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THE RESPONSE OF PRIVATE INVESTMENT TO  
AN INCREASE IN PUBLIC INVESTMENT

Mario Alloza, Danilo Leiva-León and Alberto Urtasun

## ABSTRACT

Since the 2008 crisis, public investment as a proportion of GDP has declined significantly both in Spain and in other euro area countries. That trend recently came to an end, given that public expenditure has been bolstered in response to the health crisis and will be further reinforced in Spain by the EU funds received under the Next Generation EU (NGEU) programme. Public investment's effect on economic activity will depend, among other factors, on its impact on private investment, the sign of which is, a priori, ambiguous. This article assesses the short-term relationship between public and private investment using the structural vector autoregressive (SVAR) approach. The results suggest that, on average, increases in public investment in Spain tend to generate a positive impact on private investment. In particular, an increase of 1% in public investment would be associated with an equivalent increase in private investment in the short term. This finding underscores the important role that NGEU could play in economic developments in the years ahead.

**Keywords:** public investment, NGEU, private investment, vector autoregression.

**JEL classification:** C11, C32, E22, E64.

The authors of this article are Mario Alloza, Danilo Leiva-León and Alberto Urtasun of the Directorate General Economics, Statistics and Research.

### Introduction

Since the 2008 crisis, public investment has declined significantly as a proportion of GDP and of total investment both in Spain and in other euro area countries (see Charts 1.1 and 1.2).<sup>1</sup> That trend was interrupted by the health crisis, given that certain types of public investment were included in the response to the crisis. Going forward, this spending component will be further reinforced in Spain by the Recovery, Transformation and Resilience Plan (RTRP), through which the bulk of EU funds received under Next Generation EU (NGEU) are to be channelled. The total volume of spending over the period 2020-2026 could amount to just over €83 billion (7.4% of GDP in 2020).<sup>2</sup> Four out of every five euro will be earmarked for public investment.<sup>3</sup>

What effect these measures have on economic activity depends on a range of factors. One such factor is the type of projects to be implemented. For instance, projects that have an impact on aggregate productivity (such as investment in productive infrastructure) can generate more lasting stimuli for economic activity than other projects with a lesser supply-side impact (e.g. housing renovation subsidies). A factor specific to public investment under NGEU is its capacity to mobilise private investment. One aspect that has been widely studied in the economic literature is the sign of the interplay between public and private investment. A priori, this sign is disputed, since there is a case to be made both for complementarity and substitutability between the two types of expenditure.<sup>4</sup>

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1 Public investment is one of the public expenditure categories most prone to adjustment during periods of fiscal consolidation. Pérez and Solera (2017) show how, in Spain, the contribution of public investment to the fiscal consolidation process that followed the 2009 crisis clearly exceeded its weight in public expenditure. There is reason to believe that these developments are undesirable. As a result, in the context of the European debate over the design and implementation of a future fiscal consolidation process, it has recently been suggested that “golden rules” should be introduced to safeguard a portion of public investment expenditure during such processes (see, for example, Darvas and Wolff (2021)).

2 This figure only includes the funds provided to Spain in the form of grants. It does not include a hypothetical future request for the funds available – up to a maximum of over €70 billion – in the form of loans.

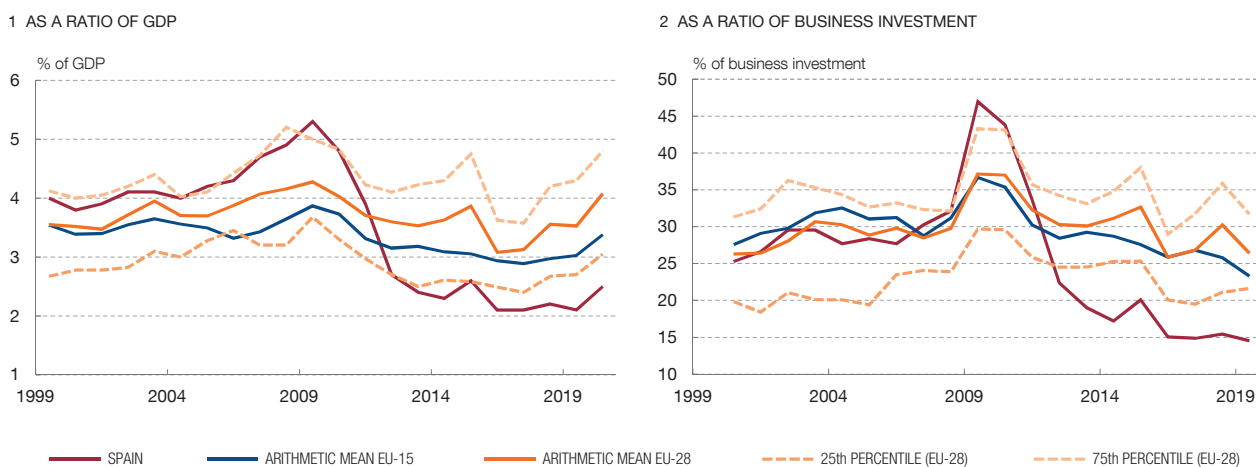
3 Of the total funds that Spain is eligible to receive in the form of grants, close to 80% would be earmarked for public investment. According to the key principles of the RTRP, the bulk of the funds will finance projects relating to sustainable mobility and territorial cohesion, renovation of the housing stock to improve energy efficiency, the promotion of renewable energy sources, private sector digitalisation and the modernisation of the public sector. In total, 40% of the funds will go towards the green transition and 29% towards digitalisation.

