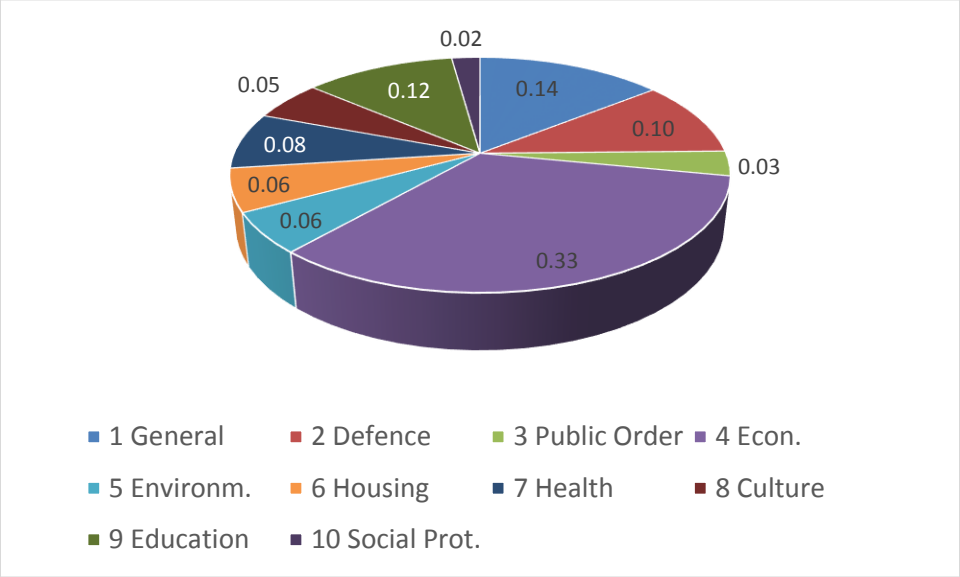
We also infer corresponding aggregate multipliers, as follows:

$$Agg\ Mult = \sum_j \widehat{Multiplier_j} \times Share\ Pub.Inv_j \qquad \textbf{\textit{Eq. 3}}$$

where $Share\ Pub.Inv_j$ denotes the share of public investment in sector j over total public investment.[22]

In Figure 4 we illustrate the breakdown of public investments by sectors for the full sample of countries. For the average EU country, the Figure highlights that the largest share falls into the Economic Affairs category (33 percent of public investment), which englobes a wide variety of activities going from agriculture to transport and R&D. Economic Affairs is followed by General Public Services (14 percent), Education (12 percent), Defense (10 percent), Health (8 percent), Environment and Housing (both 6 percent), Culture (5 percent), Public Order (3 percent) and Social Protection (2 percent).

FIGURE 4: PUBLIC INVESTMENT SHARE BY SECTOR



Source: Author's calculations.
Note: The Figure shows the distribution of public investment by economic sectors for EU countries. The distribution is computed by taking the average yearly sum of public investments, with the yearly sum computed over all countries. The sample of data used is consistent with the regression of public investment shocks on GDP growth.

Starting with the effect of public investment on GDP, Table 8a (Panel 1) shows large, and significant, contemporaneous and 1-year multipliers across most sectors. A shock to public investment in Public Order of 1 percent of GDP has the largest effect, by increasing GDP by 4.0 percent on impact. Investment in recreation has also a strong multiplier, at 2.8 percent of GDP on impact, although the estimate becomes insignificant after one year. We find strong response of GDP following increases in public investment in environmental protection (2.7), Defense (1.1), Public services (1.1) and Education (1.9). Aggregating the contemporaneous sectoral multipliers following Eq. (3) above, we infer an aggregate multiplier equal to 1.3 (2.0 after one year).

[22] Notice that this aggregation does not take into account potential interrelations across sectors, arising from a shock in sector j (i.e., a shock in sector j also leads to a change in public investments in other sectors).

Turning to aggregate Investment, we estimate large and significant multipliers across all sectors, with the exception of the 1-year multiplier associated with Public Order, Health and Recreation, and both multipliers associated with Social Protection (see Table 8a, Panel 2). Summing up the sectoral multipliers for aggregate investment, we find a contemporaneous (1 year) aggregate multiplier equal to 2.4 (2.6). In the case of private investments, we do find significant effects but only when looking at Public Services, Defense and education (see Table 8b, Panel 1). In this case, aggregating the sectoral multipliers for private investment, we find a contemporaneous (1 year) aggregate multiplier equal to 0.3 (0.8). Finally, in the case of employment, we observe significant positive reactions in the case of public services, housing, health and recreation (Table 8b, Panel 2).

Our results underscore a key role for public investments in an array of economic sectors that are at the core of the forthcoming Recovery Plan for Europe. The highest share of the European Budget is expected to allocate to fighting climate change (around 30 percent of the budget), with approximately. €374 billion targeted to natural resources and the environment. We estimated that environmental protection has a strong multiplier effect, both for GDP and for investment. A further key area of EU funding is that related to research in health (as part of the € 94.4 billion "Horizon Europe" program). We found that public investment in health seems to increase both total investment and employment, suggesting positive macroeconomic benefits for such funding.

VII. Fiscal Multipliers: A Regional Focus

Our previous findings likely hide important cross-countries heterogeneities in the size of estimated fiscal multipliers. This heterogeneity might arise as a consequence of different country-specific features and macroeconomic policies, as highlighted in the recent literature (Becker, Egger and Ehrlich, 2013; Born, Juessen and Müller, 2013; Ilzetzki, Mendoza and Végh, 2013; Basso and Rachedi, 2020).

Batini, Eyraud and Weber (2014) use some of this literature to introduce a "bucket" approach to group countries that are likely to be characterized by similar multipliers. The authors focus on key factors that are more likely to lead to higher multipliers values: low trade openness, small automatic stabilizers, fixed or quasi-fixed exchange rate regime, high degree of labor market rigidity, low level of public debt, and effective public expenditure management and revenue administration. Batini, Eyraud and Weber (2014) then propose a range of possible multipliers for countries in which estimating multipliers is not practical. Conjunctural characteristics, including the stance of monetary policy, can also be taken into account. In Appendix C, we present in detail the methodology and an application to the case of Slovenia, which suggests a multiplier in the range of 0.5 to 1.2, using recent data.[23] This range of values is above that found by Deskar-Škrbić and Šimović (2015), who infer a multiplier in the range of 0.1-0.4, using an older sample period.

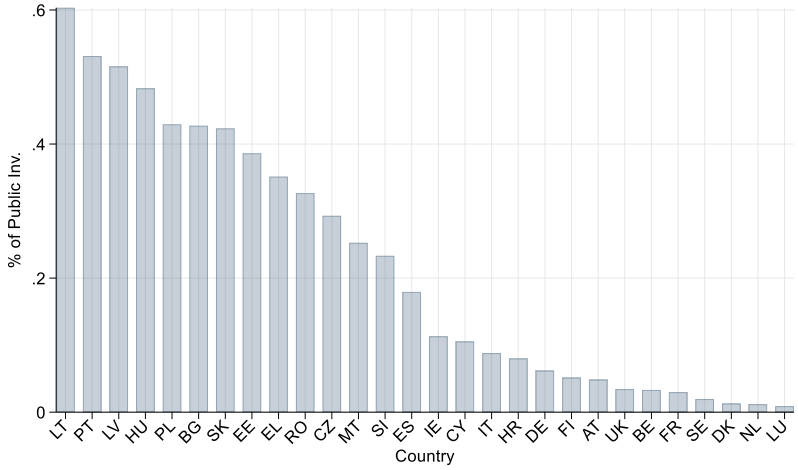
Econometrics-based approaches have tried to account for such heterogeneity using econometrics methods that allow to single out specific countries within a group of interest. An example is Combes et al. (2016), who study the spending multipliers in CEE countries, using a panel vector error correction model, which captures the common long-term path, while also allowing for different

[23] We also find that if we were to fully account the impact of the current Covid-19 crisis on the 2020 output gap, the Slovenian's multiplier would range between 0.8 and 2.1.

short-run dynamics.[24] The authors first employ a Dynamic Fixed Effects estimator and find an impact multiplier equal to 0.07 and a cumulative 1-year multiplier equal to 0.31, over the full sample of countries. Then, using a Pooled Mean Group estimator, which allows for country specific short-run dynamics the authors highlight an impact spending multiplier equal to 0.19 and a cumulative multiplier equal to 0.29, for the case of Slovenia.[25]

In addition, dividing the sample so as to focus on regional estimates can be important in light of the high heterogeneity in the disbursements of ESI funds across EU countries and regions. As shown in Figure 5, while Central and Eastern European (CEE) countries rely significantly on ESI Funds (on average ESI funds amount to a value equivalent to 38 percent of public investments), this is significantly less so when considering other regions (in the case of Western European countries, on average, ESI funds amount to a value equivalent to 11 percent of public investments).[26] Because in CEE countries ESI funds have a significant influence over national and regional macroeconomic projections, it is essential, from a policymaker perspective, to complement the results associated with the EU-average multipliers with region specific multipliers, which can increase the accuracy of regional macroeconomic forecasts.

FIGURE 5: TOTAL ESI DISBURSEMENT TO PUBLIC INVESTMENT



Source: Author's calculations.
Note: The Figure shows, for each EU country, the ratio of average total ESI Funds disbursement to average domestic public investment; the averages are computed over the available sample.

[24] The sample includes 11 CEE countries over the period 1999Q1-2013Q3.
[25] In addition, the authors also report results associated with a Mean Group estimator, allowing for both country specific long-term path and short run dynamics; in the case of Slovenia, the authors find an impact multiplier equal to 0.15 and a cumulative multiplier equal to 0.26.
[26] As already highlighted, ESI Funds are not limited to public investments; in this sense, Figure 5, which compares ESI Funds disbursements to public investments, should only be interpreted as showing the extent to which ESI Funds contribute to public investments, and hence their approximate macro-relevance for the country.

A. An Econometric Model with a Regional Interaction

We shed light on the potential differences in multipliers by amending our benchmark econometric model to allow for a region-specific interaction term, as follows:

$$\frac{\Delta Y_{i,t+h}}{GDP_{i,t-1}} = \alpha_i + t_t + \beta \frac{\Delta X_{i,t}}{GDP_{i,t-1}} + \gamma \frac{\Delta X_{i,t}}{GDP_{i,t-1}} \times D_i^c + \boldsymbol{\rho' V_{i,t}} + \epsilon_{i,t+h} \qquad \textbf{\textit{Eq. 4}}$$

It is important to emphasize that β in Eq. (4) does not represent anymore the main effect, as in Eq (1), but rather the effect associated with the group of countries that are not included in the regional dummy.[27]

The variable D_i^c is the regional dummy variable, which is set equal to 1 for a sub-sample of CEE countries, and 0 otherwise. This specification allows to infer the region-specific multiplier by looking at:

$$(\beta + \gamma)$$

For the point estimate, where γ measures the difference in the effect between the region of interest and the "base" group. This specification allows us to leverage the benefits of panel data econometrics, by reaching a more accurate inference of the model's parameters, and at the same time maintain enough flexibility to make region-specific inferences on the parameters of interest.[28]

We select a regional group of CEE countries, which are among the largest recipients of EU funds. We also select countries that are likely to share similar multipliers. Specifically, we note that, *ceteris paribus*, the fiscal multiplier is: higher in countries that are characterized by either a flexible exchange rate regime and low capital mobility or a fixed exchange rate regime and high capital mobility; higher in countries that are less open to trade.

