Stimulating Avenues: EIB Loans and Returns to Public Investment

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Abstract

We study the macroeconomic effects of public investment news shocks using a local-projection instrumental-variables framework and European data. To identify news, we exploit European Investment Bank loans for public infrastructure projects and address potential endogeneity in loan approval with an inverse-probability-weighted regression-adjustment estimator. Public investment news shocks raise employment and output, and to a lesser extent private investment, in the medium term, without generating inflation, increasing the debt burden, or crowding out consumption. The cumulative output multiplier reaches 3.38 after five years and is significant and larger when credit conditions are favorable. Using long data for Spain, we show that, absent narrative information, shocks identified through maximum forecast-error restrictions yield similar multipliers.

JEL: E62, H41, H54

Keywords: local projections, instrumental variables, multipliers, infrastructure, government investment, maximum forecast error variance restrictions.

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1 Introduction

Public investment is a key driver of infrastructure development, and policymakers increasingly use it to stimulate economic growth and mitigate cyclical downturns. Recent policy initiatives in Europe underscore the need to scale up infrastructure spending. The Draghi (2024) report on EU competitiveness calls for significantly higher investments in innovation, infrastructure, and green technology. It estimates that roughly 800 € billion additional investment per year is needed to keep Europe competitive. In parallel, Germany has announced a 500 € billion infrastructure fund over twelve years to modernize networks and advance the green transition. Besides this progress in the policy arena, most existing studies find only modest short-run effects of public infrastructure investment and, at best, moderate medium-term impacts (See Ramey (2020)).

Our paper revisits this conventional view. Unlike most prior research, which focuses primarily on the United States or annual data from OECD economies, we analyze quarterly European data and uncover sizeable medium-term effects of public investment. To identify exogenous variation, we exploit European Investment Bank (EIB) loans for infrastructure projects granted to public firms and government entities, employing a local projection instrumental variables (LP-IV) framework to estimate the dynamic effects of public investment shocks.

Using a probit model, we show that the variation in the EIB loan treatment variable is predictable: the likelihood of receiving a loan increases with higher public debt-to-GDP ratios and productivity growth, EU accession, lower trade openness, and higher share in the EIB's subscribed capital. To address potential endogeneity in loan approvals, we apply the Inverse-Probability-Weighted Regression-Adjustment (IPWRA) estimator proposed by Jordà and Taylor (2016). This doubly robust procedure corrects for selection bias by reweighting observations according to their estimated probability of treatment and including relevant controls correlated with both loan approvals and outcomes, improving the credibility of our causal estimates.

Our results show that EIB loans provide a valid and powerful instrument for identifying changes in public investment, generating persistent and sizable increases in this spending component. The resulting public investment news shocks boost medium-term output and employment, and to a lesser extent private investment, without creating inflationary pressures. Employment rises markedly in the medium term, while unemployment and real wages remain largely unchanged, indicating a labor-supply shift similar to that documented by Brückner and Pappa (2012) for government spending shocks. Productivity gains emerge with a delay and are sometimes statistically weak, reflecting the strong employment response. Importantly, the debt-to-GDP ratio does not rise, private consumption remains stable, and stock prices increase, consistent with a news-driven shock.

Because the shock is anticipated, output multipliers are statistically insignificant in the first year. They increase steadily over time, becoming significant thereafter and exceeding one after one year, driven primarily by delayed employment responses and, to a lesser extent, private investment. The insignificant short-run multipliers we obtain reflect the news nature of the shock: EIB announcements convey information about spending increases that materialize gradually reaching their pick about three years after the news shock. After five years, the cumulative output multiplier of public investment reaches approximately three, a magnitude considerably larger than most estimates reported in the existing literature.

Unlike government consumption, public infrastructure investment is inherently productive and operates through an additional mechanism: the supply-news channel (Huidrom et al., 2020). Higher public investment signals future productivity gains, offsetting contractionary Ricardian and interest-rate effects, especially in fiscally constrained economies. These expectations ease financial constraints and amplify the stimulus. We find that investment multipliers are larger during favorable financial conditions, when firms can respond more readily to positive news. By contrast, the business-cycle phase emphasized by Alloza (2022); Auerbach and Gorodnichenko (2012); Berge et al. (2021); Ghassibe and Zanetti (2022), do not materially affect investment-specific multipliers, consistent with results for government consumption (Caggiano et al., 2015; Corsetti et al., 2012; Owyang et al., 2013; Ramey and Zubairy, 2018).

Prior studies using alternative identification strategies often find low, insignificant, or even negative short-run effects of public investment on output and employment (e.g., Ilzetzki et al., 2013; Pereira and De Frutos, 1999). Related work reports that short-run multipliers for public investment are smaller than those for government consumption (Boehm, 2020), and that highway spending can even be counterproductive as a short-run stimulus (Leduc and Wilson, 2014; Ramey, 2020). Leeper et al. (2010) provide a theoretical justification for such findings by showing that implementation lags in public capital formation can generate negative short-run output responses. Medium-run estimates in the literature are also generally below those we obtain. Fernald (1999), studying the U.S. interstate highway system, finds that road investments were not unusually productive and yielded low output multipliers. Similarly, Wilson (2012), examining infrastructure spending under the American Recovery and Reinvestment Act, estimates multipliers below two and documents a positive but modest employment response after one year. Acconcia et al. (2014) report multipliers between 1.5

and 1.9 using variation from construction slowdowns induced by Mafia interference in Italy. Our estimates are consistent with the broader evidence in Jovanovic (2017), who show that cuts in government investment during fiscal consolidation had substantially larger adverse effects on subsequent output growth than equivalent reductions in government consumption.

Several factors may explain the relatively high multipliers we obtain. First, the shocks we identify are supply-driven "news" shocks, which generate persistent productivity gains and long-term growth effects. Consistent with this mechanism, Kanazawa (2021), who extracts public investment news from excess returns of narrowly defined road-pavement firms in Japan, also finds persistent and significant effects, with cumulative multipliers reaching six after four years. Second, because monetary policy in the euro area is centralized, national public investment shocks are unlikely to elicit offsetting interest-rate responses. Third, financing matters: reliance on external funding limits domestic crowding-out and strengthens the expansionary effects of investment (Priftis and Zimic, 2021). The high persistence of the shocks we identify further contributes to the large multipliers. Finally, the labor-supply shift induced by the public investment news shock, allowing employment to expand without raising unit labor costs, also helps explain the sizable medium-term multipliers we estimate.

To further relate our findings with existing estimates, we analyze the importance of identification for drawing reliable conclusions about the effects of government investment shocks. First, we show that the standard Cholesky identification of Blanchard and Perotti (2002) recovers shocks that are unanticipated and temporary that do not induce positive shifts in the labor supply and crowd out private investment. In contrast, using long quarterly data for Spain and imposing restrictions that maximize the share of the forecast error variance (MFEV) of public investment within a VAR framework improves identification and produces multipliers similar to those obtained when using EIB loans as instruments for news in public investment. However, the inherent endogeneity of public investment data continues to pose important limitations to this SVAR identification based approach.

The rest of the paper is structured as follows. Section 2 describes the aggregate data and the European Investment Bank loan dataset, provides summary statistics, and examines the predictability of EIB loans. Section 3 explains the econometric approach for estimating the effects of government investment shocks, and Section 4 reports the estimated probabilities of receiving loans, presents the baseline findings, explores nonlinearities across economic conditions and reports robustness checks. Section 5 compares our identified shocks with those derived from alternative structural methods. Section 6 concludes. The appendix includes further data details and supplementary analyses.

2 Data

2.1 Macroeconomic Variables

Our dataset comprises quarterly observations for the period 1995Q1–2020Q1. National accounts variables for all 27 EU member states are obtained from Eurostat and include: GDP, private consumption, disaggregated components of public expenditure, gross fixed capital formation, employment, unemployment, real wages and total exports and imports. We also measure private investment as total gross fixed capital formation minus gross fixed public capital formation. All series are in real values, seasonally adjusted, and expressed in logarithmic levels. From the same source, we also collect quarterly data on public debt and the consumer price index (CPI), and yearly data for the total length of motorways. Stock market indices are obtained from the OECD, with data for Cyprus and Malta sourced from national statistical releases and other official publications. Interest rates are retrieved from the ECB's statistical database. The Global Financial Cycle index, capturing the common component in risky asset prices, capital flows, and leverage across countries, is taken from Miranda-Agrippino and Rey (2020).

We compare the results of our identification approach to those of standard approaches using a long Spanish quarterly dataset (1980Q1–2020Q1). The extended time series facilitates constructing VAR shocks that maximize the forecast-error variance (MFEV) of public investment. We use the historical dataset provided by Alloza et al. (2019) to assemble extended national accounts, public debt, and the GDP deflator, and obtain historical series for employment, stock prices, and interest rates from FRED. Appendix A.1 provides detailed descriptions of all variables, their definitions, and data sources, together with summary statistics.

2.2 EIB Project Financing Data

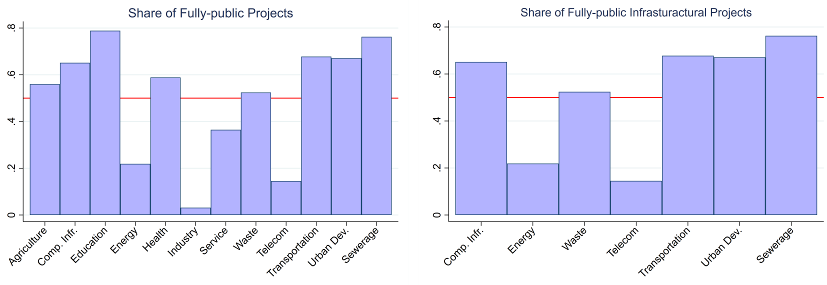
The European Investment Bank (EIB) is the long-term financing institution of the European Union. Owned by the 27 EU member states, it is one of the world's largest multilateral financial institutions. The EIB's mandate is to implement EU policy objectives by funding sustainable investment projects in areas such as climate and the environment, infrastructure, innovation and digitalization, and small and medium-sized enterprises (SMEs). In practice, the EIB provides loans that typically cover up to 50% of project costs within the EU, with minimum project sizes of about 25 € million. It also offers guarantees, equity investments, and advisory services (European Investment Bank, 2025). In 2019, for example, the EIB signed new contracts totaling 63.2 € billion, of which 55.3 € billion were within the EU and 7.9 € billion outside the EU (European Investment Bank, 2020).

Each EIB-financed project proceeds through seven stages: (1) proposal preparation by a public or private promoter, including detailed descriptions of capital investment and financing plans; (2) appraisal by the EIB, which involves a comprehensive assessment of financial, economic, social, environmental, and technical aspects, including cost–benefit analysis, cash-flow projections, profitability, and borrower creditworthiness; (3) approval by the EIB Board; (4) contract signature; (5) disbursement of funds; (6) monitoring during implementation and operation; and (7) loan repayment by the borrower.

The EIB publicly discloses project-level information, including the signature date, financing amount, project title, financing status, sector of activity, and country. Loans are classified into 13 sectors: agriculture, composite infrastructure, credit lines (mainly to SMEs), education, energy, health, industry, services, solid waste, telecommunications, transportation, urban development, and water sewerage. Due to macroeconomic data availability, we focus on loans granted between 1995 and 2020 [1] to EU-27 countries, covering a total of 12,342 projects. For each country, we aggregate the total loan value at the quarterly frequency and exclude canceled projects and credit lines, as these do not constitute public investment and are typically directed toward small and medium-sized enterprises rather than public entities. A detailed description of the data, their sectoral and regional composition, and summary statistics of the quarterly aggregates are provided in Appendix A.2.

For our empirical analysis, we restrict attention to loans allocated to infrastructure-related sectors, as these can be clearly classified as public investment. According to the EIB Statistical Report (European Investment Bank, 2020), these sectors include composite infrastructure, energy, solid waste, telecommunications, transportation, urban development, and water sewerage. Although financing is extended to both public and private promoters, the EIB does not disclose the exact public–private composition of each project. However, the data identify projects in which the public share of beneficiaries exceeds 90% that we term as "fully public" projects. Figure 1 reports the proportion of such projects relative to total financed projects, both overall and within infrastructure sectors. As shown in Panel b of Figure 1, the share of fully public projects in the energy and telecommunications sectors is below 20%, whereas in other infrastructure sectors it averages above 60%. This pattern suggests that roughly two-thirds of loans in these sectors are directed to fully public projects, with the remainder involving lower public participation. Since we are looking for a good

[1] The EIB loan data cover 1959–2025. We restrict the baseline sample to 1995–2020 due to macroeconomic data availability and to focus on the pre-COVID period, thereby avoiding contamination from the exceptional fiscal interventions of 2020–2021. Results including the post-COVID years are reported in the Appendix.



(a) all sectors **(b)** infrastructural sectors

Figure 1: Share of fully public projects in each sector (average for 1995Q1-2020Q1). Public projects are defined as those with at least a 90% public beneficiary share.

instrument for public investment, the main analysis is restricted to these sectors. Between 1995 and 2020, the EIB allocated 3,801 loans to projects in these categories. As a robustness check, we extend the sample to include energy and telecommunications and verify that excluding them does not materially affect the results.

To merge the infrastructure project financing data with country-level national accounts and other macroeconomic indicators, we construct a quarterly series by summing all infrastructure-related loans received by each country in a given quarter over the period 1995Q1–2020Q1. Table 1 reports descriptive statistics for this series. On average, EU member states received 146.4 € million per quarter (s.d. 295.9 million €), with the largest quarterly inflow amounting to 3,103.6 € million. When expressed as a share of total public investment, these loans account on average for 6.6 percent (s.d. 18.9 percent), reaching a peak of 373.2 percent in Romania in 1999Q4 [2].

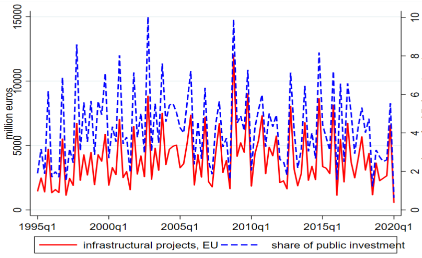
	Mean	SD	Min	Max	N
Infrastructural Projects (million euros)	146.4	295.9	0	3103.6	2703
Infrastructural to Public Investment (%)	6.6	18.9	0	373.2	2359

Table 1: Summary statistics for the aggregated quarterly infrastructure projects, 1995Q1-2020Q1

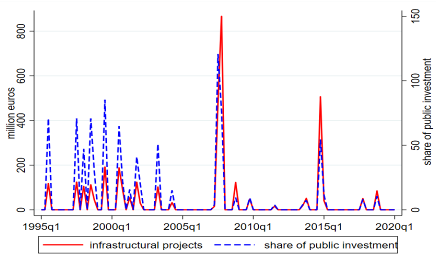
Figure 2 plots the evolution of the aggregate volume of infrastructure loans and their share in public investment for the EU-27, as well as for three illustrative cases: Bulgaria, Denmark, and Spain. Cross-country and time variation in these measures is further illustrated in Figures A.1 to A.3 in the Appendix, which include heatmaps for the sample period we consider of the total loan volume and the corresponding share in public investment. All figures confirm substantial variation in EIB loan volumes over time and across countries. Larger economies receive higher volumes, an expected level difference absorbed by country fixed effects in all our regressions. In the subsequent analysis, we use the constructed series

[2] To ensure that our results are not unduly influenced by outliers, we exclude the top one percent of the infrastructure loans to public investment distribution from the sample.

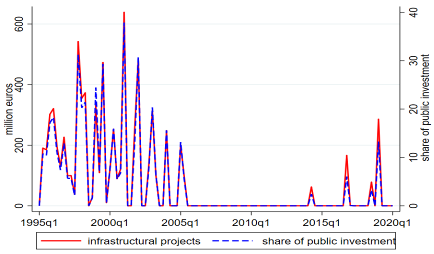
as an instrument to identify exogenous changes in government investment across the EU countries in our sample.