4 In some specific circumstances, the relationship between the two variables is positive. For instance, one idiosyncrasy of investment under NGEU is that a substantial portion must be accompanied by private investment. In particular, the RTRP includes a new project type – Strategic Projects for Economic Recovery and Transformation

Chart 1

## CHANGE IN PUBLIC INVESTMENT

Since the 2008 crisis, public investment as a proportion of GDP and total investment has declined significantly both in Spain and in other euro area countries. The response to the health crisis began to reverse this trend.



SOURCE: Eurostat.



Traditional analysis of the effects of public investment on private investment generally distinguishes between the short-term and the long-term impact. This is because different channels can operate in each of these two time frames.

In the short term, the effect of public investment on private investment is typically thought to be ambiguous. On the one hand, higher public investment boosts demand. To meet that demand, factor endowment has to be increased, including installed private capital. On the other hand, an increase in public investment (and, broadly speaking, in public expenditure) exerts upward pressure, in the absence of other offsetting measures, on the government deficit, leading to an increase in real interest rates and, given its substantial sensitivity to changes in this variable, to a decline in private investment (substitution effect).<sup>5</sup>

However, there is some consensus that, in the long term, the effect of public investment on private investment tends to be positive under a wide range of scenarios.<sup>6</sup> First, the

(PERTE by the Spanish acronym) – through which a large share of the NGEU funds are channelled. The aim of these initiatives is to co-finance public-private projects that, as the name suggests, are held to be particularly strategic for the Spanish economy. For instance, under the PERTE for the development of electric and connected vehicles, the €4.3 billion provided by general government is expected to be supplemented by €19.7 billion in private investment.

5 Boehm (2020) shows that, under a broad series of general equilibrium economic models, the substitution effect between public and private investment occurs in the event of temporary shocks to the first of these variables.

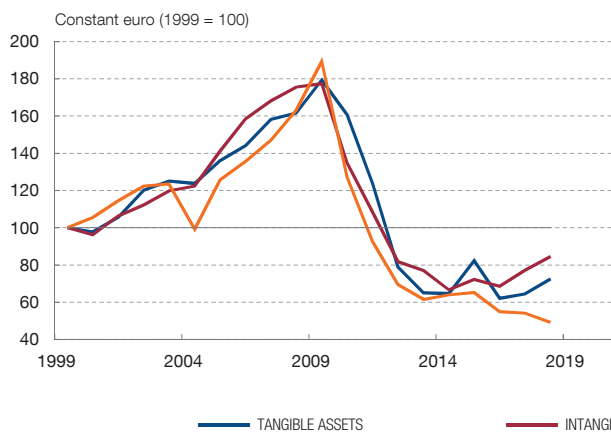
6 See Ramey (2020). In a seminal study, Baxter and King (1993) use a neoclassical model to illustrate how public investment has a highly favourable long-term effect on private investment and GDP under various assumptions regarding the efficiency of public capital.

Chart 2

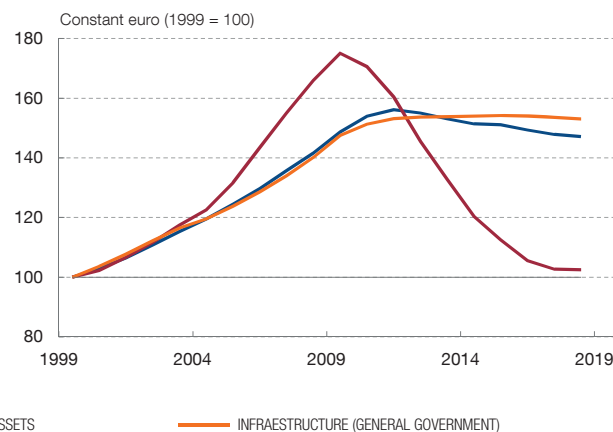
**CHANGE IN PUBLIC INVESTMENT AND CAPITAL, BY SECTOR**

The marked decline in public investment that began in 2008 has negatively affected the accumulation of public capital. This has been particularly evident in sectors with high depreciation, such as intangible assets (which include software and R&D). The reduction in the stock of productive public capital could act as a brake on business investment, insofar as said stock has an adverse bearing on employment income and private capital.