Based on the above criteria we group the following set of countries: Slovenia, Croatia, Czech Republic, Estonia and Latvia.[29] The resulting estimated multipliers for this group of countries is given by

$$(\beta + \gamma)$$

While the point estimate of the multiplier follows directly from the sum of β and γ, estimating standard errors is done following the Delta Method (see Appendix B.2).

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[27] To see this notice that equation (2) can be rewritten (excluding fixed effects and controls for simplicity) as $\frac{\Delta Y_{i,t+h}}{GDP_{i,t-1}} = \beta\theta_i^B \frac{\Delta X_{i,t}}{GDP_{i,t-1}} + \zeta\theta_i^R \frac{\Delta X_{i,t}}{GDP_{i,t-1}} + \epsilon_{i,t+h}$ where θ_i^B is a dummy variable equal to 1 when a country belongs to the base group and θ_i^R is a dummy variable equal to 1 when a country belongs to the region of interest, so that $\theta_i^B + \theta_i^R = 1$, and where $\gamma = \zeta - \beta$.

[28] There are other, more sophisticated, approaches that can efficiently account for heterogeneity; for example, it is possible to estimate an error correction model (Pesaran, Shin and Smith (1999)) with a mean group estimator that allows for different intercepts, slope coefficients and error variances across groups. Unfortunately, the small sample size, together with the annual frequency of the available EU data, make this alternative approach less suited overall.

[29] We leave further details on the selection criteria of the CEE sub-sample to Appendix B.

In the next sections we present the results; the reader can also refer to Table 1, where we summarize our findings.

B. Aggregate Multipliers in Slovenia and the CEE Sub-Region

Table 9 presents the aggregate results, after the application of the Delta method. All estimated coefficients, with the exception of the effect of investment on employment, are highly significant. Compared to the EU-wide results, we find a slightly higher GDP impact multiplier (1.3) and a slightly lower 1-year multiplier (1.6). Private investment in the CEE sub-sample responds more strongly than in the rest of the EU. For an increase of EU ESI Funds equal to one percent of GDP, private investment increases by 1.3 percent of GDP on impact (versus 0.8 for the EU average). These effects translate to the response to total investment. Finally, even though the results for percent changes in employment remain insignificant, they nevertheless point to relatively larger reactions compared to EU average; specifically, we find that employment increases by 0.1 percent on impact (similar to the EU average), and by 0.2 percent after one year (compared to 0.1 percent). These results reflect our prior that the CEE regional sub-sample is characterized, on average, by lower exchange rate flexibility, less trade integration, and relatively less capital mobility than the rest of the EU.

Our results contrast with the empirical literature on Slovenia and the CEE but are closer to the findings of micro-founded models, such as the ECB (2015)'s New-Keynesian DSGE model, which is calibrated on several European countries, including Slovenia. For Slovenia the model predicts a one-year government consumption multiplier of approximately 0.66 (for both the cases of a temporary and permanent shock), and a multiplier associated with a temporary (permanent) reduction in household's labor tax equal to 0.10 (0.56).[30]

There may be several reasons why multipliers are not well estimated using the SVARs methods employed by much of the literature on regional multipliers. First, the SVAR models force a specific functional form that may not be appropriate; for instance, Zellner and Palm (1974) show that the macroeconomy's subset of variables that economists can analyze at one time follow VARMA models rather than VARs (see also Jordà, 2005). The identification procedure also relies on assumptions that might be more or less valid depending on the context; for example, in Blanchard and Perotti (2002), it is assumed that governments do not discretionally react to contemporaneous developments in the economy. In addition, the method requires taking a decision regarding the relative ordering of fiscal variables, that is, whether government spending decisions are made prior to tax revenues decisions, or vice-versa. Finally, empirical models that use only data for Slovenia are based on small samples, leading to potentially biased estimators and imprecise standard errors.

C. Sectoral Multipliers in Slovenia and the CEE Sub-Region

Table 10 presents sectoral multipliers for total investments, GVA and employment. Panel 1 summarizes the results for total investments.[31] The sectors where we find highly significant and large

[30] ECB (2015) reports results for fiscal consolidations, but the numbers are presented here for a stimulus, under the assumption of symmetric effects between fiscal consolidation and expansion. Under the assumption that 2/3 of the fiscal package involves expenditure adjustments and 1/3 involves revenue adjustments, the "normal-times" one-year multiplier would be approximately equal to 0.47 (0.63).

[31] For the case of sectoral investments, data on Croatia is not available.

crowding-in effects are utilities (D category), where investment increases by 0.2 percent of GDP on impact and by 0.9 percent of GDP after 1 year (in comparison, the multipliers are equal to 0.1 and 0.3 for the EU average, respectively), real estate activities (L category), where investment increases by 0.3 percent of GDP on impact and by 0.4 percent of GDP after one year (in comparison, the EU average multipliers are insignificant or lower), public administration (O category), where investment increases by 0.5 percent of GDP on impact and by 0.4 percent of GDP after 1 year (in comparison the EU average multipliers are equal to 0.4 for both horizons), and education (P category), where investment increases by 0.2 percent of GDP both on impact and after 1 year (in comparison, the EU average multipliers are equal to 0.1 both on impact and after 1 year). We also find smaller and less statistically significant crowding-in effects in the cases of scientific activities and administrative and support services. As done for the case of the EU-average multipliers, we compute the sum of sectoral crowding-in coefficients across the various sectors: we find an aggregate impact equal to 1.4 of GDP and a 1-year aggregate impact equal to 2.6 of GDP.

In Panel 2 we illustrate the results corresponding to GVA. Looking at the most statistically significant results, we find a contemporaneous multiplier equal to 0.1 for agriculture (A category; compared to 0.1 for the EU average), a contemporaneous multiplier equal to 0.3 for manufacturing (compared to 0.2 for the EU average) and a contemporaneous and 1-year multipliers equal to 0.4 for construction (F category; compared to 0.4 on impact and 0.5 after 1 year, for the case of the EU average). We find a negative multiplier in the case of the health care sector, but GVA falls by only -0.05 percent contemporaneously (the multiplier is insignificant for the EU average). Finally, we find a contemporaneous multiplier of 0.1 in the case of Retail (G category; compared to 0.2 for the case of the EU average). Other sectors coefficients are insignificant, consistent with the results found for the EU. We then compute the sum across the economic sectors: we find an aggregate impact multiplier equal to 1.0, and a 1-year aggregate multiplier equal to 0.7.

As a last exercise, in Panel 3, we report the results for employment, which reacts significantly across several sectors. Although employment is negatively affected in the agricultural sector (-3.8 percent) and in the O-U activities (-0.9 percent), the effect of ESI Funds is strongly positive in construction, (2.8 percent on impact, and 6.6 percent after 1 year) and in the K-N sectors (finance, real estate, professional and administrative services), where we estimate a 2.3 percent contemporaneous increase and 4.6 percent increase after 1 year. [32] The sensitivity of employment in these sectors is much stronger in the CEE sub-region than in the EU.

D. Multipliers by Type of Investment in Slovenia and the CEE Sub-Region

Tables 11 presents the results for sectoral public investment shocks on aggregate variables. Overall, we find large and significant multipliers for all variables; starting with GDP in Panel 1, we estimate a 5.6 (respectively, 6.7) percent contemporaneous (respectively, 1 year) increase of GDP following public services shocks, a 10.2 (respectively 15.5) percent contemporaneous (respectively, 1 year) increase in GDP in the case of public order shocks, and a 4.2 (respectively, 6.8, albeit insignificant)

[32] K-N is the sum of Financial and insurance activities; Real estate activities; professional, scientific, technical, administration and support activities. O-U is the sum of public administration, defense, education, human health and social work activities, other services.

percent contemporaneous (respectively 1 year) increase in GDP following housing shocks. These multipliers are consistently higher to their EU-average counterparts). Interestingly, we do not find statistically significant effects for the case of public investments in environmental protection and social protection on GDP. Further important results are the contemporaneous multipliers of public investments in health and education, which are equal to 6.1 and 2.5 for GDP, respectively (interestingly, the EU average health GDP multiplier is estimated to be insignificant).

When turning to investments in Panel 2, the impact crowding-in effects are equal to 5.7, 9.8 and 5.6 for public services, public order and housing, respectively, and all tend to increase after 1 year. As for the case of GDP, we do not find statistically significant effects in the cases of environmental protection and social protection. We also find no statistically significant effects for investments in of recreation, culture and religion. In Panel 3 we describe the results for private investments, which do not tend to react significantly following shocks to public investment, with the exceptions of the cases of public services, public order, housing and education.

Finally, in Panel 4, we summarize the results for employment; we do find significant impacts in the case of public investments in public services, public order, health and recreation (similar to the results found for the EU sample).

Aggregating the sectoral multipliers, with weights given by the share of public investment expenditures in each category, we infer an aggregate contemporaneous (1 year) multiplier equal to 2.7 (3.1) for the case of GDP, equal to 3.2 (3.6) for the case of total investments and equal to 1.1 (1.5) for the case of private investments.

We complement the above results with a more detailed breakdown of activities, which we think might be of special interest to policymakers; specifically, we focus on public investments in the following subsectors: [33]

- General Public Services (GF01), but including only the sum of Basic Research, R&D General public services, General public services n.e.c..
- R&D computed as the sum of R&D across all sectors.
- Basic Research (as a sub-sector of General Public Services).
- Fuel and Energy and Transport; both subsectors are within the Economic Affairs category (GF04).
- Water supply (as a sub-sector of Housing and community amenities (GF06)).

In Tables 12 we summarize the results for these selected categories. We find that while the point estimate of the multipliers associated with the "adjusted" measure of total general public services shocks are mostly consistent with those estimated in Table 11, they tend to display lower significance. Interestingly, while we do not find significant multipliers for the case of aggregated R&D, we do find positive effects when analyzing the impact of Basic Research (as a sub-category of general public services), on both GDP and private investment.

Turning to the multipliers associated with the Economic Affairs sub-categories, we find significant multipliers for the cases of Fuel and Energy and transport when looking at GDP and total

investments. Furthermore, looking at water supply, multipliers are insignificant for all variables. Finally, turning to employment, we do not find statistically significant results.