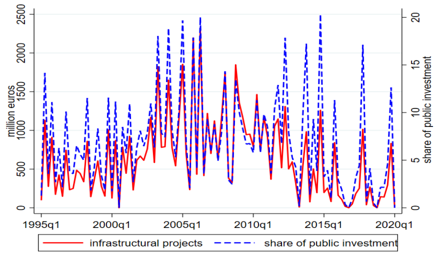
(a) EU



(b) Bulgaria



(c) Denmark



(d) Spain

Figure 2: EIB-financed infrastructure projects and their contribution to public investment for the EU27 and for three illustrative countries: Bulgaria, Denmark, and Spain. The solid red line plots the total value of EIB infrastructure loans each quarter (left axis), while the dashed blue line shows their share in total public investment (right axis).

2.3 Predicting the EIB Loan Allocation

Examining the average allocation of EIB loans across EU countries (Table A.3 in the Appendix) reveals that EIB lending is far from random. Between January 1995 and March 2020, approximately 55% of total loans were allocated to France, Germany, Spain, and Italy. However, as shown in Figure A.2 in the Appendix, relative to total investment, larger loan shares were directed toward peripheral and newer EU member states, including Bulgaria, Hungary, Slovenia, Cyprus, Croatia, and Greece. Since EIB project selection is carried out by specialized financial and engineering teams, it is plausible that certain macroeconomic or structural factors systematically influence loan allocation decisions.

Table 2 reports the results of pooled probit regressions that test whether variables such as the debt-to-GDP ratio, trade openness, GDP growth, EU accession status, previous EIB loans, a country's EIB capital share, stock market growth, infrastructure endowment (measured by motorway intensity), and labor productivity growth predict the probability of receiving a new loan at time $t + 1$.

The results indicate that countries with higher public debt-to-GDP, faster productivity growth, larger EIB capital shares, and EU accession are more likely to receive subsequent

	(1)	(2)	(3)	(4)
Macroeconomic conditions				
Debt to GDP	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Openness	-0.191***	-0.120***	-0.202***	-0.100***
	(0.015)	(0.016)	(0.020)	(0.022)
GDP growth	0.045	0.273	-0.815	-0.674
	(0.652)	(0.658)	(0.930)	(0.938)
Accession to EU	0.314***	0.213***	0.331***	0.218***
	(0.030)	(0.031)	(0.032)	(0.033)
Financial / institutional factors				
Receiving a loan at t	0.115***	0.066***	0.087***	0.046**
	(0.020)	(0.020)	(0.021)	(0.021)
EIB capital share		0.022***		0.021***
		(0.002)		(0.002)
Stock market growth		-0.050		-0.071
		(0.085)		(0.089)
Infrastructure / productivity				
Motorway intensity			0.001*	-0.000
			(0.001)	(0.001)
Productivity growth			1.289*	1.449**
			(0.747)	(0.723)
Observations	2207	2176	1982	1952
Model AUC	0.781	0.799	0.773	0.790

Table 2: Pooled probit estimates of receiving an EIB loan at time t+1

EIB loans, whereas greater trade openness—defined as the ratio of total exports plus imports to GDP—is associated with a lower likelihood. The predictive performance of the model is assessed using the Area Under the Receiver Operating Characteristic Curve (AUC). The AUC statistics, reported in the last row of Table 2, demonstrate strong predictive performance for the probit models.

3 Empirical Analysis

We examine the dynamic effects of public investment news shocks—proxied by European Investment Bank (EIB) infrastructure loan contracts—on real GDP, private investment, consumption, labor market outcomes, productivity, public debt, inflation, and stock prices across 27 EU economies. The analysis employs the instrumental-variable local projections (IV-LP) method of Jordà (2005), using the longest available quarterly panel of aggregated data from 1995Q1 to 2020Q1,[3] excluding the post-pandemic period. For each outcome

[3]Quarterly national accounts are available for most countries from 1995, with exceptions (Italy and the Netherlands (1996) and Malta (2000)). For most countries in our sample, government gross fixed capital formation data begins in 1999, with the first available year varying in a few cases (1999–2002). Exceptions are Belgium, Cyprus, France, Romania, Spain, and Sweden, for which quarterly public investment data are available from 1995.

variable and forecast horizon $h \geq 0$, we estimate the following specification:

$$y_{i,t+h} - y_{i,t-1} = \alpha_{i,h} + \gamma_{t,h} + \beta_h \hat{I}^g_{i,t} + \sum_{k=1}^{2} \Theta_{k,h} \mathrm{X}_{i,t-k} + \varepsilon_{i,t+h}, \quad h = 0, 1, 2, ... \tag{1}$$

Here, $y_{i,t+h}$ denotes the logarithm of the variable of interest for country i at horizon h, so that $y_{i,t+h} - y_{i,t-1}$ measures its cumulative growth over h periods. The terms $\alpha_{i,h}$ and $\gamma_{t,h}$ represent country and time fixed effects, respectively. The variable $\hat{I}^g_{i,t}$ corresponds to public investment instrumented with the constructed series of EIB infrastructure logged loan values. The vector $\mathbf{X}_{i,t}$ contains control variables, including two lags of GDP, public investment, total public expenditure, inflation, EIB infrastructure loans, and lags of the dependent variable (when distinct from the other controls). All series are expressed in logarithms, except unemployment rate and inflation, which is measured as the annual percentage change in the CPI. The coefficient β_h traces the dynamic response of each macroeconomic variable $y_{i,t}$ to a one-percent innovation in EIB-financed public investment. Standard errors are robust to both heteroskedasticity and serial correlation.

Given the results in Section 2.3, we adopt the Augmented Inverse Propensity-Score Weighted (AIPW) estimator to account for predictable components in treatment assignment, following the recommendations of Jordà and Taylor (2016). Specifically, we estimate the effect of EIB-financed public infrastructure investment on macroeconomic outcomes using weighted regressions, where the weights correspond to the inverse probability of receiving an EIB loan by country i in quarter t. The propensity scores are estimated using a saturated probit model that includes the control variables from equation (1), along with two lags of the public debt-to-GDP ratio, productivity growth, trade openness, a dummy variable for each country's EU accession date and countries' EIB capital share.

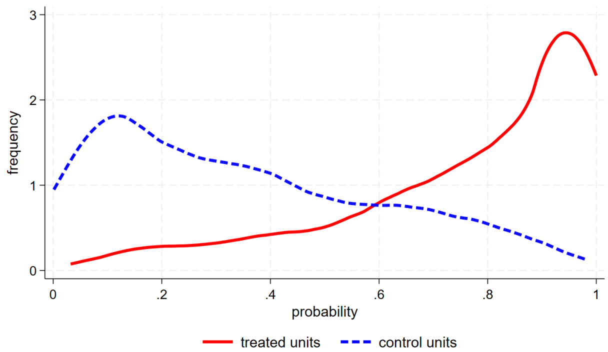


Figure 3: Distribution of the propensity score for control and treated units. The probabilities correspond to the likelihood of receiving an EIB loan in a given quarter, estimated using a saturated probit model that includes all control variables from equation 1, as well as the public debt-to-GDP ratio, economic openness, country share in EIB capital, productivity growth, and an EU accession dummy.

Figure 3 displays kernel density estimates of the propensity score distributions for treated and control observations, showing considerable overlap between the two groups.[4] The overlap indicates that both treated and untreated country–quarters share comparable observable characteristics, ensuring adequate common support for the weighting procedure. In other words, no subset of control observations is entirely unmatched to the treated ones in terms of their predicted probability of receiving an EIB loan. This overlap strengthens the credibility of the AIPW estimator, as it suggests that the reweighted sample effectively balances observable characteristics between treated and untreated groups, reducing bias in the estimated dynamic effects of EIB-financed public investment.

4 Results

4.1 Macroeconomic responses to a public investment shock

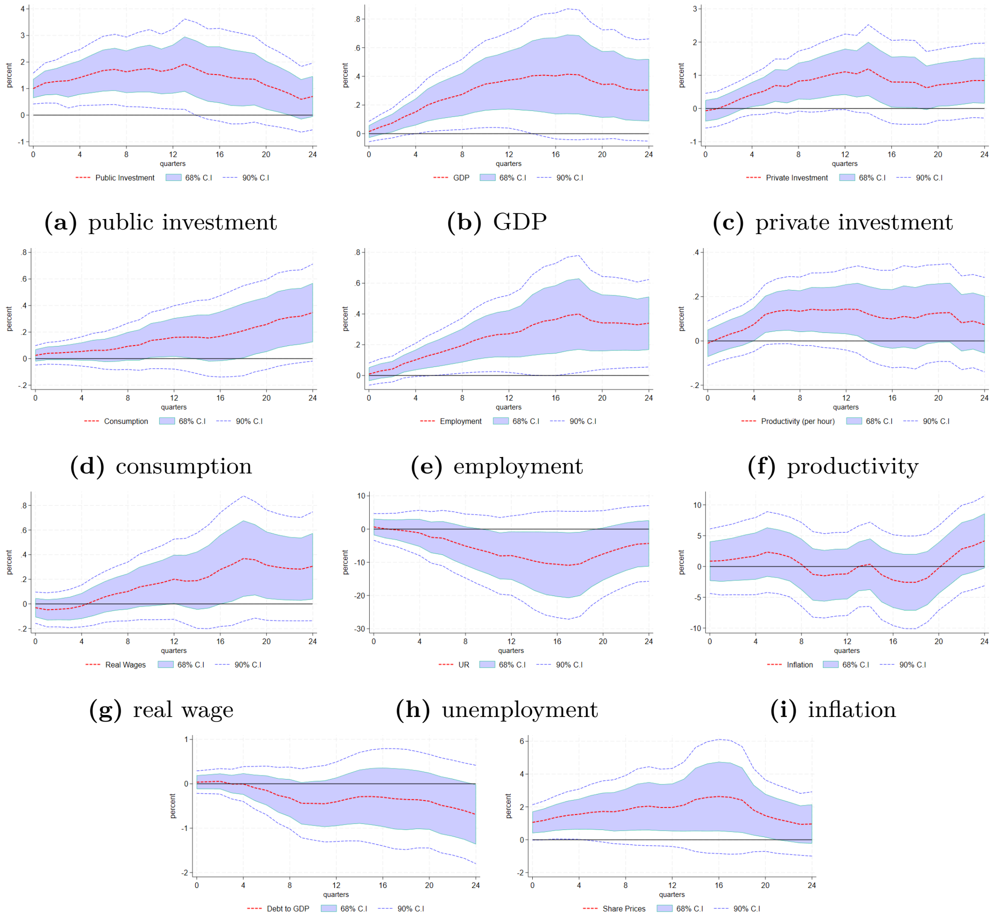
Figure 4 plots the estimated coefficients β_h from equation (1), along with 68% and 90% confidence intervals, for a range of macroeconomic variables. Panel (a) shows the response of public investment to EIB-financed infrastructure projects. Because the loan data capture the timing of financing announcements, while actual disbursements unfold gradually over several quarters, the response displays a hump-shaped pattern: the effect builds over time, peaks at roughly 2% after three years, and then gradually returns toward zero. This pattern indicates that EIB-financed projects generate a sustained and statistically significant increase in public investment and that the recovered shocks can be interpreted as news about future investment [5]. Consistent with this interpretation, Panel (k) shows a positive and immediate response of stock market performance: share prices rise by about 0.9% on impact and remain elevated throughout the estimation horizon.

Real GDP (Panel b) responds positively and persistently to a one-percent increase in public investment. While the immediate response is close to zero, it becomes positive and statistically significant after approximately three quarters, reaching a peak of about 0.4% after five years. The cumulative effect on output therefore builds gradually over time and is both economically and statistically significant in the medium term.

The response of private investment (Panel c) is slightly negative in the first two quarters but turns positive after about one year, peaking at roughly 1% three years after the shock.

[4] Because some observations exhibit propensity scores close to zero, we truncate probabilities to the [0.05, 0.95] range, which yields weights as high as 20. Following Jordà and Taylor (2016), this truncation has minimal impact on the AIPW estimates.

[5] EIB loans exhibit no persistence, and the associated shocks dissipate very quickly, as shown in Appendix Figure B.1.



(a) public investment **(b)** GDP **(c)** private investment

(d) consumption **(e)** employment **(f)** productivity

(g) real wage **(h)** unemployment **(i)** inflation

(j) debt-to-GDP **(k)** stock prices

Figure 4: Effect of a one percent increase in public investment, instrumented with EIB-financed infrastructure loans, on various macroeconomic variables. Each panel plots the estimated β_h from equation (1), with 68% (shaded) and 90% (dashed) confidence intervals. The estimation uses an unbalanced panel of EU countries, 1995Q1–2020Q1. Response functions are smoothed using a centered moving average.

This pattern is consistent with a crowding-in effect rather than displacement.[6] Real private consumption also rises persistently, following the increase in real GDP (Panel d). The cumulative response to a one-percent increase in public investment reaches about 0.4% after five years, comparable in magnitude to the GDP response, although statistical significance is weaker.

The dynamic response of employment in Panel (e) closely mirrors that of private investment, but is more precisely estimated, with a peak increase of about 0.4% after roughly four years. Productivity (Panel f), measured as output per hour worked, rises modestly in the medium term—peaking around 0.1%, although confidence intervals widen as employment and output dynamics interact.

[6] The figure reports a five-quarter centered moving average of the estimated coefficients to present smoother impulse response functions (IRFs). The unsmoothed IRFs are shown in Figure B.2 in the Appendix, where the short-run negative response of private investment and employment is more visible.

To better understand the employment response, Panels (g) and (h) plot the responses of real wages and unemployment. If the public investment news shock operated solely through labor demand, we would expect real wages to rise and unemployment to fall significantly. Instead, real wages show little reaction at any horizon, and unemployment remains statistically unchanged, despite the increase in employment. This pattern implies that the employment expansion reflects movements in both labor demand and labor supply. In the absence of quarterly participation data, the flat unemployment response, combined with rising employment, suggests an increase in labor force participation, consistent with the labor-supply shifts documented by Brückner and Pappa (2012) for broader government spending shocks.

Moreover, public infrastructure loans do not generate inflationary pressures or raise debt-sustainability concerns. CPI inflation remains statistically indistinguishable from zero at all horizons (Panel (i)), likely reflecting the combination of only mild real wage increases and productivity gains, which provide supply-side offsets to any initial demand impulse. The public debt-to-GDP ratio also remains broadly stable (Panel (j)); if anything, faster GDP growth works to reduce the ratio over time, although the effect is not statistically significant.

Overall, the evidence shows that public investment news shocks generate sizable and persistent medium-run increases in output and employment, with peak effects emerging several years after the initial shock, while neither raising inflation nor creating fiscal pressures.