VIII. CONCLUSION

In this paper we estimate fiscal multipliers of European Structural Investment (ESI) Funds disbursements and of public investment in the EU. We relied on an identification strategy that consists in computing an exogenous ("predicted") series of ESI Funds disbursements from 1994 to 2018, to achieve reasonable estimates for both aggregate and sectoral EU-wide multipliers. Overall, the results point to large and significant effects on GDP, total investment and private Investment. The sectoral analysis reveals heterogeneities across economic sectors and the type of public investments. In general, we find that the largest crowding-in effects are in labor intensive industries such as construction, defense, manufacturing, public order and education. We also find that channeling public investments in sectors such as research, public services and public order has significant implications for macroeconomic aggregates.

In the second part of our paper, we noted that the estimates of fiscal multipliers for the EU average might hide significant cross-countries heterogeneities. We focused on a group of countries belonging to the Central and Eastern European Region (Croatia, Czech Republic, Estonia, Latvia and Slovenia) that share similar macroeconomic characteristics. The regional estimates revealed overall larger fiscal multipliers when compared to the EU average. The regional analysis confirmed the importance of distinguishing between countries that share similar features in order to more precisely estimate the effects of fiscal shocks.

Our findings highlight the critical role of fiscal policy in supporting the economy in the near term, together with the importance of targeting economic sectors that have higher potential to raise macroeconomic aggregates. These observations are particularly relevant within the context of the recently approved EU recovery instrument, which gives EU member countries access to an unprecedented amount of funds that can be used in order to help repair the economic and social damage brought about by the coronavirus pandemic. In particular, our results strengthen the case for prioritizing economic sectors where Keynesian effects are strongest. Even though our work focuses on the short-term implications of fiscal stimuli, the definition and implementation of any fiscal package should also prioritize the quality of public investments that are undertaken. As highlighted in IMF (2020b), the magnitude of the current recovery efforts will inevitably bring long-term implications, both in terms of fiscal sustainability and in terms of long-term economic growth and development, and resilience to future crises. Policymakers should therefore also give paramount attention to the efficient deployment of fiscal resources.

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TABLES

TABLE 2: BROAD STRUCTURE OF NACE REV. 2 CLASSIFICATION

nace_r2	TOTAL	Total - all NACE activities	**H**	**Transportation and storage**
nace_r2	**A**	**Agriculture, forestry and fishing**	H49	Land transport and transport via pipelines
nace_r2	A01	Crop and animal production, hunting and related service activities	H50	Water transport
nace_r2	A02	Forestry and logging	H51	Air transport
nace_r2	A03	Fishing and aquaculture	H52	Warehousing and support activities for transportation
nace_r2	B-E	Industry (except construction)	H53	Postal and courier activities
nace_r2	**B**	**Mining and quarrying**	**I**	**Accommodation and food service activities**
nace_r2	**C**	**Manufacturing**	**J**	**Information and communication**
nace_r2	C10-C12	Manufacture of food products; beverages and tobacco products	J58-J60	Publishing, motion picture, video, television programme production; sound recording, programming and broadcasting activities
nace_r2	C13-C15	Manufacture of textiles, wearing apparel, leather and related products	J58	Publishing activities
nace_r2	C16-C18	Manufacture of wood, paper, printing and reproduction	J59_J60	Motion picture, video, television programme production; programming and broadcasting activities
nace_r2	C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	J61	Telecommunications
nace_r2	C17	Manufacture of paper and paper products	J62_J63	Computer programming, consultancy, and information service activities
nace_r2	C18	Printing and reproduction of recorded media	**K**	**Financial and insurance activities**
nace_r2	C19	Manufacture of coke and refined petroleum products	K64	Financial service activities, except insurance and pension funding
nace_r2	C20	Manufacture of chemicals and chemical products	K65	Insurance, reinsurance and pension funding, except compulsory social security
nace_r2	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	K66	Activities auxiliary to financial services and insurance activities
nace_r2	C22_C23	Manufacture of rubber and plastic products and other non-metallic mineral products	**L**	**Real estate activities**
nace_r2	C22	Manufacture of rubber and plastic products	L68A	Imputed rents of owner-occupied dwellings
nace_r2	C23	Manufacture of other non-metallic mineral products	M_N	Professional, scientific and technical activities; administrative and support service activities
nace_r2	C24_C25	Manufacture of basic metals and fabricated metal products, except machinery and equipment	**M**	**Professional, scientific and technical activities**
nace_r2	C24	Manufacture of basic metals	M69-M71	Legal and accounting activities; activities of head offices; management consultancy activities; architectural and engineering activities; technical testing and analysis
nace_r2	C25	Manufacture of fabricated metal products, except machinery and equipment	M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities
nace_r2	C26	Manufacture of computer, electronic and optical products	M71	Architectural and engineering activities; technical testing and analysis
nace_r2	C27	Manufacture of electrical equipment	M72	Scientific research and development
nace_r2	C28	Manufacture of machinery and equipment n.e.c.	M73-M75	Advertising and market research; other professional, scientific and technical activities; veterinary activities
nace_r2	C29_C30	Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment	M73	Advertising and market research
nace_r2	C29	Manufacture of motor vehicles, trailers and semi-trailers	M74_M75	Other professional, scientific and technical activities; veterinary activities
nace_r2	C30	Manufacture of other transport equipment	**N**	**Administrative and support service activities**
nace_r2	C31-C33	Manufacture of furniture; jewellery, musical instruments, toys; repair and installation of machinery and equipment	N77	Rental and leasing activities
nace_r2	C31_C32	Manufacture of furniture; other manufacturing	N78	Employment activities
nace_r2	C33	Repair and installation of machinery and equipment	N79	Travel agency, tour operator and other reservation service and related activities
nace_r2	**D**	**Electricity, gas, steam and air conditioning supply**	N80-N82	Security and investigation, service and landscape, office administrative and support activities
nace_r2	**E**	**Water supply; sewerage, waste management and remediation activities**	O-Q	Public administration, defence, education, human health and social work activities
nace_r2	E36	Water collection, treatment and supply	**O**	**Public administration and defence; compulsory social security**
nace_r2	E37-E39	Sewerage, waste management, remediation activities	**P**	**Education**
nace_r2	**F**	**Construction**	**Q**	**Human health and social work activities**
nace_r2	G-I	Wholesale and retail trade, transport, accommodation and food service activities	Q86	Human health activities
nace_r2	**G**	**Wholesale and retail trade; repair of motor vehicles and motorcycles**	Q87_Q88	Residential care activities and social work activities without accommodation
nace_r2	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	R-U	Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies
nace_r2	G46	Wholesale trade, except of motor vehicles and motorcycles	**R**	**Arts, entertainment and recreation**
nace_r2	G47	Retail trade, except of motor vehicles and motorcycles	R90-R92	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities
			R93	Sports activities and amusement and recreation activities
			S	**Other service activities**
			S94	Activities of membership organisations
			S95	Repair of computers and personal and household goods
			S96	Other personal service activities
			T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
			U	Activities of extraterritorial organisations and bodies

Source: Eurostat; NACE Rev. 2, "Statistical Classification of economic activities in the European Community".
Note: The Table reports the NACE REV. 2 Classification of economic activities.

TABLE 3: COFOG CLASSIFICATION

cofog99	**GF01**	**General public services**	**GF06**	**Housing and community amenities**
cofog99	GF0101	Executive and legislative organs, financial and fiscal affairs, external affairs	GF0601	Housing development
cofog99	GF0102	Foreign economic aid	GF0602	Community development
cofog99	GF0103	General services	GF0603	Water supply
cofog99	GF0104	Basic research	GF0604	Street lighting
cofog99	GF0105	R&D General public services	GF0605	R&D Housing and community amenities
cofog99	GF0106	General public services n.e.c.	GF0606	Housing and community amenities n.e.c.
cofog99	GF0107	Public debt transactions	GF07	Health
cofog99	GF0108	Transfers of a general character between different levels of government	GF0701	Medical products, appliances and equipment
cofog99	**GF02**	**Defence**	**GF0702**	**Outpatient services**
cofog99	GF0201	Military defence	GF0703	Hospital services
cofog99	GF0202	Civil defence	GF0704	Public health services
cofog99	GF0203	Foreign military aid	GF0705	R&D Health
cofog99	GF0204	R&D Defence	GF0706	Health n.e.c.
cofog99	GF0205	Defence n.e.c.	GF08	Recreation, culture and religion
cofog99	**GF03**	**Public order and safety**	**GF0801**	**Recreational and sporting services**
cofog99	GF0301	Police services	GF0802	Cultural services
cofog99	GF0302	Fire-protection services	GF0803	Broadcasting and publishing services
cofog99	GF0303	Law courts	GF0804	Religious and other community services
cofog99	GF0304	Prisons	GF0805	R&D Recreation, culture and religion
cofog99	GF0305	R&D Public order and safety	GF0806	Recreation, culture and religion n.e.c.
cofog99	GF0306	Public order and safety n.e.c.	GF09	Education
cofog99	**GF04**	**Economic affairs**	**GF0901**	**Pre-primary and primary education**
cofog99	GF0401	General economic, commercial and labour affairs	GF0902	Secondary education
cofog99	GF0402	Agriculture, forestry, fishing and hunting	GF0903	Post-secondary non-tertiary education
cofog99	GF0403	Fuel and energy	GF0904	Tertiary education
cofog99	GF0404	Mining, manufacturing and construction	GF0905	Education not definable by level
cofog99	GF0405	Transport	GF0906	Subsidiary services to education
cofog99	GF0406	Communication	GF0907	R&D Education
cofog99	GF0407	Other industries	GF0908	Education n.e.c.
cofog99	GF0408	R&D Economic affairs	GF10	Social protection
cofog99	GF0409	Economic affairs n.e.c.	GF1001	Sickness and disability
cofog99	**GF05**	**Environmental protection**	**GF1002**	**Old age**
cofog99	GF0501	Waste management	GF1003	Survivors
cofog99	GF0502	Waste water management	GF1004	Family and children
cofog99	GF0503	Pollution abatement	GF1005	Unemployment
cofog99	GF0504	Protection of biodiversity and landscape	GF1006	Housing
cofog99	GF0505	R&D Environmental protection	GF1007	Social exclusion n.e.c.
cofog99	GF0506	Environmental protection n.e.c.	GF1008	R&D Social protection

Source: Eurostat; Manual on sources and methods for the compilation of COFOG statistics.
Note: The reports the Classification of the Functions of Government (COFOG).

TABLE 4: AGGREGATE MULTIPLIERS

	(1)	(2)	(3)	(4)
ESI Funds	GDP	Tot. Inv.	Priv. Inv	Empl.
Panel 1				
Impact Multiplier (2SLS)	1.207***	1.507***	0.790**	0.106
	(0.425)	(0.339)	(0.361)	(0.216)
R-squared	0.438	0.353	0.290	0.485
Impact Multiplier (OLS)	0.877***	1.174***	0.495**	-0.00741
	(0.192)	(0.188)	(0.185)	(0.141)
R-squared	0.838	0.658	0.651	0.770
Observations	516	513	511	519
Panel 2				
1Y Multiplier (2SLS)	1.765**	1.688***	0.724**	0.0598
	(0.693)	(0.418)	(0.355)	(0.459)
R-squared	0.294	0.176	0.146	0.306
1Y Multiplier (OLS)				
	1.478***	1.450***	0.593**	0.0869
	(0.302)	(0.312)	(0.240)	(0.331)
R-squared	0.801	0.613	0.633	0.744
Observations	482	482	477	485

Source: Author's calculations.