4.2 Public Investment Ouptut Multiplier

A key metric in macroeconomic analysis is the public investment multiplier, defined as the dollar increase in GDP generated by an additional dollar of government investment. A straightforward way to compute it is to take the ratio of the cumulative GDP response to the cumulative public investment response in Figure 4 at each horizon h. Alternatively, following Ramey and Zubairy (2018), the multiplier can be estimated by regressing cumulative GDP on cumulative public investment, instrumenting the latter with exogenous EIB loan shocks. We adopt this approach and estimate the following local-projection specification:

$$\sum_{j=0}^{h} y_{i,t+j} = \alpha_{i,h} + \gamma_{t,h} + \beta_h^m \sum_{j=0}^{h} \hat{I}^g_{i,t+j} + \sum_{k=1}^{2} \Theta_{k,h} \mathrm{X}_{i,t-k} + \varepsilon_{i,t+h}, \quad h = 0, 1, 2, ... \tag{2}$$

To estimate (2), we proceed in two steps as before: First, we estimate $\sum_{j=0}^{h} \hat{I}^g_{i,t+j}$ using EIB loans for public infrastructural projects, conditioning on the same set of control variables included in vector $\mathbf{X}_{i,t}$. In the second step, we use the fitted value to estimate equation (2). Because both output and public investment enter in logs, coefficient β_h^m then measures

	Horizon			
	t=0	1-year	3-years	5-years
Output Elasticity	**0.00**	**0.04**	**0.11*** **	**0.12** **
	(0.03)	(0.03)	(0.04)	(0.06)
Output Multiplier	**0.02**	**1.14**	**3.13*** **	**3.38** **
	(0.93)	(0.91)	(1.20)	(1.74)
Private Investment Elasticity	**−0.57***	**0.04**	**0.18**	**0.24**
	(0.28)	(0.18)	(0.17)	(0.19)
Private Investment Multiplier	**-3.17***	**0.25**	**0.99**	**1.36**
	(1.56)	(1.03)	(0.92)	(1.05)
Employment Elasticity	**-0.05**	**0.03**	**0.10*** **	**0.14*** **
	(0.04)	(0.03)	(0.04)	(0.05)
Employment Multiplier	**-0.09**	**0.06**	**0.21*** **	**0.27*** **
	(0.07)	(0.06)	(0.08)	(0.09)
Productivity Elasticity	**0.04**	**0.002**	**0.04**	**0.05**
	(0.06)	(0.04)	(0.04)	(0.05)
Productivity Multiplier	**0.0009**	**0.000**	**0.0009**	**0.0011**
	(0.0011)	(0.0008)	(0.0010)	(0.0013)

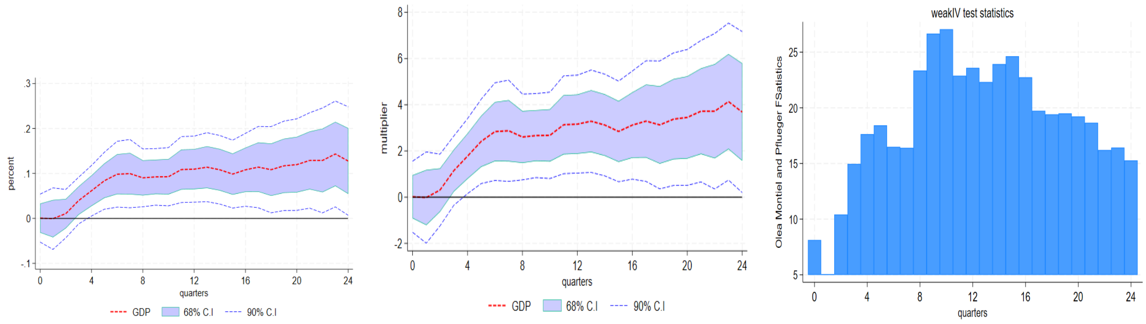
Table 3: Cumulative effect of public infrastructure on different variables and at different horizons, estimated from equation (2). Standard errors in parentheses. Estimates are based on an unbalanced panel of EU countries, 1995Q1–2020Q1. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the cumulative elasticity of output with respect to public investment at each horizon h. We transform elasticities into multipliers by multiplying the estimated β_h^m by the sample average ratio of GDP to public investment.

The first two rows of Table 3 and Figure 5 report the cumulative elasticities and corresponding output multipliers at different horizons h. The impact effect on output is zero but increases over time. After three years, the cumulative elasticity is 0.11 and statistically significant and 0.12 after five years. This implies that a 1% increase in public investment raises GDP by about 0.12% after five years. Converting these elasticities into multipliers yields statistically significant three- and five-year public investment multipliers of 3.13 and 3.38, respectively.

4.3 Instrument Quality

The first-stage regression confirms that EIB loan allocations are a strong and statistically significant predictor of public investment growth, with F-statistics well above conventional weak-instrument thresholds after one year (see Panel (c) of Figure 5). Those statistics support the instrument's relevance. The estimated pattern is consistent with the gradual disbursement of EIB loans and the well-documented "time-to-build" delays typically associated with public investment projects.



(a) cumulative elasticity **(b)** cumulative multiplier **(c)** F statistics

Figure 5: Public investment cumulative elasticity and multiplier at different horizons. Panel (a) plots the estimated β_h^m from equation (2), together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. Panel (b) plots the corresponding multipliers, and panel (c) reports the first-stage weak-IV test F-statistics for equation (2) as developed by Olea and Pflueger (2013). The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1.

The identification strategy assumes that EIB lending decisions are guided primarily by project-specific and technical criteria and long-term considerations and planning rather than by short-term macroeconomic conditions. This suggests that the instrument is plausibly exogenous to contemporaneous demand shocks, reinforcing the validity of using EIB loan allocations to identify exogenous variation in public investment.

4.4 Other Multipliers

The remianing rows of Table 3 (and Figure B.3 in the Appendix) reports the cumulative elasticities and multipliers for private investment, employment, and labor productivity. These estimates are obtained by estimating β_h^m in equation (2) separately for each outcome variable.

A one percent increase in public investment leads to a significant short-run decline in private investment, although the cumulative elasticity and multiplier rise to 0.24 and 1.36, respectively, after five years, while remaining statistically insignificant. Employment also declines on impact but rises significantly after three years, by 0.10 percent, and by 0.14 percent after five years, which corresponds to approximately 0.21 and 0.27 thousand additional jobs per million euros of public investment. Labor productivity, measured as output per hour worked, shows no statistically significant response at any horizon. Thus, consistent with the results in Figure 4, the medium-run output multiplier is driven primarily by the substantial increase in employment, while longer-term productivity gains are reflected in the persistent stimulus associated with public investment news shocks.

Our estimated multipliers are considerably larger than those reported in most of the existing literature. Several factors help explain this magnitude. First, the shocks we identify through European Investment Bank infrastructure loans are supply-driven news shocks, which generate persistent productivity gains and long-run growth, thereby stimulating private investment (see also Canova and Pappa (2025)). Second, national public investment shocks in the EU do not interact with domestic monetary policy, limiting crowding-out effects and amplifying fiscal responses (Klein and Winkler, 2021; Ramey and Zubairy, 2018). Third, external financing is an important mechanism: as emphasized by Broner et al. (2022) and Priftis and Zimic (2021), when the EIB covers a large share of project costs, domestic private spending is less constrained. Moreover, the high persistence of EIB-induced shocks, consistent with Dupaigne and Fève (2016) and Alloza et al. (2025), leads to larger and more durable output effects than those typically found in SVAR models identified through timing restrictions (e.g., Blanchard and Perotti, 2002). Finally, the implied rise in labor force participation we document provides an additional channel that amplifies the output multiplier.

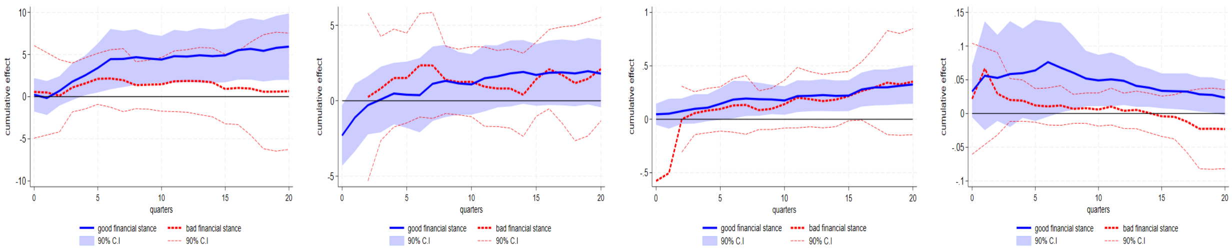
4.5 State-dependent multipliers

We next examine whether the public investment multiplier varies with the state of the economy. Specifically, we estimate the following state-dependent local projection model at different horizons h:

$$\sum_{j=0}^{h} y_{i,t+j} = \alpha_{i,h} + \gamma_{t,h} + I_{t-1}\left[\beta^{m}_{A,h}\sum_{j=0}^{h} I^{g}_{i,t+j} + \sum_{k=1}^{2}\Theta_{A,k,h}\mathrm{X}_{i,t-k}\right] + (1 - I_{t-1})\left[\beta^{m}_{B,h}\sum_{j=0}^{h} I^{g}_{i,t+j} + \sum_{k=1}^{2}\Theta_{B,k,h}\mathrm{X}_{i,t-k}\right] + \varepsilon_{i,t+h} \tag{3}$$

where I_t is a state indicator. We consider three types of state dependency and define ($I_t = 1$) when (i) global financial conditions are favorable, (ii) the EU economy is in recession, or (iii) public debt is above a high threshold, and ($I_t = 0$) otherwise. Global financial conditions are captured by the quarterly Global Financial Cycle index from Miranda-Agrippino and Rey (2020), while recession periods follow the OECD Euro Area dating (peak to trough). High-debt episodes are defined as country–quarter observations with debt-to-GDP ratios above the 50th percentile of the full sample distribution. The vector ($\mathbf{X}_{i,t}$) includes the same control variables as in equation (2). In this setup, ($\beta^{m}_{A,h}$) and ($\beta^{m}_{B,h}$) represent the public investment cumulative elasticities under the two economic states.

Appendix Figure B.4 shows that corresponding multipliers are broadly similar in recessions and expansions, consistent with U.S. evidence in Ramey and Zubairy (2018) for government consumption shocks. We also condition the estimates on the public debt-to-GDP



(a) GDP **(b)** private investment **(c)** employment **(d)** share prices

Figure 6: Public investment cumulative effect for good vs. bad financial cycles. Each panel plots the estimated $\beta_{A,h}$ and $\beta_{B,h}$ from equation (3), together with 90% confidence intervals. States are defined as explained in the text. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1. For readability, we omit wide bad-financial-cycles confidence bands at few horizons due to small sample size.

ratio by comparing countries below and above the median. Again, we find no statistically significant differences in the responses of GDP, private investment, or employment. Only share prices react more strongly in low-debt countries (Figure B.5).[7]

The only state variable that meaningfully alters the size of the multipliers is global credit conditions. As shown in Figure 6, multipliers are larger in magnitude and statistically significant when global financial conditions are favorable. This pattern is consistent with the easing of credit constraints, in line with the mechanism emphasized by Huidrom et al. (2020).

4.6 Robustness Checks

We assess the robustness of our baseline results through several complementary exercises. First, we vary the number of lags in the controls and augment the specification with additional variables, including private investment, consumption, tax rates, and stock market indices, to check for sensitivity to dynamic choices or omitted variables. The results, shown in Appendix Figures C.1 and C.2, remain qualitatively unchanged. Second, to ensure that no single country drives the findings, we re-estimate the baseline multipliers while excluding each country in turn. The resulting impulse responses and cumulative multipliers closely match the baseline and lie within its confidence bands (Figures C.3 and C.4). Third, we estimate the model using ordinary least squares, regressing outcomes directly on EIB loans without instrumenting public investment. As shown in Appendix Figure C.5, the results are broadly similar—though somewhat more precisely estimated, indicating that the shocks cap-

[7]Confidence intervals widen slightly because of smaller sample sizes. Results are similar when using the seventy-fifth percentile of the debt distribution or when replacing binary state indicators with continuous interaction terms, which allows the multiplier to vary smoothly with the conditioning variables (Figures B.6 to B.8 in the Appendix). The continuous-interaction exercise, however, indicates that multipliers rise gradually as the debt-to-GDP ratio increases.

ture news about public investment beyond EIB financing. Moreover, the near-zero impact responses support the exclusion restriction, suggesting that EIB loans influence macroeconomic outcomes primarily through public investment and thus provide valid exogenous variation.

We also perform several checks related to data definition and sample weighting. As shown in Figures C.6 and C.7 in the Appendix, re-estimating the model without inverse propensity score weights yields similar dynamics for public investment, but results in moderately larger standard errors and some notable differences in other macroeconomic responses. Unlike the IPWRA estimates, consumption exhibits a persistent crowding-out, private investment crowds in on-impact, labor productivity falls, and the implied output multiplier is smaller. Moreover, as shown in panel (b) of Figure C.7, the first stage F statistics are significantly lower, indicating weak-instrument concerns when using the original (unweighted) loans data. We further re-specify the probit models to estimate the probability of receiving exclusively infrastructural loans, rather than total loans, and in a separate exercise expand the infrastructure definition to include telecommunications and energy projects. The estimation results are presented in Figures C.8, C.9, C.10, and C.11 in the Appendix. In both cases, the results are consistent with the main estimates. Finally, to account for potential dynamic heterogeneity, we estimate the effect of EIB infrastructure loans on different macroeconomic variables, separately for each country, and then compute their cross-sectional average; the results remain robust under this alternative aggregation method and show similar dynamics (Figure C.12 in the Appendix).

5 Alternative identifications

In our analysis, we estimate public investment multipliers using EIB infrastructure loan announcements as an exogenous instrument. To benchmark our results, we next apply alternative identification strategies proposed in the literature to recover public investment shocks and compare the corresponding estimates. This comparison helps clarify the specific transmission mechanisms of our EIB-based shock and highlights its advantages relative to other approaches.

Blanchard–Perotti shocks One of the most widely used measures of exogenous fiscal policy innovations in the literature is that proposed by Blanchard and Perotti (2002) (henceforth BP). BP shocks are identified within a structural VAR using timing restrictions that exploit the sluggish within-period response of fiscal variables to output. This approach isolates the unanticipated component of fiscal policy from its endogenous response to economic conditions. Following this strategy, using our unbalanced panel, we regress public investment on its own lags, as well as the lags of GDP, total public expenditure, and inflation,[8] including country and time fixed effects. The residuals from this regression are then extracted as public investment shocks following the BP identification approach.

By construction, the shocks identified using the BP methodology differ from those in our analysis. The BP approach captures unanticipated innovations in government investment, whereas our EIB-contract-based shocks reflect anticipated movements, since the loan data mainly record financing announcements while disbursements occur gradually over several quarters. Figure D.1 in the Appendix confirms that the dynamic responses to BP and EIB shocks are qualitatively different. BP shocks induce a temporary increase in public investment that dissipates rapidly, with the effect largely disappearing within four years. Consistent with the short-lived nature of the investment response, the effects on aggregate activity are modest.

Real GDP increases slightly on impact but the effect fades within two years. Consumption does not respond significantly to the shock at any horizon. BP shocks generate a statistically significant crowding-out effect on private investment, which remains negative throughout the period. Employment also declines persistently, reflecting weaker labor demand in the private sector, while labor productivity rises marginally—driven by lower employment rather than higher output. Overall, BP-identified public investment shocks yield limited short-run gains in output but cause persistent contractions in private investment and employment.

Figure D.2 in the Appendix reports the estimated cumulative multipliers for GDP (Panel (a)) and private investment (Panel (b)), obtained from equation (2) using BP shocks as instruments for cumulative public investment. The on-impact output multiplier is 0.26, rising to 0.65 after three years and 0.71 after five years—much smaller in magnitude than our local projection IV estimates. In contrast, private investment falls sharply on impact and remains below baseline throughout, with cumulative effects of –0.88 and –2 after three and five years, respectively.

MFEV-based shocks We next adopt an alternative identification strategy based on the methodology proposed by Uhlig (2004) and extended to defense news shocks by Ben Zeev

[8]To ensure comparability, we employ the same set of control variables used in the local projection regressions. As shown by Plagborg-Møller and Wolf (2021) the recovered impulse responses are the same with those of a SVAR model that includes public investment, output, total public expenditure, and inflation, ordering public investment first.

and Pappa (2017). This approach identifies exogenous disturbances that maximize the share of the forecast error variance (MFEV) of a target variable that is assumed to be exogenous to the macroeconomic environment over subsequent periods[9].