Note: Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01. The table indicates that, using the 2SLS method, a 1 percent of GDP increase in ESI disbursements increases GDP, contemporaneously, by 1.207 percent on average.

TABLE 5: SECTORAL MULTIPLIERS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ESI Funds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Panel 1																			
Tot. Inv.																			
Impact M.	0.00783	-0.0136	0.260***	0.138**	0.0947***	-0.0201	0.0298	0.175	-0.000185	-0.00832	0.0226	0.126	0.0413**	0.0892**	0.389***	0.0934***	-0.0215	0.0185	0.00322
	(0.0263)	(0.0182)	(0.0967)	(0.0686)	(0.0267)	(0.0459)	(0.0447)	(0.109)	(0.0132)	(0.0481)	(0.0146)	(0.119)	(0.0205)	(0.0359)	(0.131)	(0.0284)	(0.0213)	(0.0153)	(0.00735)
Obs.	505	482	503	474	496	508	499	488	497	497	505	507	487	498	488	493	492	490	493
R-squared	0.149	0.114	0.103	0.044	0.057	0.168	0.195	0.161	0.133	0.158	0.126	0.303	0.085	0.140	0.110	0.128	0.069	0.131	0.127
1Y M.	0.0739*	-0.00522	0.193	0.335**	0.207***	0.0590	-0.0130	0.122	-0.00746	0.00374	0.0292	0.344**	0.0710**	0.0649	0.390***	0.138***	0.0450*	0.0442**	0.0127
	(0.0412)	(0.0244)	(0.145)	(0.161)	(0.0306)	(0.0508)	(0.0463)	(0.108)	(0.0154)	(0.0408)	(0.0270)	(0.157)	(0.0286)	(0.0446)	(0.119)	(0.0388)	(0.0258)	(0.0212)	(0.00939)
Obs.	472	451	477	450	460	472	464	461	460	468	476	476	458	468	458	464	464	460	461
R-squared	0.256	0.134	0.149	0.174	0.254	0.139	0.246	0.115	0.247	0.021	0.079	0.205	0.145	0.502	0.190	0.098	0.153	0.289	0.031

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ESI Funds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Panel 2																			
GVA																			
Impact M.	0.0988*	0.0186	0.221*	-0.0468	-0.0116	0.421***	0.156*	0.114	0.0261	0.0318	-0.0103	-0.0362	0.0543	-0.00402	-0.0696	-0.0118	-0.0307	0.0168	0.00728
	(0.0536)	(0.0223)	(0.113)	(0.0549)	(0.00909)	(0.137)	(0.0880)	(0.0719)	(0.0229)	(0.0346)	(0.0547)	(0.0886)	(0.0443)	(0.0218)	(0.0483)	(0.0387)	(0.0291)	(0.0248)	(0.0131)
Obs.	519	499	516	499	519	512	519	516	509	517	517	515	516	512	513	516	516	520	521
R-squared	0.213	0.012	0.048	0.037	-0.003	0.235	0.172	0.039	0.017	0.022	0.048	-0.005	0.004	0.016	0.053	0.061	0.026	0.046	0.010
1Y M.	0.167*	0.000594	0.395*	-0.112	0.00184	0.482***	0.214	0.135	0.0469	-0.0630	0.226	-0.0759	0.114	-0.0107	-0.105	0.0226	-0.0220	0.00630	-0.0173
	(0.0866)	(0.0296)	(0.234)	(0.0696)	(0.0181)	(0.157)	(0.191)	(0.0959)	(0.0436)	(0.0521)	(0.138)	(0.0955)	(0.0819)	(0.0512)	(0.0758)	(0.0647)	(0.0565)	(0.0335)	(0.0200)
Obs.	485	466	484	470	486	478	486	480	479	483	486	482	483	482	483	482	485	487	485
R-squared	0.219	0.116	0.015	0.013	0.019	0.184	0.099	-0.002	0.037	0.020	0.020	-0.010	0.032	-0.004	0.103	0.058	0.023	0.035	0.054

Source: Author's calculations.

Notes: The Table shows the sectoral contemporaneous and 1-year multipliers associated with an aggregate ESI Funds shock. As an example, the Table suggests that a 1 percent of GDP increase in ESI Funds contemporaneously increases Manufacturing Investment (C) by 0.260 percent of GDP. In terms of NACE Rev.2 nomenclature, A = "Agriculture, forestry and fishing", B = "Mining and quarrying", C = "Manufacturing", D = "Electricity, gas, steam and air conditioning supply", E = "Water supply, sewerage, waste management and remediation", F = "Construction", G = "Wholesale and retail trade; repair of motor vehicles and motorcycles", "H = "Transportation and storage", I = "Accommodation and food service activities", J = "Information and communication", K = "Financial and insurance activities", L = "Real estate activities", M = "Professional, scientific and technical activities", N = "Administrative and support service activities", O = "Public administration and defense; compulsory social security", P = "Education", Q "Human health and social work activities", R = "Arts, entertainment and recreation", S = "Other service activities". Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 6: SEMI-ELASTICITIES

	(1) A	(2) B	(3) C	(4) D	(5) E	(6) F	(7) G	(8) H	(9) I	(10) J	(11) K	(12) L	(13) M	(14) N	(15) O	(16) P	(17) Q	(18) R	(19) S
Panel 1																			
Investments																			
Inv.(Mln. Euros)	1.81	0.76	11.66	2.62	1.40	2.36	4.06	5.21	0.94	4.12	1.94	22.49	3.22	3.70	5.69	2.54	*2.68*	1.15	0.49
GDP (Mln. Euros)	375.71	399.02	375.71	399.02	385.99	375.71	385.99	385.99	385.99	375.86	375.71	375.71	386.19	385.99	385.99	385.99	*385.99*	385.99	385.99
Weighted Impact M	**1.62**	**-7.15**	**8.38**	**21.01**	**26.11**	**-3.21**	**2.84**	**12.96**	**-0.08**	**-0.76**	**4.37**	**2.10**	**4.96**	**9.30**	**26.38**	**14.20**	***-3.10***	**6.18**	**2.51**
Weighted 1Y M.	**15.31**	**-2.74**	**6.22**	**51.00**	**57.08**	**9.41**	**-1.24**	**9.03**	**-3.06**	**0.34**	**5.64**	**5.75**	**8.53**	**6.78**	**26.45**	**20.99**	**6.49**	**14.78**	**9.91**
Panel 2																			
GVA																			
GVA (Bln. Euros)	5.97	2.33	56.56	6.35	3.14	18.76	37.76	15.89	8.74	16.13	17.22	36.16	21.01	13.38	21.43	16.77	*22.68*	4.23	5.89
GDP (Bln. Euros)	369.64	381.51	369.64	381.51	369.64	369.64	369.64	369.64	369.64	369.64	369.64	369.64	369.64	369.64	369.64	369.64	*369.64*	369.64	369.64
Weighted Impact M	**6.12**	**3.05**	**1.44**	**-2.81**	**-1.36**	**8.30**	**1.53**	**2.65**	**1.10**	**0.73**	**-0.22**	**-0.37**	**0.96**	**-0.11**	**-1.20**	**-0.26**	***-0.50***	**1.47**	**0.46**
Weighted 1Y M.	**10.35**	**0.10**	**2.58**	**-6.73**	**0.22**	**9.50**	**2.10**	**3.14**	**1.98**	**-1.44**	**4.85**	**-0.78**	**2.01**	**-0.30**	**-1.81**	**0.50**	***-0.36***	**0.55**	**-1.09**

Source: Author's calculations.

Notes: The Table shows the sectoral contemporaneous and 1 year weighted multipliers associated with an aggregate ESI Funds shock, as explained in the main text. As an example, the Table suggests that a 1 percent of GDP increase in ESI Funds contemporaneously increases Manufacturing Investment (C) by an amount equivalent to 8.38 percent of average manufacturing investments.

In terms of NACE Rev.2 nomenclature, A = "Agriculture, forestry and fishing", B = "Mining and quarrying", C = "Manufacturing", D = "Electricity, gas, steam and air conditioning supply", E = "Water supply, sewerage, waste management and remediation", F = "Construction", G = "Wholesale and retail trade; repair of motor vehicles and motorcycles", "H = "Transportation and storage", I = "Accommodation and food service activities", J = "Information and communication", K = "Financial and insurance activities", L = "Real estate activities", M = "Professional, scientific and technical activities", N = "Administrative and support service activities", O = "Public administration and defense; compulsory social security", P = "Education", Q "Human health and social work activities", R = "Arts, entertainment and recreation", S = "Other service activities". Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 7: SECTORAL MULTIPLIERS

	(1)	(2)	(3)	(4)	(5)	(6)
ESI Funds	A	B-E	F	G-J	K-N	O-U
Panel 1						
Employment						
Impact M.	-0.189	-0.488	1.291	-0.137	1.292**	-0.607*
	(0.883)	(0.333)	(0.912)	(0.293)	(0.566)	(0.347)
Obs.	514	518	517	520	520	513
R-squared	0.014	0.230	0.415	0.223	0.111	0.147
Panel 2						
1Y M.	-1.304	0.0837	3.077	0.761	2.756**	-0.568
	(1.163)	(0.700)	(1.874)	(0.713)	(1.354)	(0.582)
Obs.	483	485	482	485	488	485
R-squared	0.007	0.208	0.276	0.188	0.132	0.146

Source: Author's calculations.

Notes: The Table shows the sectoral contemporaneous and 1-year multipliers associated with an aggregate ESI Funds shock. As an example, the Table suggests that a 1 percent of GDP increase in ESI Funds contemporaneously increases employment in the K-N sectors by 1.292 percent.