We focus on Spain, for which sufficiently long quarterly data are available, extending the sample to 1980Q1–2020Q1 following Alloza et al. (2019). The VAR specification used to identify MFEV shocks mirrors that employed in the local projection estimations and includes public investment, GDP, total expenditures, and the GDP deflator, all in logarithmic form. To account for financial factors that may influence investment, we also include the debt-to-GDP ratio and credit spreads for Spain [10]. For comparability, we re-estimate the BP shocks and our EIB-based local projection shocks using the same Spanish dataset. Given the results in Table 2, we regress EIB loans on debt-to-GDP, openness, GDP growth, previous EIB loans, stock market performance, and productivity growth, and use the residuals from this regression as instruments for changes in public investment to capture the unpredictable component of EIB loan allocation [11].

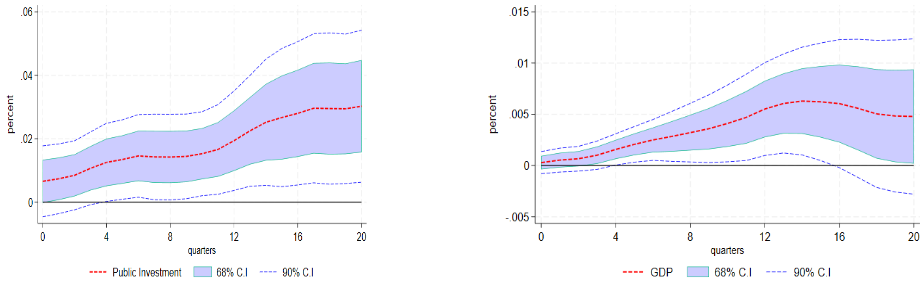
Figure 7 displays the estimated responses of public investment (left panel) to each of the three identified shocks. The first row reports the effects of EIB infrastructure loans, which exhibit a persistent increase in public investment over time. The second and third rows show the responses to the MFEV and BP shocks, respectively. Consistent with the panel estimation, the BP shock generates a short-lived increase in public investment that dissipates completely after four years, whereas the MFEV shock produces a more persistent effect, remaining positive over the full horizon. This persistence contributes to a more pronounced GDP response (right panel of Figure 7) and, as a result, higher multipliers in the medium term. These patterns suggest important similarities between the EIB loan shock and the MFEV shock. Both appear to signal information about sustained increases in future public investment and the trajectory of economic growth.

We next estimate the cumulative output multipliers using the three different shocks as instruments for public investment. The results are presented in Figure 8. The dynamics of the cumulative multiplier obtained from the EIB and MFEV shocks are very similar: the

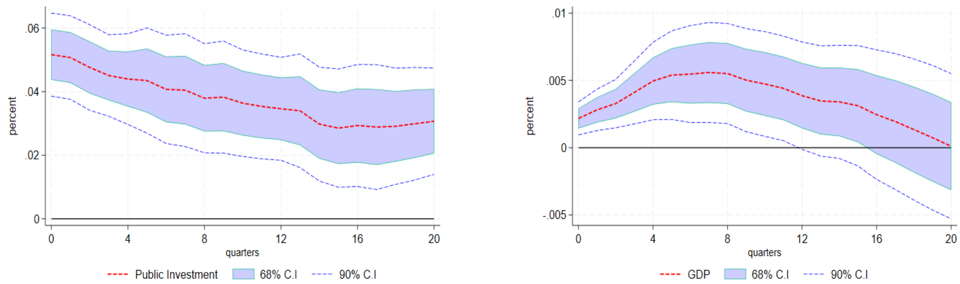
[9] We acknowledge that the MFEV approach has limitations when applied to public investment, as this variable is not fully exogenous. However, we mitigate potential predictability concerns by including both macroeconomic and financial variables in the SVAR specification, ensuring that the identified shocks capture innovations that are as exogenous as possible to broader economic conditions.

[10] Section D.2 in the Appendix provides additional details on the construction of this shock. Recent work by Ben Zeev et al. (2025) extends medium-run restrictions to a panel VAR to identify defense spending news, but we do not adopt their approach because EIB loans, unlike defense spending, are endogenous. Instead, we focus on Spain to illustrate how alternative identification strategies recover public spending shocks in a single-country setting when we account for loans endogeneity.

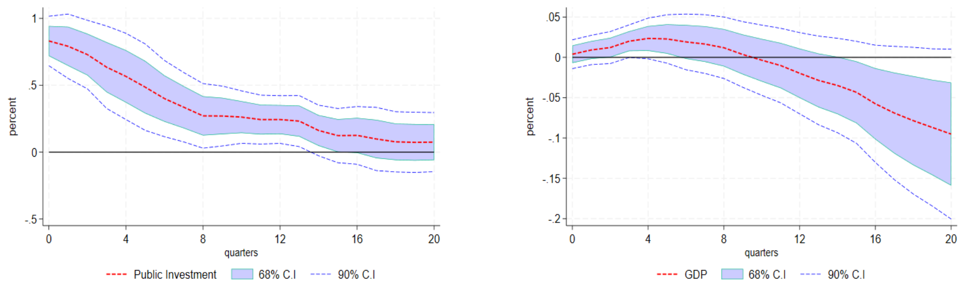
[11] Because Spain receives EIB loans in most quarters in our sample, we regress loan values directly on relevant macroeconomic and financial variables rather than defining a loan-allocation dummy as in the panel analysis.



(a) EIB



(b) MFEV



(c) BP

Figure 7: Dynamic responses of public investment and output to identified shocks. The first row reports the reduced form estimated effect of a 1% shock on public investment (left) and output (right) using similar controls as equation (1), with 68% (shaded) and 90% (dashed) confidence intervals. The second row shows results from a SVAR where public investment shocks are identified using the MFEV approach, and the third row uses the BP identification. Estimates are based on Spanish data from 1980Q1 to 2020Q1, with responses smoothed using a centered moving average.

multiplier is negligible on impact, rises steadily over time, and reaches its peak after roughly four years. Both shocks produce large estimated cumulative multipliers. In contrast, the BP shock yields an output multiplier that never exceeds unity, peaks within two years, and converges to zero by year four, reflecting the short-lived nature of the public investment response it captures.

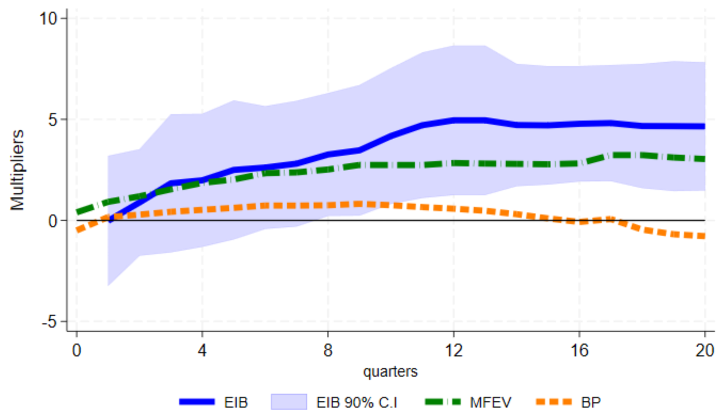


Figure 8: Public investment cumulative multiplier at different horizons, using different shocks as instruments in equation (2). The solid blue line uses EIB loans as the instrument; the long-dashed green line uses the MFEV shock; and the short-dashed orange line uses the BP residual shock. Shaded blue areas show 90% confidence bands for the EIB specification. For readability, we omit the wide confidence band at horizon zero. The estimation is based on Spanish data over the period 1980Q1–2020Q1.

6 Conclusion

Public investment is a central instrument for infrastructure development and a key policy tool for stimulating economic growth. However, much of the existing literature finds only modest short-run effects and limited medium-term gains from such spending.

This paper introduces a new source of exogenous variation in public investment to reassess its macroeconomic effects in EU countries. Using European Investment Bank (EIB) loan approvals as an instrument, we identify "news" shock about public investment spending. Our results show that government investments news generate large and persistent output gains: while the impact multiplier is near zero, it exceeds one after a year and reaches roughly 3.3 after five years. Private investment and employment follow a similar trajectory, shifting from initial crowding-out to significant medium-term crowding-in. Crucially, these gains occur without fueling inflation or increasing the public-debt-to-GDP ratio.

We also find that multipliers are larger when global financial conditions are favorable. Comparing our identification strategy with existing approaches highlights the distinct news nature of the shocks we recover. Whereas standard VAR-based shocks relying on timing restrictions typically yield small output multipliers and significant crowing-out effects on private investment, the persistence and productivity-enhancing effects of the shocks we recover produce substantially higher medium-term multipliers and an increase in private investment and employment.

Finally, we demonstrate that traditional identification methods based on timing restrictions fail to capture anticipated public investment shocks, leading to markedly different conclusions about fiscal stimulus. By contrast, approaches that maximize the forecast error variance of public investment, though limited by the endogeneity of spending, produce results consistent with our proposed methodology.

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A Appendix

A.1 Macroeconomic Data Description

This section provides additional information on data construction and variable definitions. Table A.1 reports descriptive statistics for the EU27 panel (1995Q1–2020Q1). Quarterly national accounts series for EU member states are obtained from Eurostat and include GDP, private consumption, government consumption, public investment, gross fixed capital formation, exports, and imports. All quarterly macro series are seasonally adjusted, expressed in real terms (using the GDP deflator), and transformed into logarithmic levels. When a seasonally adjusted series is not available, we apply seasonal–trend decomposition by LOESS (STL) to seasonally adjust the series.

Employment, unemployment rate, wages, general government debt, and CPI are also obtained from Eurostat. Stock market indices are sourced from the OECD; for Cyprus and Malta, data are taken from national statistical releases and other official publications. Interest rates are retrieved from the ECB Statistical Data Warehouse. The Global Financial Cycle (GFC) monthly index is taken from Miranda-Agrippino and Rey (2020) and aggregated to quarterly frequency using a simple within-quarter average. Inflation is defined as the annual change in the CPI, and trade as the sum of exports and imports for each country and quarter. Annual motorway-length data are collected from Eurostat, converted to quarterly frequency via linear interpolation, and scaled by country area to construct a motorway-intensity measure. We also control for the share of each EU member state in the EIB's subscribed capital, using the breakdown of capital shares as of March 2020 as reported in EIB governance documents. [12].

Table A.2 reports descriptive statistics for Spain (1980Q1–2020Q1): quarterly national accounts, employment and labor productivity, financial variables, and EIB infrastructure loans. Eurostat provides quarterly macro series from 1995 onward; for earlier years, we extend the national accounts and public debt data back to 1980 using growth rates from the historical dataset in Alloza et al. (2019). Historical series for employment, stock prices, and interest rates from FRED. The credit spread is defined as the 10-year sovereign yield difference between Spain and Germany. Labor productivity growth is defined as the quarterly growth rate of output per worker. All transformations follow the conventions used in the baseline panel dataset.

[12] https://www.eib.org/en/about/governance-and-structure/shareholders/index

	mean	sd	min	max	N
GDP (million euros)	104341	168258	1457	813645	2703
total consumption	78583	127245	1176	595525	2699
total investment	21823	34973	148	170778	2699
public consumption	21519	34358	293	165755	2699
public investment	3611	5133	27	22142	2359
exports	40411	59773	747	404496	2699
imports	37744	53335	836	353805	2699
trade to GDP (%)	107	62	22	369	2699
debt to GDP (%)	59	34	3	187	2273
employment (thousands)	7214	9617	145	45240	2707
unemployment rate	9	4	2	28	2615
real wage	38441	65381	566	357190	2703
CPI inflation	3	6	-4	187	2500
stock market index	131	437	5	8443	2580
output per worker (index)	90	15	38	130	2703
output per hour (index)	88	16	38	126	2703
labor productivity growth	1	2	-10	21	2676
motorway intensity	20	19	0	83	2432
GFC index	53	93	-254	251	2727

Table A.1: Descriptive Statistics for macro variables, EU27 countries from 1995Q1 to 2020Q1

	mean	sd	min	max	N
GDP (million euros)	211150	57408	124065	299494	161
total consumption	165521	40760	105628	230702	161
total investment	48255	15463	25593	83292	161
public expenditure	87552	27947	36057	140234	161
public investment	7875	2735	2503	14219	161
exports	52466	29032	12561	107143	161
imports	52839	29888	10317	96825	161
trade to GDP (%)	46	16	19	68	161
debt to GDP (%)	58	25	16	105	161
employment (thousands)	16201	3149	11322	21415	161
CPI inflation	4	4	-2	13	161
labor productivity growth	1	3	-17	13	160
credit spread	290	272	1	925	161
stock market index	67	36	7	155	141
EIB infrastructure loans	510	526	0	2303	161

Table A.2: Descriptive Statistics for macro variables, Spain from 1980Q1 to 2020Q1

A.2 EIB Loans Summary Statistics

The EIB classifies loans into 13 sectors of economic activity. We focus on loans granted between 1995Q1 and 2020Q1 to EU-27 countries, which cover 12,342 projects (Table A.4). For each country, we aggregate the total value of approved loans at the quarterly frequency. These loans do not mechanically correspond to public investment and, in many cases, finance private or mixed-ownership entities (including SMEs and state-owned firms). To account for this heterogeneity, we classify each project into two groups based on the share of public beneficiaries: fully public projects ((public share $\geq$ 90 percent) and *other projects* (public share $<$ 90 percent). Table A.3 shows the distribution of projects by beneficiary type across countries, and Table A.4 shows the same distribution across sectors of activity.

Country	Fully public	Other	Total	Share (%)
Austria	117	386	503	4.08
Belgium	92	271	363	2.94
Bulgaria	25	75	100	0.81
Croatia	31	65	96	0.78
Cyprus	28	94	122	0.99
Czechia	56	234	290	2.35
Denmark	89	159	248	2.01
Estonia	41	37	78	0.63
Finland	143	201	344	2.79
France	419	797	1,216	9.85
Germany	471	1,399	1,870	15.15
Greece	100	284	384	3.11
Hungary	83	202	285	2.31
Ireland	76	90	166	1.35
Italy	301	1,510	1,811	14.67
Latvia	32	42	74	0.60
Lithuania	30	52	82	0.66
Luxembourg	8	81	89	0.72
Malta	14	11	25	0.20
Netherlands	88	182	270	2.19
Poland	393	362	755	6.12
Portugal	145	394	539	4.37
Romania	80	124	204	1.65
Slovakia	21	165	186	1.51
Slovenia	17	94	111	0.90
Spain	685	1,089	1,774	14.37
Sweden	158	199	357	2.89
Total	**3,743**	**8,599**	**12,342**	**100.00**

Notes: "Fully public" refers to projects with public beneficiaries' share $\geq$ 90%; "Other" includes mixed or private beneficiaries. Share is the country's share of total loans in percent.

Table A.3: Number of EIB loans by country and beneficiary type, 1995:Q1–2020:Q1

Table A.5 reports descriptive statistics for the quarterly country-level aggregates. "Total projects" refers to the sum of all financed projects in a given quarter. We also separately

Sector of activity	Fully public	Other	Total	Share (%)
Agriculture, fisheries, forestry	34	25	59	0.48
Composite infrastructure	121	61	182	1.47
Credit lines	14	3,629	3,643	29.52
Education	379	92	471	3.82
Energy	219	1,054	1,273	10.31
Health	224	179	403	3.27
Industry	60	1,543	1,603	12.99
Services	227	449	676	5.48
Solid waste	99	89	188	1.52
Telecommunications	56	357	413	3.35
Transport	1,445	800	2,245	18.19
Urban development	409	189	598	4.85
Water, sewerage	456	132	588	4.76
Total	**3,743**	**8,599**	**12,342**	**100.00**

Notes: "Fully public" refers to projects with public beneficiaries' share $\geq$ 90%; "Other" includes mixed or private beneficiaries. Share is the sector's share of total loans in percent.