In terms of NACE Rev.2 nomenclature, A = "Agriculture, forestry and fishing", B = "Mining and quarrying", C = "Manufacturing", D = "Electricity, gas, steam and air conditioning supply", E = "Water supply, sewerage, waste management and remediation", F = "Construction", G = "Wholesale and retail trade; repair of motor vehicles and motorcycles", "H = "Transportation and storage", I = "Accommodation and food service activities", J = "Information and communication", K = "Financial and insurance activities", L = "Real estate activities", M = "Professional, scientific and technical activities", N = "Administrative and support service activities", O = "Public administration and defense; compulsory social security", P = "Education", Q "Human health and social work activities", R = "Arts, entertainment and recreation", S = "Other service activities". Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 8a: SECTORAL MULTIPLIERS OF PUBLIC INVESTMENT

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	*(9)*	(10)
Public Inv.	Public S.	Defence	Public Ord.	Econ Affairs	Environm.	Housing	Health	Recreation	Education	Social P.
Panel 1										
GDP										
Impact M.	1.078***	1.137**	4.033**	0.697***	2.702***	1.076	1.096	2.836**	*1.891***	0.895
	(0.357)	(0.470)	(1.792)	(0.168)	(0.896)	(0.635)	(0.741)	(1.207)	*(0.697)*	(0.694)
Obs.	510	511	512	511	512	513	514	511	*511*	510
R-squared	0.796	0.794	0.810	0.807	0.800	0.796	0.793	0.795	*0.823*	0.794
1Y M.	2.311***	0.832	8.480**	1.235***	2.874**	3.072**	0.287	3.587	*2.846***	1.230
	(0.728)	(0.859)	(3.916)	(0.360)	(1.358)	(1.283)	(0.974)	(2.528)	(1.096)	(1.310)
Obs.	479	481	481	480	483	482	481	483	*483*	480
R-squared	0.784	0.778	0.784	0.789	0.769	0.780	0.781	0.766	*0.790*	0.786
Panel 2										
Total Inv.										
Impact M.	1.450***	2.237***	6.616***	1.364***	3.352***	1.908***	2.775***	3.626***	4.344***	0.796
	(0.420)	(0.305)	(1.819)	(0.330)	(0.673)	(0.678)	(0.981)	(1.238)	(0.475)	(1.171)
Obs.	515	512	514	511	511	511	511	513	514	511
R-squared	0.578	0.583	0.621	0.639	0.590	0.603	0.626	0.572	0.703	0.561
1Y M.	2.807***	3.195***	6.147	1.075**	3.985***	4.091***	1.425	2.898	4.939***	1.366
	(0.329)	(0.692)	(3.622)	(0.395)	(1.247)	(1.109)	(0.948)	(1.828)	(1.243)	(1.357)
Obs.	476	474	478	474	477	476	476	478	480	476
R-squared	0.608	0.600	0.607	0.631	0.601	0.601	0.620	0.588	0.640	0.607

Source: Author's calculations.

Notes: The Table shows the contemporaneous and 1-year multipliers associated with sectoral shocks to public investments. As an example, the Table suggests that a 1 percent of GDP increase in public investments associated with "General public services" contemporaneously increases GDP by 1.078 percent. In terms of COFOG nomenclature, "Public S." corresponds to "General public services", "Defense" corresponds to "Defense", "Public Ord." corresponds to "Public order and safety", "Econ Affairs" corresponds to "Economic Affairs", "Environm." Corresponds to "Environmental Protection", "Housing" corresponds to "Housing and community amenities", "Health" corresponds to "Health", "Recreation" corresponds to "Recreation, culture and religion", "Education" corresponds to "Education", "Social" corresponds to "Social Protection". Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 8b: SECTORAL MULTIPLIERS OF PUBLIC INVESTMENT

Public I.	(1) Public S.	(2) Defence	(3) Public Ord.	(4) Econ Affairs	(5) Environm.	(6) Housing	(7) Health	(8) Recreation	*(9)* Education	(10) Social P.
Panel 1										
Private Inv.										
Impact M.	0.236	0.785*	1.994	-0.0830	0.456	-0.895	-0.0731	0.262	*1.461****	-0.928
	(0.278)	(0.397)	(1.390)	(0.299)	(0.643)	(0.588)	(0.829)	(0.807)	*(0.494)*	(0.916)
Obs.	508	513	512	510	513	509	512	512	*513*	509
R-squared	0.609	0.568	0.630	0.615	0.603	0.616	0.620	0.569	*0.692*	0.596
1Y M.	1.849***	0.939	3.016	-0.0171	0.509	1.092	-0.643	0.345	*2.477***	-0.403
	(0.297)	(1.030)	(2.418)	(0.276)	(0.757)	(0.721)	(1.075)	(1.286)	(1.173)	(1.011)
Obs.	477	476	477	475	476	477	476	478	*480*	477
R-squared	0.620	0.606	0.626	0.631	0.628	0.606	0.645	0.602	*0.652*	0.623
Panel 2										
Empl.										
Impact M.	0.902***	0.620	1.276	0.101	0.463	1.095**	0.584*	1.111*	0.441	0.836
	(0.254)	(0.505)	(1.246)	(0.120)	(0.622)	(0.486)	(0.312)	(0.566)	(0.450)	(0.862)
Obs.	514	516	517	516	516	517	516	515	514	516
R-squared	0.766	0.736	0.761	0.758	0.735	0.756	0.742	0.740	0.775	0.766
1Y M.	1.656*	0.432	3.862	0.284	-0.303	0.851	0.456	1.870	0.857	-0.802
	(0.837)	(0.844)	(2.403)	(0.256)	(1.257)	(0.737)	(0.730)	(1.423)	(0.849)	(1.249)
Obs.	480	481	482	481	481	480	481	481	479	481
R-squared	0.737	0.721	0.744	0.740	0.726	0.741	0.744	0.724	0.735	0.753

Source: Author's calculations.

Notes: The Table shows the contemporaneous and 1-year multipliers associated with sectoral shocks to public investments. As an example, the Table suggests that a 1 percent of GDP increase in public investments associated with "General public services" increases private investment by 1.849 percent of GDP after 1 year. In terms of COFOG nomenclature, "Public S." corresponds to "General public services", "Defense" corresponds to "Defense", "Public Ord." corresponds to "Public order and safety", "Econ Affairs" corresponds to "Economic Affairs", "Environm." Corresponds to "Environmental Protection", "Housing" corresponds to "Housing and community amenities", "Health" corresponds to "Health", "Recreation" corresponds to "Recreation, culture and religion", "Education" corresponds to "Education", "Social" corresponds to "Social Protection". Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 9: AGGREGATE MULTIPLIERS FOR CEE SUB-SAMPLE

	(1)	(2)	(3)	(4)
ESI Funds	GDP	Tot. Inv.	Priv. Inv	Empl.
Panel 1				
Impact M. (2SLS)	1.257***	1.809***	1.258**	0.139
	(0.450)	(0.561)	(0.601)	(0.168)
R-squared	0.831	0.659	0.637	0.769
Observations	516	514	512	519
Panel 2				
1Y M. (2SLS)	1.629**	2.058***	1.247**	0.210
	(0.797)	(0.659)	(0.529)	(0.734)
R-squared	0.800	0.612	0.633	0.744
Observations	482	482	477	485

Source: Author's calculations.

Note: Standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. The table indicates that, using the 2SLS method, a 1 percent of GDP increase in ESI disbursements increases GDP, contemporaneously, by 1.257 percent on average.

TABLE 10: SECTORAL MULTIPLIERS– CEE SUB-SAMPLE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ESI Funds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Panel 1																			
Tot. Inv.																			
Impact M.	-0.0545	0.0202	0.192	0.245***	0.0786*	0.0244	0.0214	0.231	-0.0252	-0.00916	0.0141	0.282***	0.0314	0.0950**	0.513***	0.168***	0.0278	-0.0116	0.00906
	(0.0374)	(0.0153)	(0.124)	(0.0506)	(0.0424)	(0.0354)	(0.0590)	(0.198)	(0.0155)	(0.0375)	(0.0197)	(0.0939)	(0.0336)	(0.0449)	(0.110)	(0.0338)	(0.0316)	(0.00887)	(0.0116)
1Y M.	0.0551	0.00506	0.409*	0.879***	0.153*	0.0883	-0.0151	-0.0608	-0.0185	0.0555	0.0623	0.444**	0.117**	0.0727	0.415***	0.226***	0.0494	0.00424	0.0179
	(0.0665)	(0.0272)	(0.218)	(0.113)	(0.0792)	(0.0592)	(0.0755)	(0.0954)	(0.0195)	(0.0445)	(0.0478)	(0.178)	(0.0568)	(0.0462)	(0.126)	(0.0410)	(0.0401)	(0.0197)	(0.0163)
Panel 2																			
GVA																			
Impact M.	0.129**	0.0313	0.333**	-0.0628	-0.00811	0.437**	0.120*	0.104	0.0380	0.0165	-0.0198	0.00208	0.0653	0.0524**	-0.0150	0.00722	-0.0506**	-0.0148	0.0243
	(0.0643)	(0.0451)	(0.149)	(0.0930)	(0.0106)	(0.177)	(0.0610)	(0.0999)	(0.0335)	(0.0480)	(0.0610)	(0.137)	(0.0571)	(0.0210)	(0.0427)	(0.0384)	(0.0256)	(0.0173)	(0.0172)
1Y M.	0.328	0.00123	0.446	-0.134	-0.0128	0.441**	0.241	0.125	0.0679	-0.0140	0.298*	-0.115	0.124	0.0641	-0.00644	-0.00160	-0.0342	-0.0298	-0.0175
	(0.225)	(0.0495)	(0.304)	(0.149)	(0.0155)	(0.215)	(0.210)	(0.141)	(0.0495)	(0.0570)	(0.157)	(0.134)	(0.0759)	(0.0552)	(0.0848)	(0.0573)	(0.0509)	(0.0328)	(0.0185)

	(1)	(2)	(3)	(4)	(5)	(6)
ESI Funds	A	B-E	F	G-J	K-N	O-U
Panel 3						
Employm.						
Impact M.	-3.761**	-0.00376	2.751***	0.144	2.263***	-0.923***
	(1.586)	(0.286)	(0.913)	(0.582)	(0.739)	(0.327)
1Y M.	-4.176**	0.737	6.564***	0.632	4.565**	0.206
	(1.978)	(0.754)	(1.820)	(1.216)	(2.284)	(0.717)

Source: Author's calculations.

Notes: The Table shows the sectoral contemporaneous and 1 year multipliers associated with an aggregate ESI Funds shock. As an example, the Table suggests that a 1 percent of GDP increase in ESI Funds contemporaneously increases Real Estate Investment (L) by 0.282 percent of GDP, for countries in the regional group.

In terms of NACE Rev.2 nomenclature, A = "Agriculture, forestry and fishing", B = "Mining and quarrying", C = "Manufacturing", D = "Electricity, gas, steam and air conditioning supply", E = "Water supply, sewerage, waste management and remediation", F = "Construction", G = "Wholesale and retail trade; repair of motor vehicles and motorcycles", "H = "Transportation and storage", I = "Accommodation and food service activities", J = "Information and communication", K = "Financial and insurance activities", L = "Real estate activities", M = "Professional, scientific and technical activities", N = "Administrative and support service activities", O = "Public administration and defense; compulsory social security", P = "Education", Q "Human health and social work activities", R = "Arts, entertainment and recreation", S = "Other service activities". Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 11: SECTORAL MULTIPLIERS OF PUBLIC INVESTMENT- CEE SUB-SAMPLE

Public Inv.	(1) Public S.	(2) Defence	(3) Public Ord.	(4) Econ Affairs	(5) Environm.	(6) Housing	(7) Health	(8) Recreation	*(9)* Education	(10) Social P.
Panel 1										
GDP										
Impact M.	5.600**	0.483	10.18***	1.059**	4.017	4.184**	6.055**	3.384**	2.451**	0.475
	(2.214)	(2.349)	(2.651)	(0.393)	(3.139)	(1.519)	(2.731)	(1.613)	(1.032)	(3.008)
1Y M.	6.746**	3.610	15.51***	1.247*	6.968	6.804	4.067	3.342	2.597**	-5.477
	(2.615)	(3.659)	(5.202)	(0.706)	(7.333)	(4.480)	(2.762)	(3.127)	(1.209)	(3.567)
Panel 2										
Total Inv.										
Impact M.	5.688***	1.469	9.798***	0.947**	4.065	5.613**	7.057**	3.409	4.673***	1.353
	(1.098)	(1.410)	(1.896)	(0.449)	(2.937)	(2.134)	(3.093)	(2.423)	(1.077)	(3.529)
1Y M.	10.75**	3.833*	12.36**	0.942	3.313	8.883**	3.177	2.879	5.480***	3.858
	(4.059)	(2.243)	(4.706)	(0.656)	(2.661)	(3.900)	(2.176)	(3.261)	(1.508)	(3.445)

Public Inv.	(1) Public S.	(2) Defence	(3) Public Ord.	(4) Econ Affairs	(5) Environm.	(6) Housing	(7) Health	(8) Recreation	*(9)* Education	(10) Social P.
Panel 3										
Private Inv.										
Impact M.	2.128	-0.462	4.827*	-0.407	0.555	2.316	4.657	1.058	2.458**	-1.137
	(1.310)	(0.906)	(2.518)	(0.433)	(2.499)	(1.443)	(3.186)	(1.692)	(1.194)	(3.353)
1Y M.	7.090**	0.609	5.841	0.106	0.620	6.964**	1.280	1.215	2.722*	-0.686
	(2.681)	(1.667)	(4.237)	(0.441)	(2.337)	(3.332)	(2.139)	(2.604)	(1.521)	(3.468)
Panel 4										
Employment										
Impact M.	1.578	-0.232	1.599	0.144	0.471	1.881	2.487***	1.153*	0.845	-0.356
	(1.330)	(1.509)	(2.241)	(0.197)	(0.877)	(1.513)	(0.692)	(0.569)	(0.716)	(3.284)
1Y M.	4.700***	-2.189	5.235**	0.347	1.200	4.456	3.146	2.643	0.686	-1.214
	(1.044)	(3.712)	(2.432)	(0.526)	(2.020)	(2.841)	(2.512)	(2.140)	(0.825)	(3.554)

Source: Author's calculations.

Notes: The Table shows the contemporaneous and 1-year multipliers associated with sectoral shocks to public investments. As an example, the Table suggests that a 1 percent of GDP increase in public investments associated with "Education" contemporaneously increases private investment by 2.458 percent of GDP. In terms of COFOG nomenclature, "Public S." corresponds to "General public services", "Defense" corresponds to "Defense", "Public Ord." corresponds to "Public order and safety", "Econ Affairs" corresponds to "Economic Affairs", "Environm." Corresponds to "Environmental Protection", "Housing" corresponds to "Housing and community amenities", "Health" corresponds to "Health", "Recreation" corresponds to "Recreation, culture and religion", "Education" corresponds to "Education", "Social" corresponds to "Social Protection". Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 12: SECTORAL MULTIPLIERS OF PUBLIC INVESTMENT- CEE SUB-SAMPLE (SELECTION OF SECTORS)

Public Inv.	(1) General P.S.	(2) R&D	(3) Research	(4) Energy	(5) Transport	(6) Water S.
Panel 1 GDP						
Impact M.	5.761**	3.847	6.671**	0.327	0.967**	2.745
	(2.670)	(6.573)	(2.535)	(2.104)	(0.380)	(1.782)
1Y M.	7.092	9.283	7.007	11.38*	0.999*	3.296
	(4.715)	(12.19)	(4.772)	(6.453)	(0.562)	(5.748)
Panel 2 Total Inv.						
Impact M.	5.334*	5.734	5.244	0.658	1.084*	4.045
	(3.040)	(5.321)	(3.136)	(2.727)	(0.599)	(2.385)
1Y M.	10.65	3.237	10.01	8.005	0.801	5.100
	(6.950)	(6.768)	(7.116)	(6.833)	(0.644)	(4.873)

Public Inv.	(1) General P.S.	(2) R&D	(3) Research	(4) Energy	(5) Transport	(6) Water S.
Panel 3 Private Inv.						
Impact M.	2.812**	4.554	3.025**	6.688	-0.452	-3.040
	(1.345)	(4.817)	(1.448)	(4.537)	(0.439)	(2.761)
1Y M.	7.011	1.772	6.980	8.555	-0.0352	0.220
	(5.055)	(4.933)	(4.986)	(5.324)	(0.412)	(3.627)
Panel 4 Employment						
Impact M.	-0.701	3.876	-1.518	-0.695	0.109	1.348
	(2.382)	(3.505)	(2.145)	(3.071)	(0.161)	(1.732)
1Y M.	0.772	3.088	0.179	1.475	0.400	-0.863
	(2.618)	(2.788)	(2.800)	(2.559)	(0.566)	(1.771)

Source: Author's calculations.

Notes: The Table shows the contemporaneous and 1-year multipliers associated with sectoral shocks to public investments. As an example, the Table suggests that a 1 percent of GDP increase in public investments associated with Basic Research contemporaneously increases aggregate private investment by 3.025 percent of GDP. In terms of COFOG nomenclature, "General P. S." corresponds to "General public services", but including only the sum of Basic Research, R&D General public services, General public services n.e.c.., "R&D" corresponds to the sum of R&D investments across all COFOG sectors, "Research" corresponds to Basic Research, identified as a subsector of "General public services", "Energy" corresponds to "Fuel and energy" within "Economic Affairs", "Transport" corresponds to "Transport" within "Economic Affairs", "Water" corresponds to "Water Supply" within "Housing and community amenities". Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

X. APPENDIX A - EUROPEAN STRUCTURAL INVESTMENT FUNDS

The European Structural Investment (ESI) Funds refer to EU funding, jointly managed by the European Commission (EC) and the EU countries, with the purpose of supporting investment in job creation and a sustainable and healthy European economy and environment. ESI are disbursed through five funds: the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Cohesion Fund (CF), the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF), and currently make over half of EU funding. Moreover, the EU also disburses funds through a Youth Employment Initiative (YEI) that supports young people who are not in education, employment or training (so-called, NEETs).

The EU has gone through five programming periods that usually lasted 7 years each: 1989-1993, 1994-1999, 2000-2006, 2007-2013 and the ongoing 2014-2020. For the ongoing 2014-2020 program, these funds totaled approximately EUR450 billion. ESI funds are approved by the European Commission (EC) and implemented by Member States and their regions under shared management.[34] A key feature of each program is the distinction between commitments and payments. Before the start of each program, the EU agrees to a budgetary commitment, which is a reservation of appropriations to cover for subsequent payments. Commitments are distributed relatively evenly over the programming period.[35] Differently, payments are appropriation covering expenditures due in a current year and arising from the legal commitments entered in the current year and/or earlier years. Each disbursement happens either through grants or financial instruments such as loans, guarantees and equity. These instruments can be national, regional, transnational and cross-border. In the case of financial instruments, a national managing authority is responsible for channeling the funds to a financial intermediary who will in turn supply the financial products to the final recipients.

In terms of implementation, after the definition of commitments for the programming period, local authorities and agents can submit project proposals, which are then accepted or rejected by the EC. If accepted, the EC then defines a ceiling on each approved project. The local manager who undertakes the project can then benefit from reimbursement of the expenditures, but only after they are incurred.

In terms of classification, ESI funds are allocated under different "banners"; the lion share of ESI payments is classified under three objectives: payments associated with Objective 1 (Convergence) are aimed at stimulating growth in lagging regions (and can only be allocated in regions with a GDP per capital below 75 percent of the EU average), while payments associated with Objective 2 (Regional Competitiveness and Employment objective) are allocated to regions in structural decline; finally, payments associated with Objective 3 (European Territorial

[34] ESIF programs focus on 11 objectives: 1) Research and innovation, 2) Information and communications technology (ICT), 3) SME competitiveness, 4) Low carbon economy, 5) Climate change adaptation and risk management, 6) Environment and resource efficiency, 7) Sustainable transport and network bottlenecks, 8) Employment and labor mobility, 9) Social inclusion and poverty, 10) Education and 11) Institutional capacity.

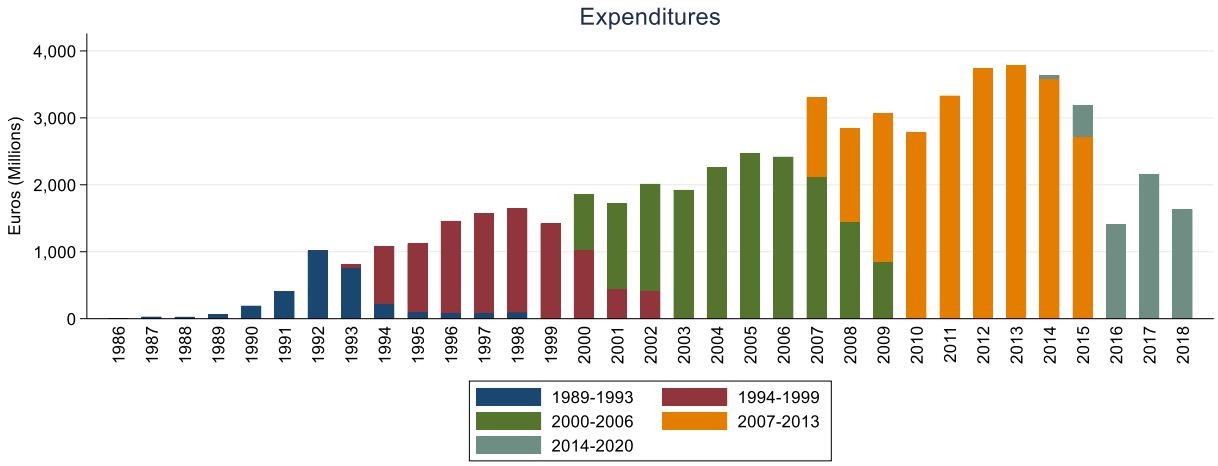
[35] The first installment of the budget commitment is released automatically, following the start of the program. Future commitments are made annually and can be adapted in case of amendments to the program.

Cooperation objective) are devolved to support education and employment policies in regions not included under Objective 1.

The literature often distinguishes between these three objectives to focus on a selection: for example, Coelho (2019) exclusively analyses Objective 1 and 2 transfers, while studies involving regression discontinuity design (Becker et al. 2010, 2013) are confined to Objective 1 payments so as to achieve identification of the causal effects.