Table A.4: Number of EIB loans by sector and beneficiary type, 1995:Q1–2020:Q1

report aggregated volumes for fully public projects and other projects. In addition, we provide summary statistics for aggregated loan volumes by sector of activity. All series are expressed in millions of euros.

	mean	sd	min	max	N
Total projects (million euros)	386.9	714.7	0.0	5832.5	2727.0
- public sector projects	128.7	289.4	0.0	2789.7	2727.0
- other projects	258.1	523.2	0.0	5068.1	2727.0
Sectors:					
- agriculture	1.7	22.3	0.0	700.0	2727.0
- composite infrasturacture	6.9	48.2	0.0	1063.0	2727.0
- credit lines	117.8	296.2	0.0	4638.1	2727.0
- education	14.6	70.1	0.0	1317.5	2727.0
- energy	42.5	129.9	0.0	1535.0	2727.0
- health	9.5	42.9	0.0	615.0	2727.0
- industry	38.7	124.7	0.0	2186.6	2727.0
- services	16.1	85.6	0.0	1552.0	2727.0
- solid waste	2.3	15.2	0.0	360.0	2727.0
- telecommunication	17.0	74.7	0.0	950.0	2727.0
- transportation	89.9	214.4	0.0	2221.4	2727.0
- urban development	15.9	66.0	0.0	1000.0	2727.0
- water, sewerage	14.0	53.5	0.0	690.2	2727.0

Table A.5: Descriptive Statistics for the aggregated quarterly EIB loan data,, EU27 countries from 1995Q1 to 2020Q1

A.3 Between and within-country variation of EIB infrastructural loans

Figures A.1 to A.3 document cross-sectional and time-series variation in EIB-financed infrastructure projects. Figure A.1 shows a heatmap of quarterly loan volumes (million euros) by country and quarter, revealing pronounced between- and within-country variation. Larger economies receive higher volumes—an expected level difference absorbed by country fixed effects in all our regressions.

Figure A.2 plots the same EIB loans data scaled by total public investment; dispersion is substantially larger in relative terms. A small number of country–quarters observations exhibit exceptionally high loans to public investment ratios; we drop these outliers to avoid their impact on our estimates. Figure A.3 presents the time series of total loans for the EU as a whole and separately for each EU27 country, highlighting within-country dynamics over the sample.

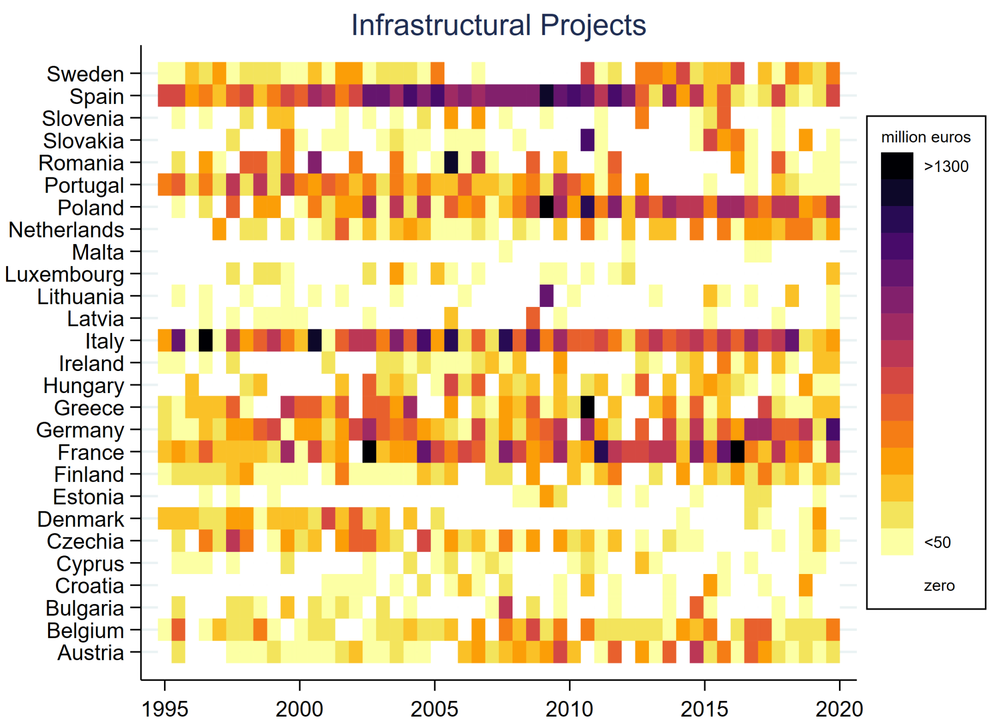


Figure A.1: Infrastructural projects (million euros, , 1995q1 to 2020q1)

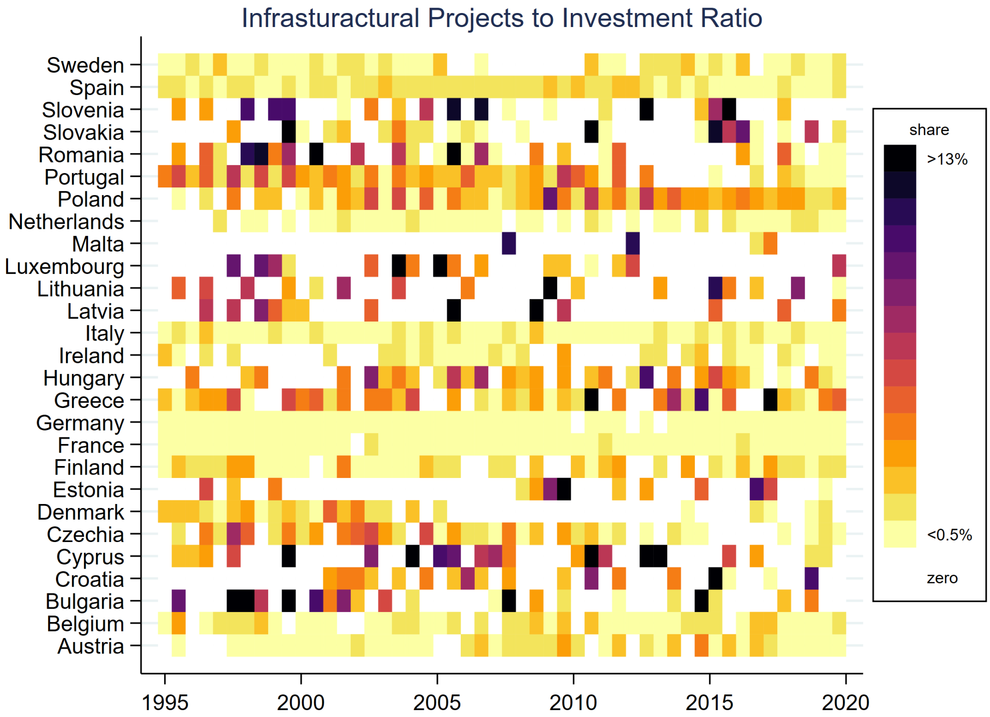


Figure A.2: Infrastructural projects as share of public investment, 1995q1 to 2020q1

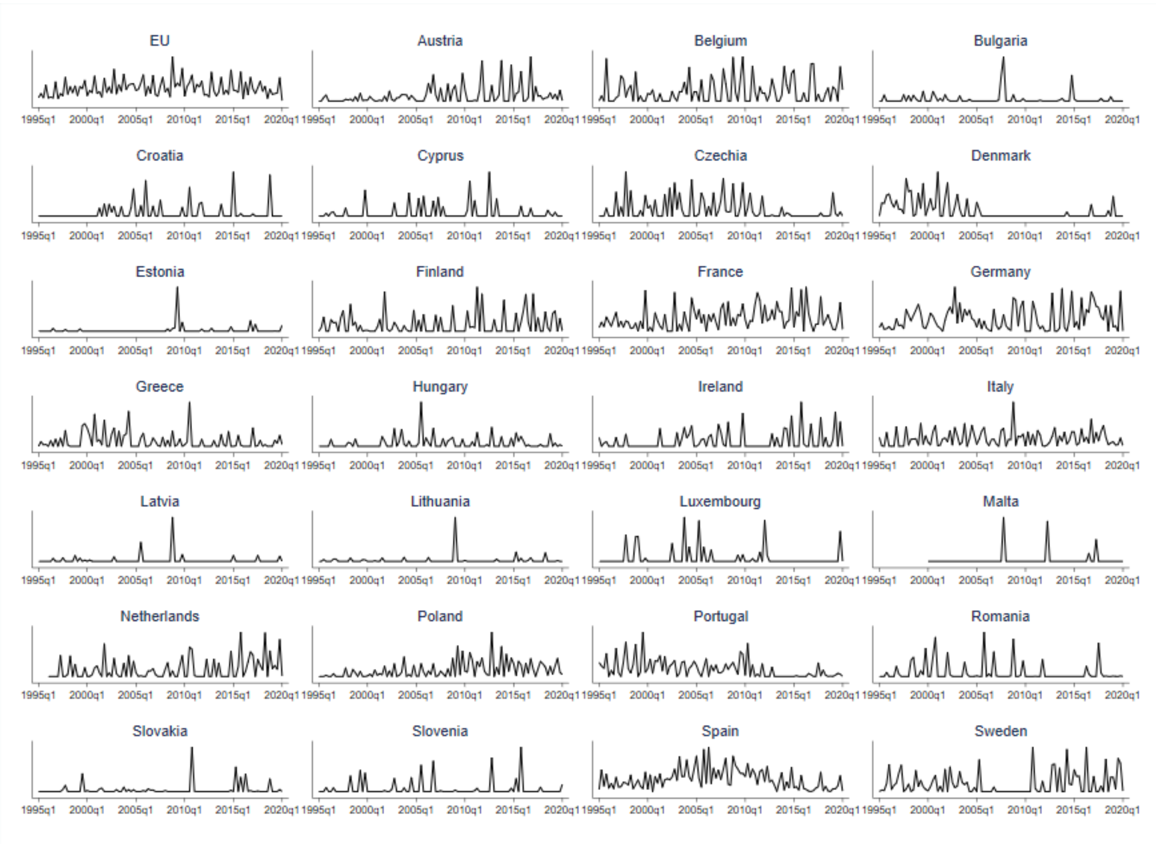


Figure A.3: Evolution of infrastructural projects in different EU countries for 1995Q1-2020Q1

B Additional results

B.1 Persistence of EIB infrastructure loan shocks

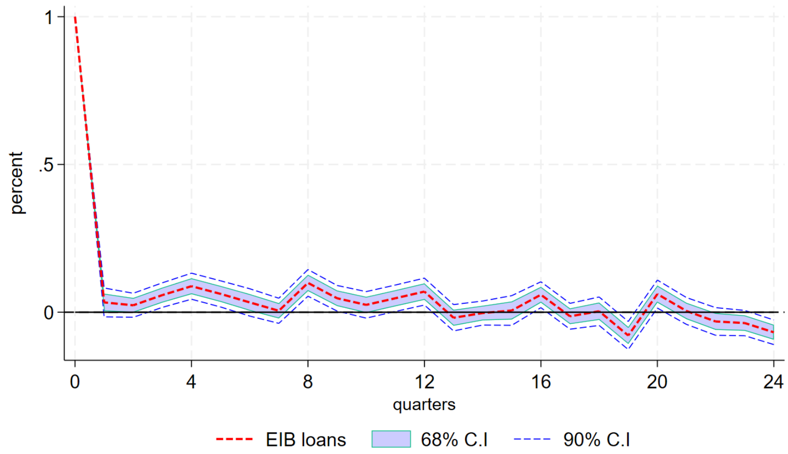
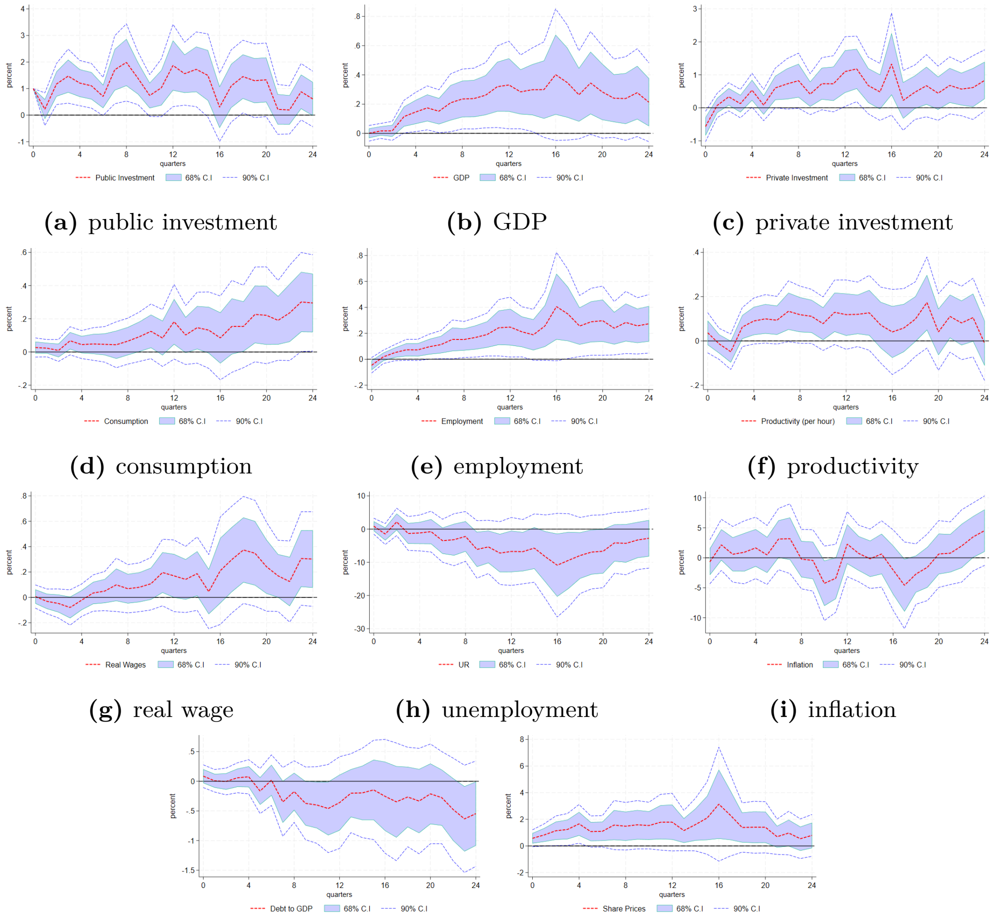


Figure B.1: Effect of a one percent increase in EIB-financed infrastructure loans estimated from equation (1), together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1.

B.2 Non-smoothed responses

In local projections, we estimate the dynamic response of each variable separately at each horizon h (the β_h in equation (1)). Unlike VAR impulse responses—where the path is implied by the model's transition dynamics—LP responses are estimated horizon by horizon and can display non-monotonic patterns. Figure B.2 shows the raw, unsmoothed responses. To present smoother response functions, we apply a centered five-quarter moving average to the estimated coefficients throughout the paper.



(a) public investment **(b)** GDP **(c)** private investment

(d) consumption **(e)** employment **(f)** productivity

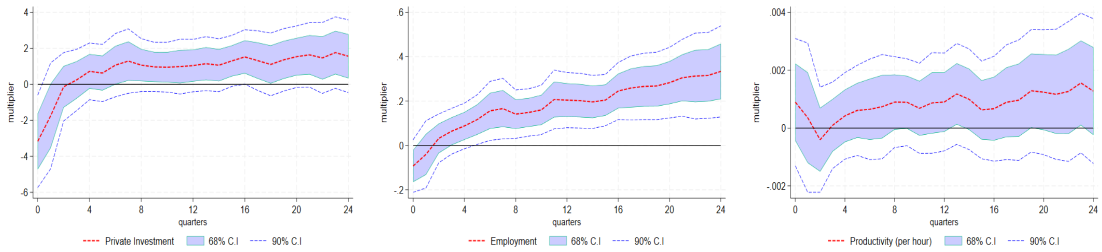
(g) real wage **(h)** unemployment **(i)** inflation

(j) debt-to-GDP **(k)** stock prices

Figure B.2: Effect of a one percent increase in public investment, instrumented with EIB-financed infrastructure loans, on different macroeconomic variables. Each panel plots the estimated β_h from equation (1), together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1.