In Figure 6 below we illustrate the evolution of total (modeled) expenditures for each programming period; a first observation is the sharp decline in expenditures associated with the 2014-2020 programming period; notice that while it is normal in the first years of implementation to observe low payments, a quick comparison reveals that, in relative terms, the 2014-2020, is showing much lower payment rates. Despite this trend, (Bachter, Ferry and Gal, 2018) argue that, with respect to financial commitments (not shown in the Figure), the 2014-2020 programming period has picked up and is now on par with the 2007-2013 period. As a matter of fact, 53.4 percent of the funding has been already allocated to projects as of January 2018. As a second observation, notice that payments extend well beyond the end of the programming period, especially during earlier periods. These delays have become shorter with the introduction of decommitment rules ("N+2" and "N+3") which set a maximum limit before de-commitment of funds is carried out.

FIGURE 6: EU EXPENDITURES



Source: Author's calculations.
Note: The Figure illustrates the evolution through time of EU expenditures associated with EU Structural Investment Funds. Each color represents expenditures associated with a given programming period.

XI. APPENDIX B - IDENTIFICATION STRATEGY

B.1. Instrumental Variable

Following Kraay (2014) this Appendix describes the steps followed in order to compute the predicted disbursement series.

Using the ESI Funds disbursement dataset, "predicted disbursement" series can be computed at the country level as follows:

1. Assign each fund disbursement to a specific "program period-objective 1" bin. The program periods of ESI Funds are given by 1994–1999, 2000–2006, 2007–2013 and 2014–2020. The funds included are ERDF, ESF, CF, EAFRD, EMFF. The objective 1 criterion distinguishes between regions that are covered by the convergence criterion and those that are not.[36] Overall, the number of bins is equal to $4 \times 2 = 8$ bins. Call the set of bins ב.
2. For a given bin $I \in$ ב, select a funding i; then compute the average disbursement profile across all other EU funding belonging to I, excluding the EU funding i in question. Apply this average predicted disbursement profile to the original commitment associated with i (by taking the ratio), so as to obtain the series of predicted funding-level disbursements.[37] Repeat this procedure for each $i \in I$ and for each $I \in$ ב.
3. Aggregate the predicted funding-level disbursement series at the country level.

We review several assumptions that we impose in order to overcome some of the data limitations that characterize the available datasets

The main dataset on EU payments that we use for the estimation does not contain information on the initial planned (commitment) amounts associated with each series of disbursements. While we have also access to separate datasets on commitments, the latter do not allow for a satisfactory match at the NUTS2 regions level[38]. As a result, in our benchmark estimation we instead assume that, for each one of the completed past programs, the measured total sum of expenditures matches the initially planned amount.

In relation to the ongoing 2014-2020 program period, this latter assumption would be inappropriate. Fortunately, we have access to a separate dataset containing both expenditures and data on commitments[39] for the years going from 2014 to 2020. This latter dataset, despite not having a NUTS2 regional breakdown can still be used to compute disbursement rates at the country-year-fund level. Specifically, we impute the country-fund-year level disbursement rates to our original NUTS2 level payments dataset, under the assumption that disbursement rates observed at the country-fund-year level apply homogeneously across all NUTS2 regions belonging to the corresponding country-fund-year category. After combining payments at the

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[36] See OECD Glossary of Statistical Terms - Objectives 1, 2 and 3 (for allocation of European Union structural funds) Definition.

[37] Due to a lack of data on commitments, for the cases of completed programs it is assumed that the total sum of disbursement equals the initial commitment.

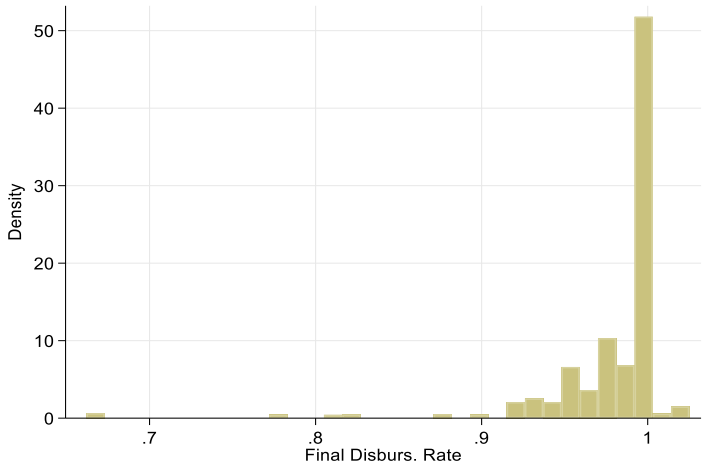
[38] For example, in some cases the datasets report the commitments associated with a given fund and NUTS-2 region, while in other cases the reported commitment is associated with a fund and thematic objective but not a NUTS-2 region.

[39] "The EU 2014-2020 payments" dataset.

NUTS2 level with disbursement rates, we can finally impute an initial commitment value associated with each region-fund-program in our payments dataset.

In relation to completed programs (up to the 2007–2013 program), it is well possible that initial commitments are not entirely absorbed by member states, which would weaken our initial assumption on full absorption of commitments. To quantify the severity of this possibility, we rely on several datasets on commitments amounts by country fund year and theme. Unfortunately, these latter datasets do not include a consistent regional breakdown, hence preventing us to reach an accurate match between payments and commitments. Nevertheless, we can still use the data in order to compute a disbursement rate at the country-fund level of granularity. In Figure 7 we report the density of *final* disbursement rates associated with both the 2000–2006 and 2007–2013 programs.

FIGURE 7: DENSITY OF FINAL DISBURSEMENT RATES



Source: Author's calculations.
Notes: This figure shows the density of cumulative disbursement rates computed as the total sum of actual payments to the total commitment amount. This figure includes only the following programs: 2000–2006, 2007–2013

Reassuringly, the Figure shows that, in virtually all the cases, the final observed absorption rate exceeded 90% of the initial commitments (with a significant peak at 1), which confirms the validity of our assumption on full absorption of commitments for past completed programs.

B.2. *Econometric Model and Estimation*

We discuss here additional details on the econometric model, by reviewing the included controls and the methodology that we follow in order to compute standard errors of functions of parameters.

Controls: As discussed in the main text, the model includes a set of controls stacked in the vector $\boldsymbol{X}$. The vector includes the lag of GDP growth, in order to account for the effects of economic activity, the lag of the outcome variable (this is justified on the grounds that even though loan commitments are made prior to the realization of shocks, the latter might be persistent or

predictable. To the extent that loans commitments might be correlated with contemporaneous shocks, this in turn would lead to a correlation between commitments and future shocks). Furthermore, the model includes one measure of year-on-year changes in (lagged) institutional quality and one measure of year-on-year changes in (lagged) financial risk (broadly defined), which are proxied using the International Country Risk Guide (ICRG) ratings. In both cases higher values of the ratings signify better institutional quality and less financial risk, respectively. These variables are justified especially when addressing the impact of fiscal shocks of investments, since changes in institutional or financial risk factors can have significant influence on institutional investors (see for example Ahlquist, 2006). Finally, the model contains a dummy variable for 2009, interacted with the fiscal shock. While there is no explicitly control for monetary and nominal interest rates, the model features time fixed effects. Although the sample also contains non-Eurozone countries, the majority of the countries under analysis generally maintains their domestic currencies aligned with the Euro throughout the sample period.

As a final note, in the case of the OLS regressions, where we study the multiplier of sectoral shocks to public investments, we also add an additional control in the form of the (lagged) change in the sum of public investments, excluding public investments belonging to the sector under scrutiny.

Outliers: Outlier observations are identified and excluded following a two-step approach:

Using judgement to identify specific years (i.e., years associated with austerity programs); the excluded observations include: Cyprus (2012, 2013, 2014), Portugal (2011), Spain (2011), Ireland (2011, 2015, 2016), Finland (2015, 2016).

Applying an "automated" method, which consists in identifying regression (standardized) residuals exceeding 2.5 standard deviations, as similarly done by Acemoglu et al. (2019).

Delta Method: Standard errors associated with $\beta + \gamma$ are computed following the "Delta Method". Essentially the Delta Method approximates the standard errors of transformations of random variable using a first-order Taylor approximation. Because β, γ are themselves random variables, we can use the delta method to approximate the standard errors of their transformation, $\beta + \gamma$.

For a vector of random variable Z, call $G(Z)$ the transformation function; then, following a Taylor expansion, it can be shown that:

$$Var\big(G(Z)\big) \approx \nabla G(Z)^T \times Cov(Z) \times \nabla G(Z)$$

B.3. *CEE Sub-Sample Selection Procedure*

In this section we outline the procedure followed in order to select the sub-sample of CEE countries that we pair together with Slovenia in the regional dummy D^c. As described in the main text, we classify countries, based on theory; fiscal multipliers are generally:

- Higher in countries that are characterized by either a flexible exchange rate regime & low capital mobility *or* a fixed exchange rate regime & high capital mobility.
- Higher in countries that are less open to trade.

We use the standard exchange rate regimes classification from Shambaugh (2004) to determine whether a country has a currency peg in a given year (a 0-1 dummy), and a measure of capital account openness from Quinn-Toyoda (Quinn and Toyoda, 2011), where higher values correspond to higher degrees of capital account openness (with a minimum of 0 and maximum of 100). Regarding trade integration, we compute the ratio of exports plus imports over GDP. For each CEE country we then calculate the sample average of each one of the three variables.[40]

We then classify each CEE economy as having a flexible exchange rate if the corresponding average of the peg variable falls below 0.5 (and correspondingly, we classify a given economy as having a fixed exchange rate if the corresponding average peg variable falls above 0.5). Concerning capital account openness and trade integration, we classify countries in 3 buckets (based on the 3 quantiles of the distribution).

Following a procedure reminiscent of Batini, Eyraud and Weber (2014) we assign a score to each country-variable pair:

- Independently of the exchange rate regime and regarding trade integration, countries that fall in the upper bucket ("high" trade integration) are assigned a value of 2, countries that fall in the intermediate bucket are assigned a value of 1, while countries that fall in the lower bucket ("low" trade integration) are assigned a value of 0.
- Conditional on a fixed (flexible) exchange rate regime, countries that fall in the upper bucket for the capital account variable are assigned a value of 2 (0), countries that fall in the intermediate bucket are assigned a value of 1 (1) and countries that fall in the lower bucket are assigned a value of 0 (2).

For each country we sum-up the scores, we show the results in Table 13; according to the above criteria countries with a higher score, also should have a larger multiplier. We group Slovenia together with Czech Republic, Croatia, Estonia and Latvia.

[40] The sample of CEE countries include Slovenia, Czech Republic, Poland, Slovakia, Croatia, Lithuania, Latvia, Estonia, Bulgaria, Hungary and Romania.

TABLE 13: CEE REGIONAL SCORE

iso	Cap. Mob.	Peg	Trade	Score
PL	73.61	0.00	0.83	4
RO	91.67	0.33	0.70	4
HR	98.86	0.82	0.86	3
LT	100.00	0.94	1.26	3
CZ	99.31	0.22	1.31	2
EE	100.00	1.00	1.42	2
LV	99.31	0.67	1.07	2
SI	100.00	0.83	1.31	2
BG	90.97	0.94	1.11	1
SK	95.83	0.56	1.60	1
HU	100.00	0.11	1.51	0

Source: Author's calculations.