B.3 Cumulative effect on private investment, employment, and labor productivity

Figure B.3 reports cumulative multipliers for private investment, employment, and labor productivity across all horizons. We first estimate elasticities using equation (2) and then convert them to multipliers using the average ratio of each variable to public investment. Summary results appear in Table 3, which reports the implied cumulative elasticities and multipliers at selected horizons

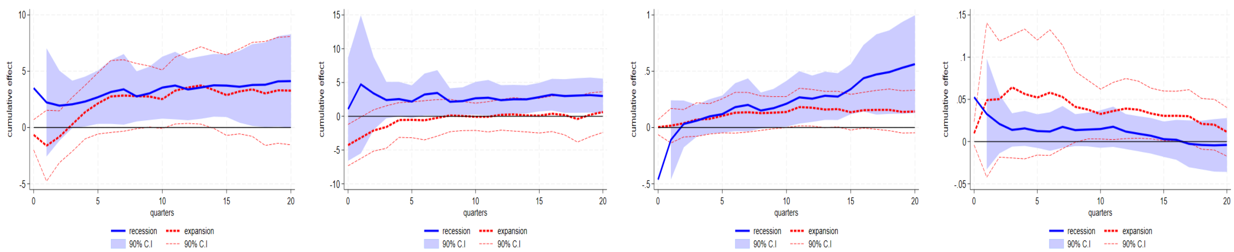


(a) private investment **(b)** employment **(c)** productivity

Figure B.3: Cumulative effect of public investment on private investment, employment, and labor productivity. Each panel plots the estimated β_h^m from equation (2) for a different variable, together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1.

B.4 State-dependent results

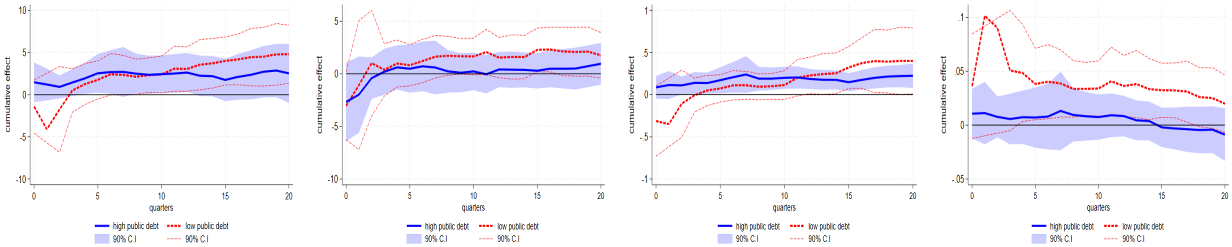
Figure B.4 reports state-dependent local projections from equation (3) for different variables when we interact the shock with regime indicators for the business-cycle phase (recession vs. expansion). Each panel displays horizon-by-horizon coefficients with 90% confidence bands, allowing a direct comparison of dynamics across states. Clearly the state of the business cycle does not affect significantly the size of the multiplier.



(a) GDP **(b)** private investment **(c)** employment **(d)** share prices

Figure B.4: Public investment cumulative effect for recessionary vs. expansionary periods. Each panel plots the estimated $\beta_{A,h}$ and $\beta_{B,h}$ from equation (3), together with 90% confidence intervals. States are defined as explained in the text. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1.

When next look on state dependencies in Figure B.5 regarding the fiscal position (high vs. low public debt-to-GDP) according to the regime indicators and thresholds in section 4.5 of the paper we again find no significant state dependencies.



(a) GDP **(b)** private investment **(c)** employment **(d)** share prices

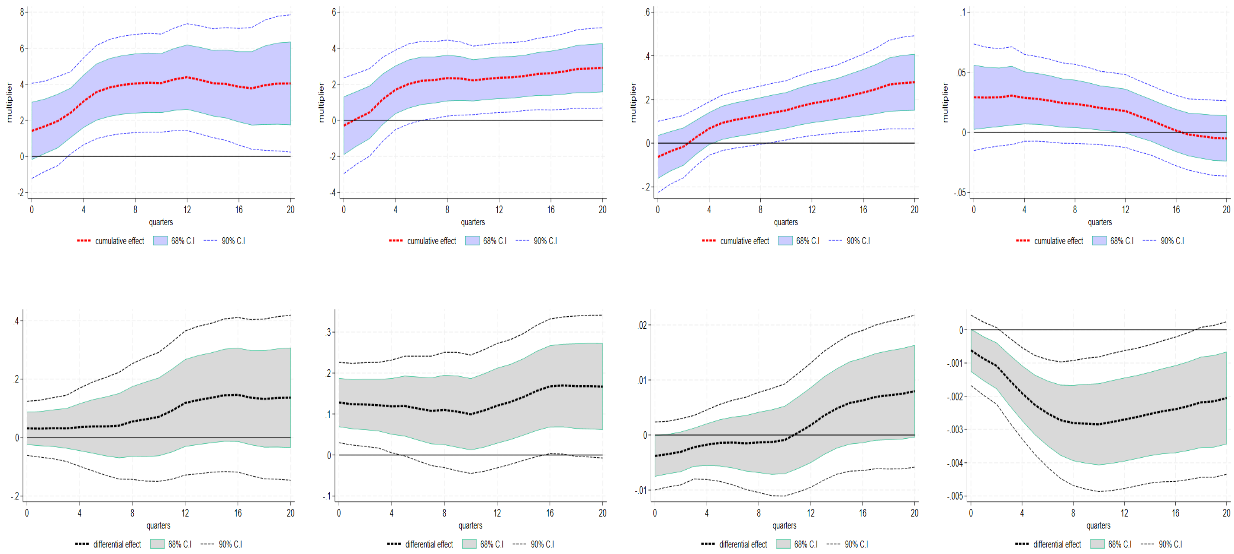
Figure B.5: Public investment cumulative effect for high vs. low public debt ratios. Each panel plots the estimated $\beta_{A,h}$ and $\beta_{B,h}$ from equation (3), together with 90% confidence intervals. States are defined as explained in the text. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1. For readability, we omit wide low-debt confidence bands at few horizons due to small sample size.

B.5 Interaction with continuous state variables

As an alternative way to study state dependence, we interact the public-investment shock with a continuous state variable rather than using regime dummies. Specifically, we estimate

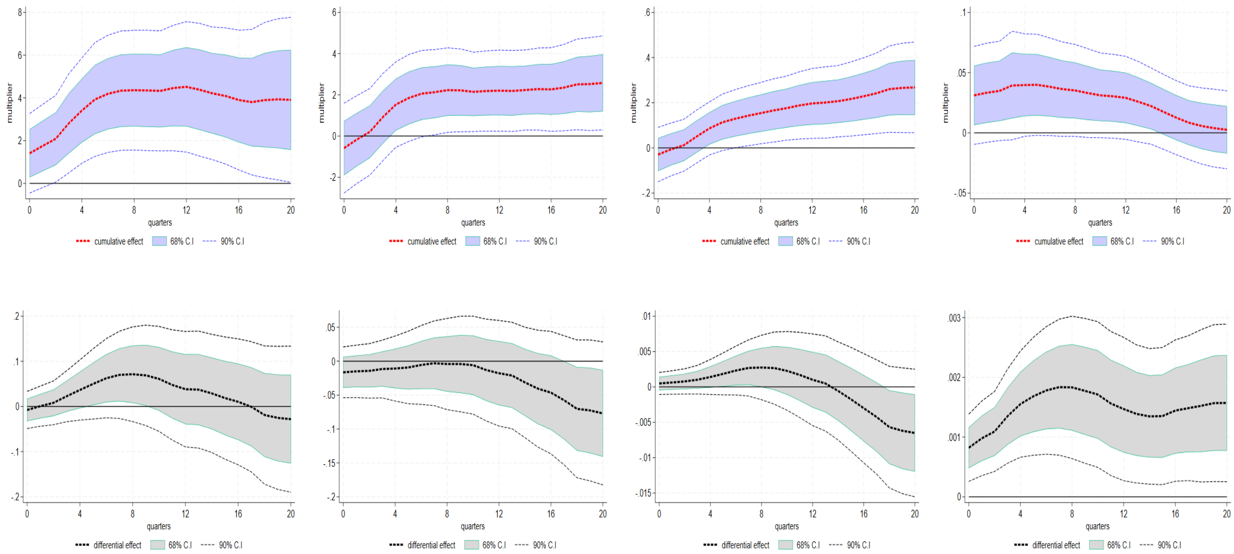
$$\sum_{j=0}^{h} y_{i,t+j} = \alpha_{i,h}+\gamma_{t,h}+\beta_h^m \sum_{j=0}^{h} I^g_{i,t+j}+\zeta_h^m \left(\sum_{j=0}^{h} I^g_{i,t+j} \times State_t\right)+\xi_h\, State_t+\sum_{k=1}^{2} \Theta_{k,h} X_{i,t-k}+\varepsilon_{i,t+h} \tag{B.1}$$

where $State_t$ is a continuous indicator of economic conditions (business-cycle indicator, the global financial cycle (GFC) index, or the public-debt-to-GDP ratio). All other variables are defined as in equation (2). The interaction term is instrumented in the standard way, using the product of the shock instrument and the state variable, i.e., $\left(\sum_{j=0}^{h} I^g_{i,t+j} \times State_t\right)$ is instrumented with (EIB infrastructure loans$_{i,t}$ $\times$ $State_t$). The top row of Figures B.6 to B.8 reports the estimated cumulative output multiplier β_h^m and the bottom row reports the marginal (state-contingent) effect ζ_h^m for different state variables (recession indicator, Global Financial Cycles index, and public-debt-to-GDP ratio, respectively).



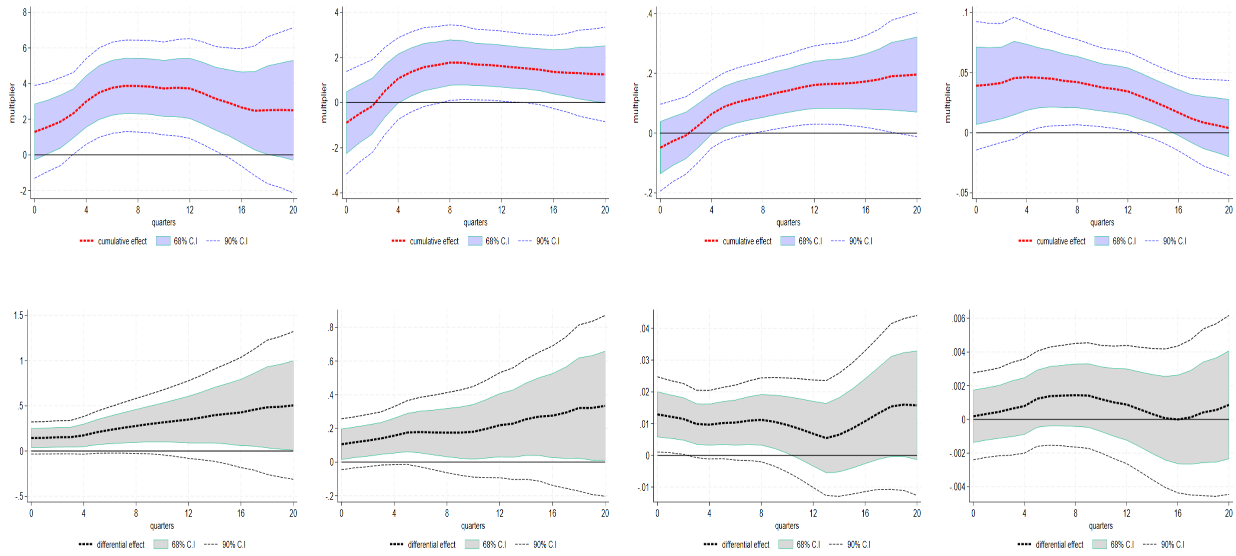
(e) GDP **(f)** private investment **(g)** employment **(h)** share prices

Figure B.6: Public investment cumulative effect and the state-contingent effect for recessionary vs. expansionary periods. Each top panel plots the estimated β_h^m from equation (B.1), while bottom panels plot the marginal effect of different state variables (ζ_h^m), together with 68% and 90% confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1



(e) GDP **(f)** private investment **(g)** employment **(h)** share prices

Figure B.7: Public investment cumulative effect and the state-contingent effect for good vs. bad financial cycles. Each top panel plots the estimated β_h^m from equation (B.1), while bottom panels plot the marginal effect of different state variables (ζ_h^m), together with 68% and 90% confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1



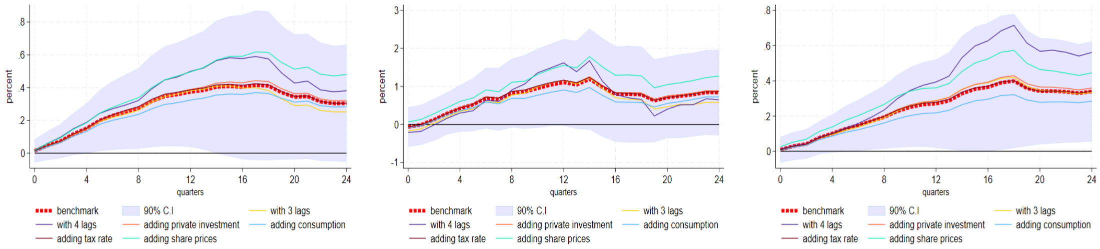
(e) GDP **(f)** private investment **(g)** employment **(h)** share prices

Figure B.8: Public investment cumulative effect and the state-contingent effect for high vs. low public debt ratio. Each top panel plots the estimated β_h^m from equation (B.1), while bottom panels plot the marginal effect of different state variables (ζ_h^m), together with 68% and 90% confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1

C Robustness Exercises

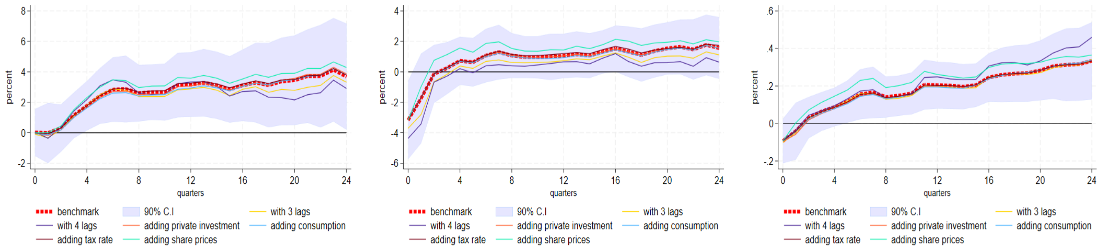
C.1 Alternative specifications

As a robustness check, we re-estimate equations (1) and (2) using alternative specifications of the local projections. In particular, we vary the lag length (considering 3 and 4 lags for all control variables), augment the baseline specification with additional controls (two lags of private investment, consumption, tax rate, and share prices), and re-estimate the responses. Figures C.1 and C.2 show that the resulting impulse responses and cumulative multipliers are close to the benchmark. The dynamic patterns are stable across specifications, with differences well within the confidence bands.



(a) GDP **(b)** private investment **(c)** employment

Figure C.1: Effect of a one percent increase in public investment, instrumented with EIB-financed infrastructure loans, on different macroeconomic variables. The dashed red line in each panel plots the estimated β_h from equation (1), together with its 90% (shaded blue area) confidence interval. Solid lines show re-estimates using alternative specifications of equation 1. Response functions are smoothed using a centered moving average.

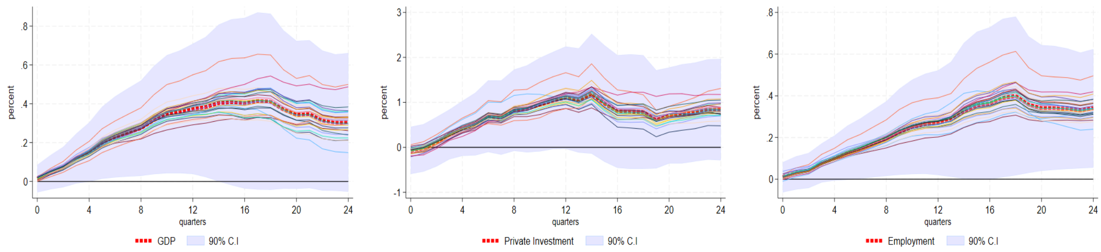


(a) GDP **(b)** Private investment **(c)** Employment

Figure C.2: Cumulative effect of public investment, instrumented with EIB-financed infrastructure loans, on different macroeconomic variables. The dashed red line in each panel plots the estimated β_h^m from equation (2), together with its 90% (shaded blue area) confidence interval. Solid lines show re-estimates using alternative specifications of equation 2.

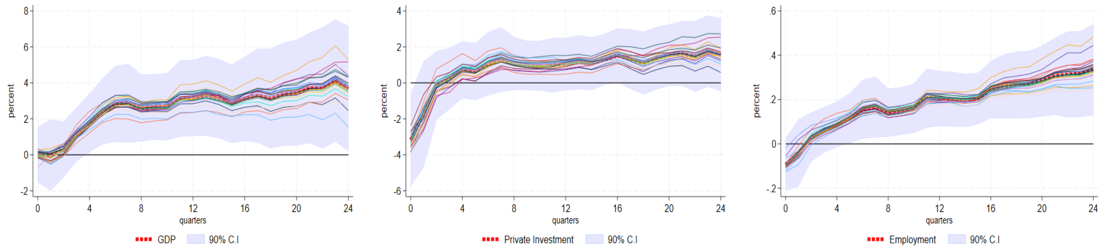
C.2 Excluding countries in turn

We further assess whether our results are driven by any single country. To this end, we re-estimate equations (1) and (2) excluding one country at a time. Figures C.3 and C.4 show that the estimated impulse responses and cumulative multipliers remain close to the benchmark. Differences across leave-one-out specifications are small and remain well within the confidence bands.



(a) GDP **(b)** private investment **(c)** employment

Figure C.3: Effect of a one percent increase in public investment, instrumented with EIB-financed infrastructure loans, on different macroeconomic variables. The dashed red line in each panel plots the estimated β_h from equation (1), together with its 90% (shaded blue area) confidence interval. Solid lines show re-estimates excluding one country at a time. Response functions are smoothed using a centered moving average.



(a) GDP **(b)** Private investment **(c)** Employment

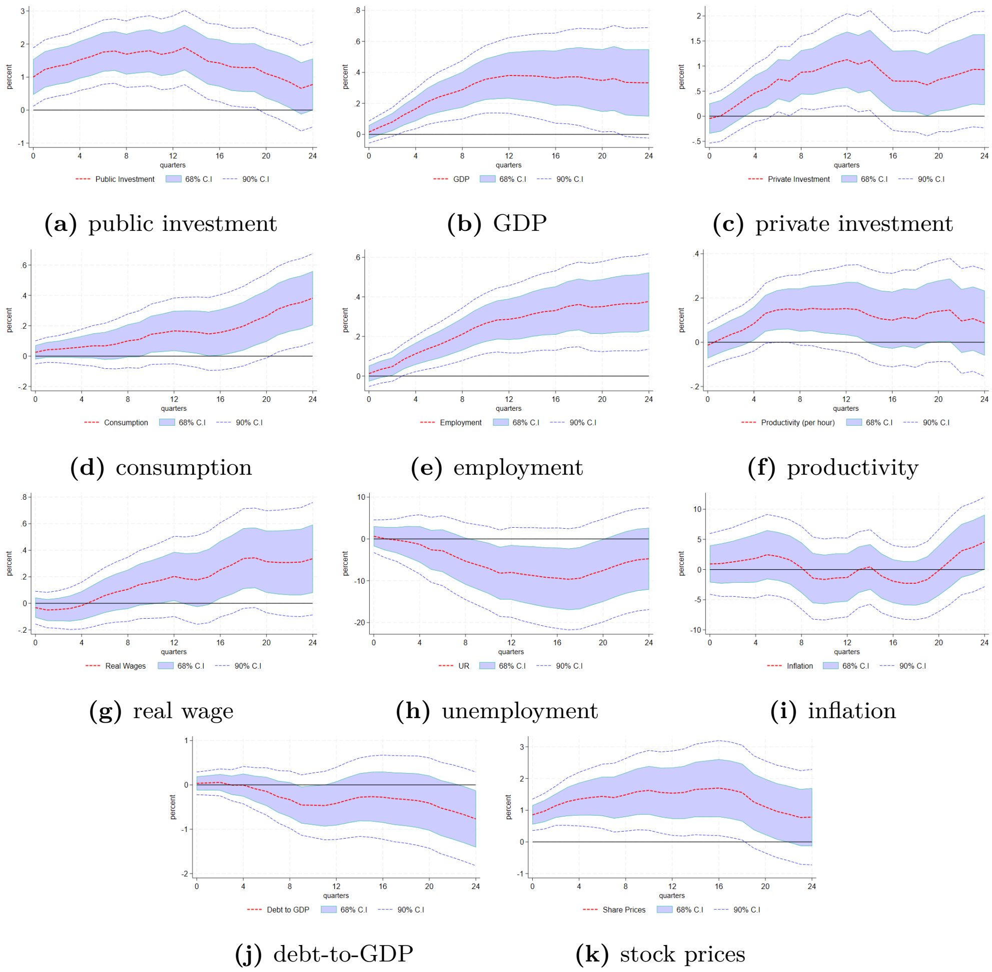
Figure C.4: Cumulative effect of public investment, instrumented with EIB-financed infrastructure loans, on different macroeconomic variables. The dashed red line in each panel plots the estimated β_h^m from equation (2), together with its 90% (shaded blue area) confidence interval. Solid lines show re-estimates excluding one country at a time.

C.3 Reduced form OLS local projections

Figure C.5 reports reduced-form OLS local projections based on equation (1). For each horizon h, the cumulative growth of the outcome is regressed on the common set of controls and the log of total EIB infrastructure loans as a direct regressor.

C.4 Unweighted regressions

As detailed in Section 2.3, we use an augmented inverse-probability weighting (AIPW) scheme to account for predictable components of treatment. Equations (1) and (2) are estimated by weighted regressions, where weights are the inverse estimated probability that country i receives an EIB loan in quarter t. Reweighting balances observables between treated and untreated observations and reduces bias in the dynamic effects of EIB-financed investment. For comparison, Figures C.6 and C.7 show unweighted estimates: standard errors are larger, consumption exhibits a persistent crowding-out, on-impact crowding-in of private



(a) public investment **(b)** GDP **(c)** private investment

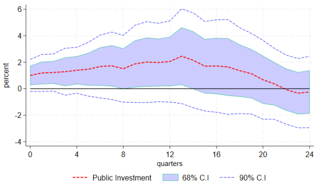
(d) consumption **(e)** employment **(f)** productivity

(g) real wage **(h)** unemployment **(i)** inflation

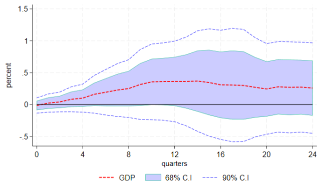
(j) debt-to-GDP **(k)** stock prices

Figure C.5: Effect of a one percent increase in EIB-financed infrastructure projects on different macroeconomic variables. Each panel plots the estimated β_h from reduced form regressions with a similar specification to equation (1), together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1. Response functions are smoothed using a centered moving average.

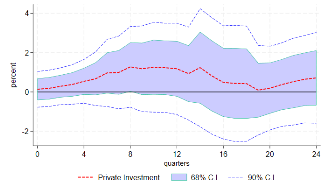
investment, labor productivity falls, and the implied output multiplier is smaller. Moreover, as shown in panel (b) of Figure C.7, the first stage F statistics of the unweighted estimations are significantly lower, indicating weak-instrument concerns when using the original loans data.



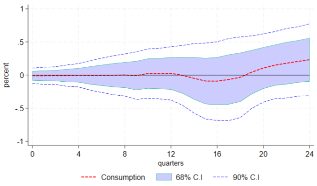
(a) public investment



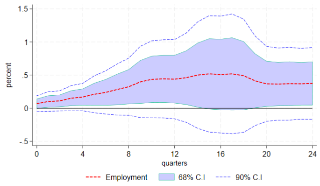
(b) GDP



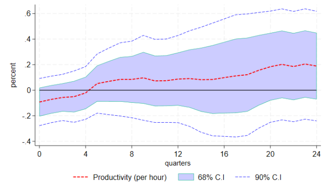
(c) private investment



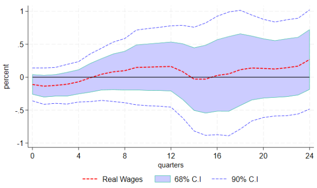
(d) consumption



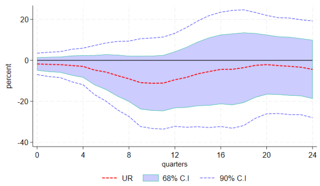
(e) employment



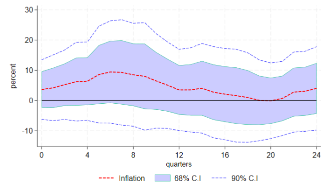
(f) productivity



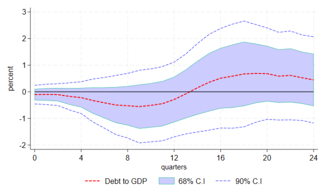
(g) real wage



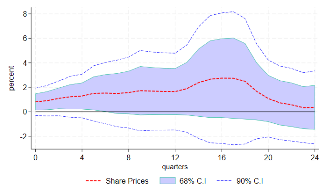
(h) unemployment



(i) inflation

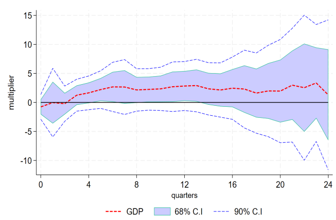


(j) debt-to-GDP

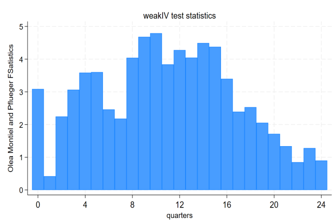


(k) stock prices

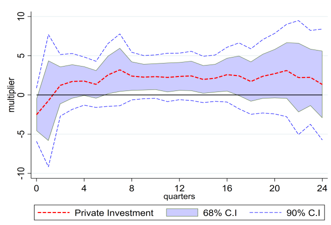
Figure C.6: Effect of a one percent increase in public investment, instrumented with EIB-financed infrastructure loans, on different macroeconomic variables (non-weighted regressions). Each panel plots the estimated β_h from equation (1), together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1. Response functions are smoothed using a centered moving average.



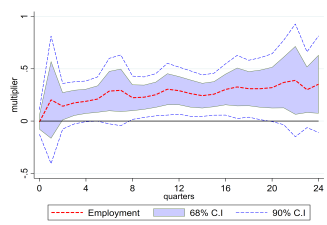
(a) GDP



(b) F-Statistics



(c) private investment

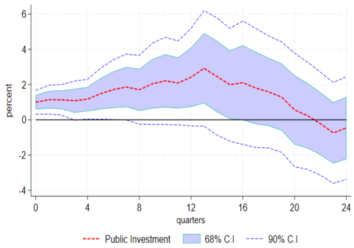


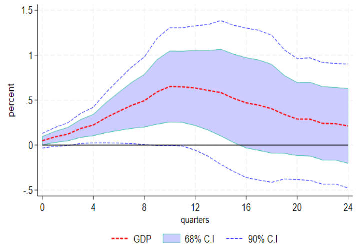
(d) employment

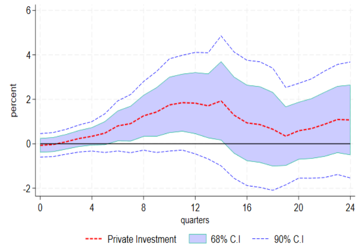
Figure C.7: Cumulative effect of public investment on output, private investment, and employment (non-weighted regressions). Each panel plots the estimated β_h^m from equation (2) for a different variable, together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. Panel (b) reports the first-stage weak-IV test F-statistics for equation (2) as developed by Olea and Pflueger (2013). The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1.

C.5 Alternative weighting scheme

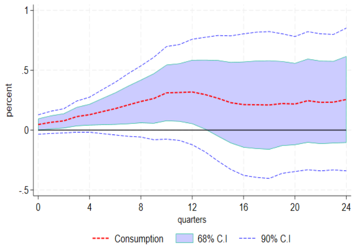
As discussed in the paper, the baseline weights each observation by the inverse probability that a country receives any EIB loan in a given quarter (excluding credit lines and canceled projects). As a robustness check, we instead weight by the inverse probability of receiving an infrastructure loan in that quarter, using the same definition of infrastructure sectors in the main text. This addresses potential allocation bias specific to infrastructure loans. Figures C.8 and C.9 show results that are very similar to the benchmark.

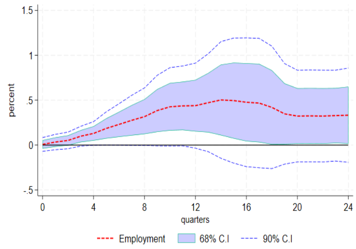


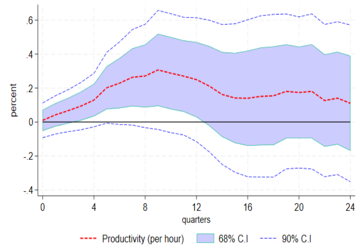




(a) public investment **(b)** GDP **(c)** private investment

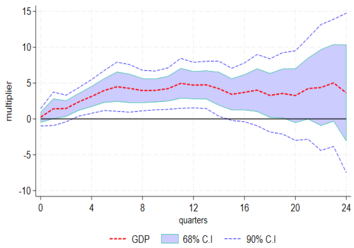


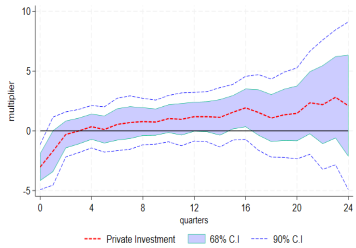




(d) consumption **(e)** employment **(f)** productivity

Figure C.8: Effect of a one percent increase in public investment, instrumented with EIB-financed infrastructure loans, on different macroeconomic variables. Each panel plots the estimated β_h from equation (1), together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1. Response functions are smoothed using a centered moving average.