Note: The Table shows the average degree of capital mobility (computed using the Quinn-Toyoda Index), the average of the Peg Index from Shambaugh (2004), the average of the ratio of exports plus imports over GDP and the total Score computed as described in the text. Averages are computed over the sample period for each country in the CEE sub-sample.

XII. APPENDIX C - ROBUSTNESS CHECK

In this section, we measure the sensitivity of the estimated aggregate multipliers presented in the main text by including two additional control variables; specifically, we add the (lagged) change in "other" gross inflows to GDP and the (lagged) change in the real effective exchange rate. The former is justified on the grounds that our sample includes several small open economies, which are influenced by international dynamics, especially in relation to global banking flows (see, Bruno and Shin (2015), for a model describing the transmission of shocks through the international banking system and Rey (2015) for a more general account of the global financial cycle in capital inflows).[41] The latter captures the impact of trade performance on economic activity and growth (see David, 2017). We report the results in Tables 14 and 15 below; notice that data availability of the controls reduces the sample size used for estimation; nevertheless, all coefficients in Tables remain closely aligned with the corresponding aggregate multipliers that we described in the main text, hence giving further support to the main conclusions of this note.

TABLE 14: AGGREGATE MULTIPLIERS (ROBUSTNESS CHECK)

`	(1)	(2)	(3)	(4)
ESI Funds	GDP	Tot. Inv.	Priv. Inv	Empl.
Panel 1				
Impact Multiplier (2SLS)	1.293***	1.403***	0.680*	0.0393
	(0.474)	(0.338)	(0.356)	(0.212)
R-squared	0.828	0.688	0.679	0.779
Observations	460	456	456	459
Panel 2				
1Y Multiplier (2SLS)	1.607**	1.689***	0.754**	0.0390
	(0.652)	(0.430)	(0.383)	(0.413)
R-squared	0.796	0.628	0.643	0.733
Observations	427	426	425	428

Source: Author's calculations.
Note: Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01. The table indicates that, using the 2SLS method, a 1 percent of GDP increase in ESI disbursements increases GDP, contemporaneously, by 1.293 percent on average.

[41] The "other" investment liabilities category also includes bank loans, currency and deposits, trade credits and other liabilities from non-residents against resident banking institutions.

TABLE 15: AGGREGATE MULTIPLIERS FOR CEE SUB-SAMPLE (ROBUSTNESS CHECK)

	(1)	(2)	(3)	(4)
ESI Funds	GDP	Tot. Inv.	Priv. Inv	Empl.
Panel 1				
Impact Multiplier (2SLS)	1.332***	1.729***	1.078*	0.108
	(0.469)	(0.562)	(0.553)	(0.195)
R-squared	0.825	0.682	0.678	0.779
Observations	461	457	456	459
Panel 2				
1Y Multiplier (2SLS)	1.505**	2.086***	1.326**	0.128
	(0.760)	(0.638)	(0.548)	(0.783)
R-squared	0.796	0.6286	0.643	0.7333
Observations	427	426	425	428

Source: Author's calculations.

Note: Standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. The table indicates that, using the 2SLS method, a 1 percent of GDP increase in ESI disbursements increases GDP, contemporaneously, by 1.332 percent on average.

XIII. APPENDIX D - THE BUCKET APPROACH OF BATINI, EYRAUD AND WEBER (2014)

In this section we describe the methodology of Batini, Eyraud and Weber (2014) and illustrate an application for the case of Slovenia. This approach represents an important contribution that can help inform policymakers, especially in those situations where there might be limits concerning data availability, or as a first diagnostic step before running more formal models.

In practice, the methodology consists in bunching countries into three groups that are likely to have similar multipliers based on their characteristics. The choices of characteristics and the calculation of their importance for fiscal multipliers is based on findings from the extensive literature on fiscal multipliers and on how these characteristics have been found to affect fiscal multipliers.

For Slovenia, the size of the fiscal multiplier can be inferred by noting a set of structural and conjunctural features of the Slovenian economy. In practice the implementation of the bucket approach consists of two steps:

a) assigning a value of 1 if a characteristic generally perceived as associated with a large multiplier is satisfied, and zero otherwise.
b) Summing up the scores found in a) above in order to determine the level of the first-year multiplier (low, medium, high) in normal times ("normal times" multiplier)

The structural characteristics that are generally associated with a large multiplier are:

a) Low trade openness, as measured by the ratio of the sum of exports and imports to GDP.
   Slovenia has a high degree trade openness, with an average ratio of total trade to GDP equal to approximately 1.54 during the years going from 2015 to 2019. Since this value is above a threshold of approx. 0.59, the score is set to 0. [42]

b) Small automatic stabilizers, as measured by the ratio of public spending to nominal GDP.
   Slovenia has a high level of public spending to GDP, with a ratio equal to an average of 0.45 of GDP, over the period going from 2014 to 2018. Since this value is above a threshold of approximately 0.34 of GDP, the score is set to 0. [43]

c) Fixed or Quasi-fixed Exchange rate regime as defined by the Annual Report on Exchange Rate arrangement (AREAER)
   Since Slovenia is a member of the Eurozone, the score is set equal to 1.

[42] The threshold corresponds to the weighted average of the sum of imports and exports to GDP computed across AEs, EMEs and LICs between 2015 and 2019.
[43] The threshold corresponds to the weighted average of public spending to GDP computed across AEs, EMEs and LICs between 2014 and 2018.

d) High Degree of labor market rigidity: the degree of labor market rigidity is computed using the labor market efficiency indicator, as measured by the World Competitiveness Report.
Slovenia's labor market, despite significant progress in recent years, is still considered to be less flexible than the world median, as of 2017; the score is therefore set to 1.

e) Low level of public debt as measured by the country's gross government debt to GDP ratio.
Slovenia' gross government debt was equal to 66 percent of GDP in 2019. For Advanced Economies a level below 100 percent of GDP is generally considered safe by financial markets (i.e., with a relatively low risk premium; see Ardagna, Caselli and Lane (2007) and Conway and Orr (2002)); the score is therefore set to 1.

f) Effective public expenditure management and revenue administration.
Even though IMF (2019) highlights that Slovenia's labor tax system contains distortions and inefficiencies and that "improving the revenue mix could better support growth", and that Slovenia "has strong potentials to raise revenues more efficiently" and should embark in "growth-enhancing tax reform" we think that Slovenia, has an effective public expenditure management and revenue administration, when compared to all other countries. Based on this assessment the score is set at 1.[44]

Depending on the total score it is then possible to assign a first year "normal times" multiplier range: A country with a total score of 0 to 3 is assumed to have a "low" multiplier, one with a total score of 3 or 4 is considered to have a medium multiplier and one with a total score of 4 to 6 is considered to have a large multiplier. For each multiplier Table 14 below establishes a range of values. Notice that in case of a total score of 3 and 4, the overlap allows the use of judgement. According to the above discussion Slovenia total score is equal to 4 (see Table 15)**.**

Table16: Buckets Ranges

Country Category	Multiplier Range
Low Multiplier	0.1–0.3
Medium Multiplier	0.4–0.6
High Multiplier	0.7–1.0

Source: Batini, Eyraud and Weber (2014).
Notes: When a country is assessed to be in the bucket "Low Multiplier", Batini et al. (2014) recommend choosing a multiplier in the range 0.1-0.3, in normal times (see below on how to adjust according to position in the business cycle and to monetary policy space).

[44] Unfortunately, Slovenia is not included in the Public Expenditure and Financial Accountability (PEFA) program, which is the standard source to measure a country's relative performance in effective public expenditure management and revenue administration. Therefore, our choice to assign a score of 1 is based on judgment and feedback from country desk economists.

Table17: Slovenia Scores Based on Structural Characteristics

Structural	Value
Degree of trade openness	0
Size of automatic stabilizers	0
Exchange rate regime	1
Degree of labor market rigidity	1
Level of public debt	1
Effective expenditure/revenue management	1

Source: author's calculations.

Notes: The Table shows the score assigned to Slovenia for each characteristic.

Starting with a total score of 4, which suggests either a medium or high "normal times" fiscal multiplier, a further adjustment is carried by integrating information on conjunctural characteristics of the domestic economy.

a) *Adjusting for the Business Cycle Phase:* because an economy at the lowest point of the cycle is more receptive to fiscal policy, Batini, Eyraud and Weber (2014) recommend increasing the range by 60 percent (both upper and lower bounds); similarly, because an economy at the peak of the cycle is less receptive to fiscal policy, the computed range should be decreased by 40 percent (both upper and lower bounds). In all other cases interpolation can be used in order to adjust the range.
In 2019, Slovenia experienced a moderate positive output gap (1.8 percent of potential GDP); putting this in historical context Slovenia experienced a positive output gap peak equal to 7.6 percent in 2008; by interpolation, this suggests shrinking the range of the fiscal multiplier by approximately 9 percent on both bounds.

b) *Adjusting for the Monetary Policy Stance:* When monetary policy is at the effective lower bound and is fully constrained, the range should be increased by 30 percent. Otherwise, if constraints arise from other policy considerations, interpolate.
Since Slovenia is part of the Euro Area, the range is adjusted by increasing the range by 30 percent on both bounds

The final multiplier for Slovenia is then given by applying the following formula to each bound of the "normal times" multiplier found above:

$$M = M_{NT} \times (1 + Cycle) \times (1 + Mon)$$

Where M is the final multiplier, M_{NT} is the "normal times" multiplier, $Cycle$ is the cyclical factor and Mon is the monetary policy factor. The application of the above formula gives $M_{medium} = [0.47, 0.71]$ for the case of a medium multiplier and $M_{high} = [0.83, 1.18]$ for the case of a high multiplier.

How would the above multiplier change if we were to account for the current economic contraction associated with the COVID-19 pandemic? As highlighted in the April 2021 IMF World

Economic Outlook, Slovenia experienced a 5.5 percent decline in GDP during 2020. We therefore apply the most stringent condition of the bucket approach and assume that the economy is at the lowest point in the cycle;[45] then $M_{medium}^{Covid} = [0.83, 1.25]$ for the case of a medium multiplier and $M_{high}^{covid} = [1.46, 2.08]$ for the case of a high multiplier.

The wide range of the final fiscal multiplier allows policymakers to include judgments based on both priors and economic theory; considerations that need to be taken into account include the size of the economy that is controlled by the government versus the private sector and the credibility of the fiscal program.

Even though the bucket-approach offers a quick and easy methodology to infer the size of the multiplier it is better suited for countries that do not have enough data to estimate multipliers statistically. Also, it is a sort of an average estimate for countries exhibiting the requisite characteristics and there is likely a lot of heterogeneity within these groups.

[45] This additional exercise is performed with the caveat that the current contraction is unique in the magnitude and characteristics of the supply shock; as discussed in Guerrieri, Lorenzoni and Straub (2020), in the current crisis, standard fiscal stimulus can be less effective than usual because some sectors of the economy are shut down, which mutes the Keynesian multiplier.