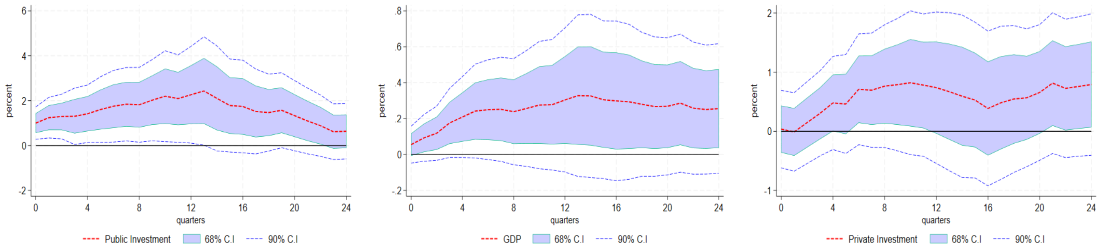


(a) GDP **(b)** Private investment **(c)** Employment

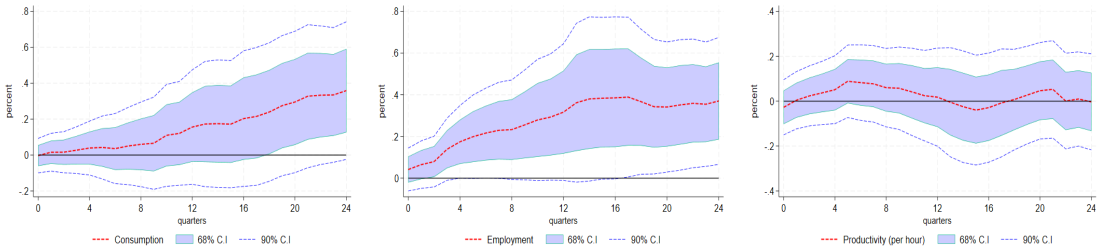
Figure C.9: Cumulative effect of public investment on GDP, private investment, and employment. Each panel plots the estimated β_h^m from equation (2) for a different variable, together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1.

C.6 Broader definition of infrastructure loans

As a further robustness check, we broaden the definition of infrastructure loans used as the instrument. In the main analysis, the set of eligible sectors is restricted to those where fully public projects constitute the majority of financed projects (on average above 60 percent of loans). Here we add the energy and telecommunications sectors, where the share of fully public projects is below 20 percent, and re-estimate equations (1) and (2). Figures C.10 and C.11 show that the dynamic responses and cumulative multipliers remain close to the benchmark.

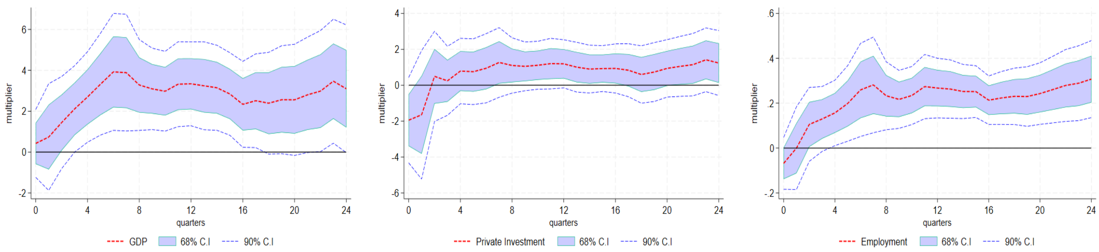


(a) public investment **(b)** GDP **(c)** private investment



(d) consumption **(e)** employment **(f)** productivity

Figure C.10: Effect of a one percent increase in public investment, instrumented with EIB-financed infrastructure loans, on different macroeconomic variables. Each panel plots the estimated β_h from equation (1), together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1. Response functions are smoothed using a centered moving average.

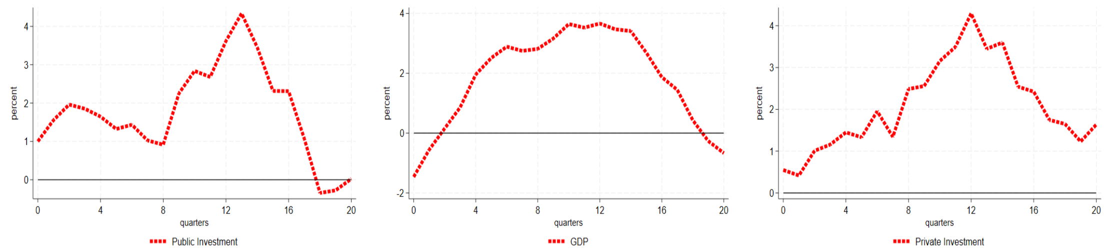


(a) GDP **(b)** Private investment **(c)** Employment

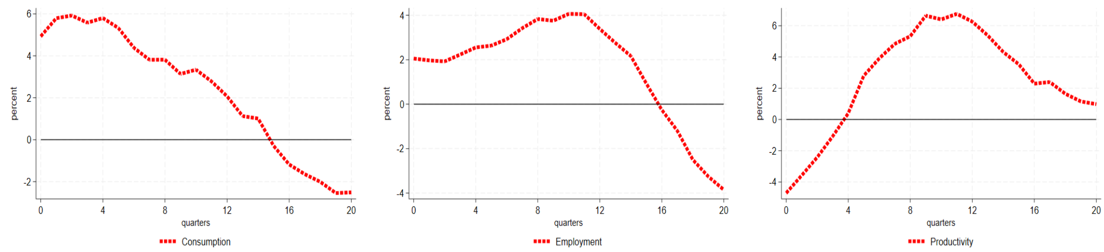
Figure C.11: Cumulative effect of public investment on GDP, private investment, and employment. Each panel plots the estimated β_h^m from equation (2) for a different variable, together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1.

C.7 Dynamic Heterogeneity

To assess whether dynamic heterogeneity affects our results, we estimate local projections separately for each country and then average the responses across units. The average is computed using inverse–standard-error weights to give more precision to estimates with lower sampling uncertainty. Because the time series available for each country is short (about 80 observations at $h = 0$, declining with the horizon), we implement reduced-form OLS rather than IV at the unit level. As shown in Figure C.5, OLS and IV deliver very similar dynamics in the panel, which supports using OLS at the unit level. Figure C.12 plots the resulting weighted-average responses. The dynamic patterns closely resemble the panel estimates reported in the main text, especially at earlier horizons, indicating that our baseline results are not driven by dynamic heterogeneity across countries.



(a) public investment **(b)** GDP **(c)** private investment



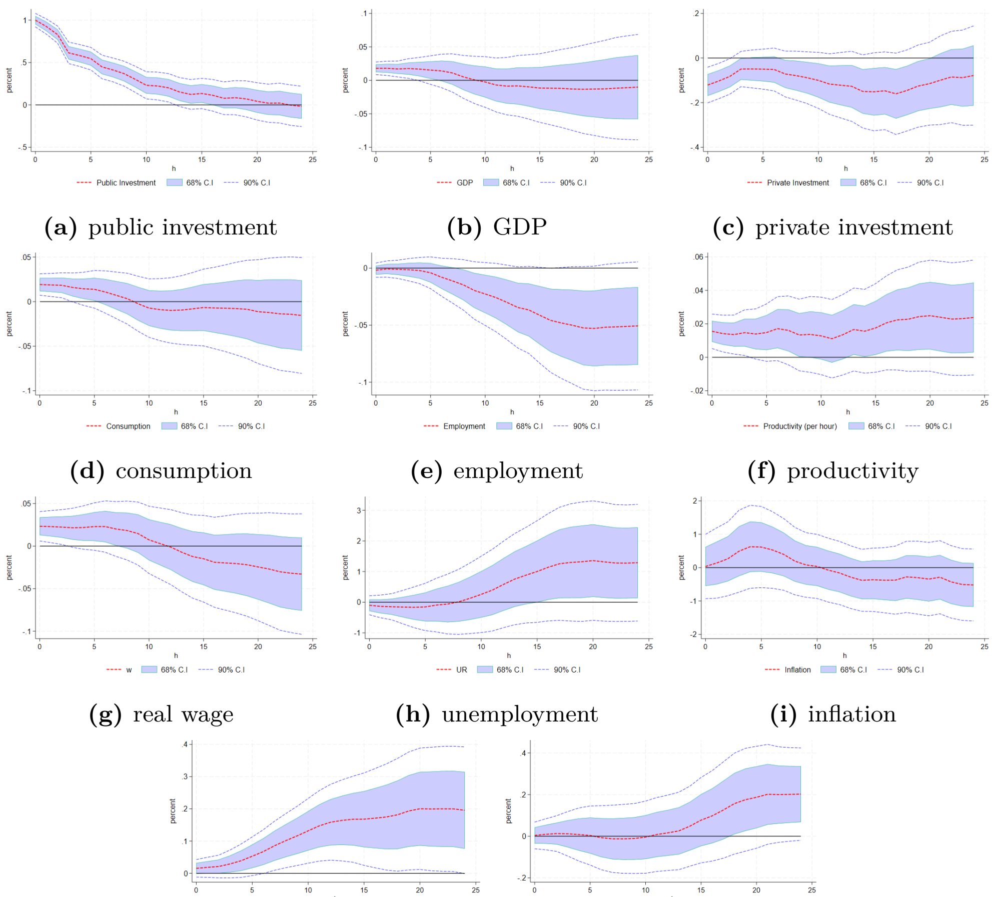
(d) consumption **(e)** employment **(f)** productivity

Figure C.12: Effect of a one percent increase in EIB-financed infrastructure projects on different macroeconomic variables. Each panel plots the estimated β_h from reduced form regressions with a similar specification to equation (1). The red dashed line plots the weighted average of the estimation results for each EU27 country over the period 1995Q1–2020Q1. Response functions are smoothed using a centered moving average.

D Alternative Shock Constructions

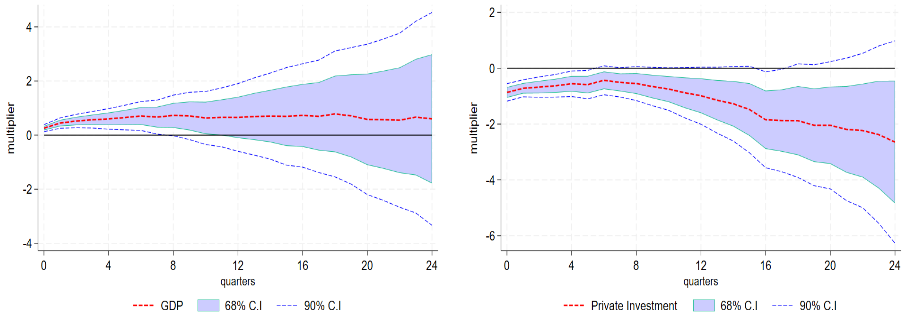
D.1 Residual-based Blanchard-Perotti shocks

As an alternative shock measure, we extract the unanticipated component of public investment by removing its predictable variation (referred to as Blanchard-Perotti (BP) shocks in Ramey and Zubairy (2018)). Specifically, we regress the log of public investment on its own lags and lagged macro controls (GDP, total public expenditure, and inflation) using the same information set as in the baseline local projection specification. The residual from this forecasting equation is interpreted as the public-investment shock and is used as the instrument in equation (1). Figure D.1 shows the results of these estimates, showing a short-lived effect of public investment, and as a result on output, and also a persistent crowding out effect on the private sector. The estimates also point to a significant rise in the public-debt-to-GDP ratio. Figure D.2 shows the corresponding cumulative multipliers for GDP and private investment from equation (2). Using BP shocks as the instrument yields significantly smaller output multipliers and a persistent, increasingly negative effect on private investment.



(a) public investment **(b)** GDP **(c)** private investment
(d) consumption **(e)** employment **(f)** productivity
(g) real wage **(h)** unemployment **(i)** inflation
(j) debt-to-GDP **(k)** stock prices

Figure D.1: Effect of a one percent increase in public investment, instrumented with BP shocks, on different macroeconomic variables. Each panel plots the estimated β_h from equation (1), together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1. Response functions are smoothed using a centered moving average.



(a) GDP **(b)** Private investment

Figure D.2: Cumulative effect of public investment on GDP and private investment. Each panel plots the estimated β_h^m from equation (2) for a different variable using BP shock as instrument, together with 68% (shaded blue area) and 90% (dashed blue lines) confidence intervals. The estimation is based on an unbalanced panel of EU countries over the period 1995Q1–2020Q1.

D.2 MFEV-based shocks

We construct a maximum–forecast-error-variance (MFEV) shock that extracts the innovation maximizing the share of the FEV of public investment over subsequent years. The VAR mirrors the baseline information set used in the local projections and includes (in logs) public investment, GDP, and total expenditures, as well as CPI inflation. To capture financial conditions relevant for investment, we add the debt-to-GDP ratio and the credit spread (the 10-year sovereign yield differential: Spain minus Germany).

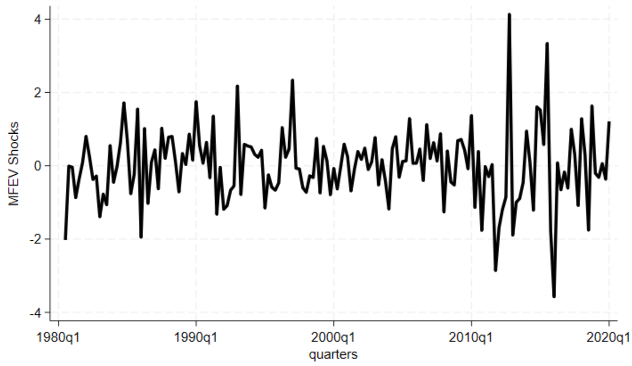


Figure D.3: Identified MFEV shock for Spain, 1980Q1–2020Q1. The VAR analysis to extract this shock includes (in logs) public investment, GDP, total expenditures, CPI inflation, debt-to-GDP ratio, and the credit spread.

We implement the procedure on Spain, where a long quarterly sample is available (1980Q1–2020Q1), adapting the computational approach of Kurmann and Otrok (2017). Specifically, we identify the first shock that maximizes the FEV of Spanish public investment over a five-year horizon. Figure D.3 shows the resulting MFEV shock series. Figure D.4 reports the fraction of forecast error variance explained by this shock across variables

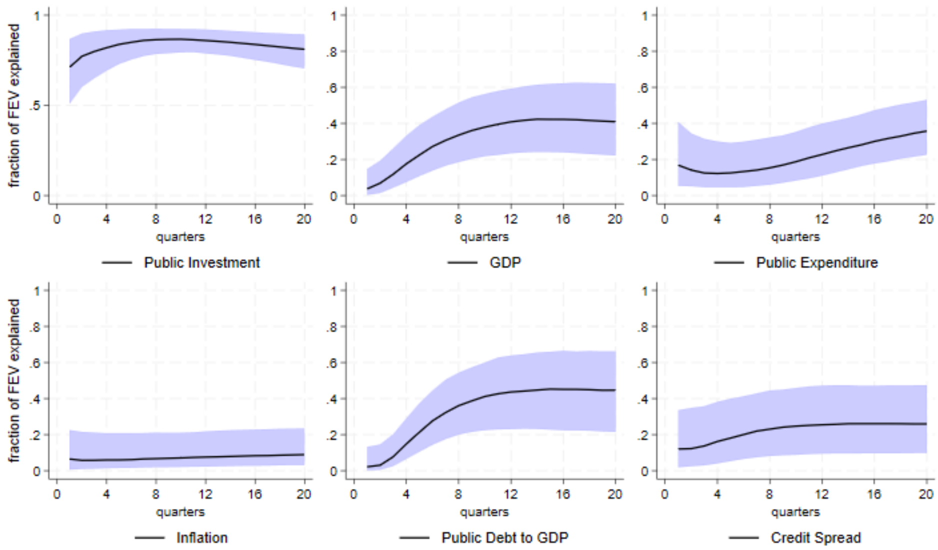


Figure D.4: Share of forecast error variance explained by the identified public-investment MFEV shock at each horizon h (95% confidence intervals).

and horizons, with 95% confidence intervals. The MFEV shock explains more than 85% of the FEV of public investment, while the corresponding shares are below 40% for GDP, total expenditure, and the debt-to-GDP ratio and below 20% for the remaining variables in the VAR.