1 GROSS PUBLIC INVESTMENT



2 STOCK OF PUBLIC CAPITAL



SOURCE: Instituto Valenciano de Investigaciones Económicas.

substitution effect observed in the short term is typically tempered if the boost to private investment persists over time.<sup>7</sup> In addition, the complementarity tends to be greater and to occur sooner if the public investment projects include certain characteristics, such as short implementation time frames or the spending being funded through less distortionary tax instruments.<sup>8</sup> Moreover, the greater the potential to catalyse productivity, the more marked that complementarity will be, since public investment expenditure leads to higher returns on private capital and, therefore, increased private investment (hence the importance of carefully selecting the NGEU-funded projects). Examples of public investment that acts as a catalyst for private sector productivity are new infrastructures and communications improvements, which tend to encourage private investment, as well as public investment in intangible goods, which usually gives rise to private-sector R&D investment projects.

In the case of Spain, the decline in public investment since 2008 has been particularly marked and affected all components, having a significant impact over time on the stock of public capital (see Charts 2.1 and 2.2). For the reasons discussed above, this could adversely affect employment income and private capital, which would act

7 This is because agents form their expectations bearing in mind that factors' marginal productivity will be positively affected by an accumulation of productive public capital over a longer period of time (see Dupaigne and Fève (2016)).

8 Leeper, Walker and Yang (2010) note that public investment in low-productivity projects funded using distortionary taxes may have a low or even negative impact on private investment in the long term.

as a brake on business activity. Thus, higher public investment in areas such as infrastructure and R&D could have a particularly strong effect in terms of encouraging private investment.<sup>9</sup>

Owing to the various above-mentioned channels, the question as to public investment's net impact on private investment in the short term cannot be answered a priori, meaning that empirical analysis is required. This is a particularly salient issue at the present juncture, when the extent to which fiscal stimuli under NGEU can serve as a catalyst for the ongoing recovery is a point in question. Accordingly, this article focuses a detailed analysis of the relationship between public and private investment over a short-term horizon.<sup>10</sup>

## Methodology and data used

Structural vector autoregressions (SVAR) can be a useful empirical framework to infer the relationship between two variables when economic theory offers no clear indication of its sign. This modelling strategy permits the different variables to endogenously influence each other (e.g. public investment influencing private investment) and simultaneously allows evaluation of the effect of an exogenous shock to one variable (e.g. public investment) when the others (including, for example, private investment) remain unchanged.

In an SVAR model, as a technical requirement for identifying parameters, certain restrictions must be imposed regarding the relationships between the variables. There are various techniques for defining these restrictions. This article proposes a sign restriction-based approach, which uses the signs of the effects between certain variables suggested by economic theory. For the effect of public investment shocks on private investment, which is the focus of this article, no sign is imposed, precisely to avoid influencing the results *ex ante* (see Fry and Pagan (2011)).<sup>11</sup> Further, the economic cycle has a significant bearing on both investment types, which makes it more difficult to identify the impact of a public investment shock on private investment. In an effort to accurately estimate this effect, the proposed identification used in this article is supplemented by a variable reflecting the Spanish economy's fiscal position, as a tool to help identify the pertinent effects.

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9 Ramey (2020) argues that the further the stock of public capital stands from its optimal steady-state level, the higher its marginal productivity and, therefore, its impact on private investment and activity.

10 See Banco de España (2021) and Albrizio and Geli (2021) for an analysis of the factors that would allow NGEU to become a catalyst for long-term growth.

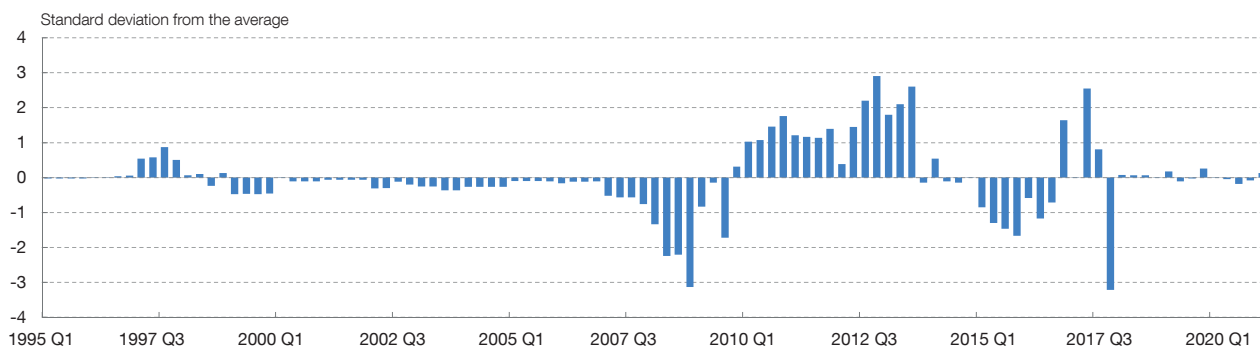
11 A common alternative to sign restriction identification is the recursive identification approach, where the order in which the variables are affected by each other is determined a priori (see, for example, Pereira (2000) and Mitnik and Neumann (2001)). However, estimations under this approach tend to be highly sensitive to the assumption regarding the order in which the variables are affected by one another, owing to the inherent endogeneity between private and public investment. In this respect, the sign restriction identification approach has the advantage of requiring no assumption regarding the order in which some variables affect others; it also tends to be more robust to the simultaneity of the effects between the variables, as is the case between public and private investment.

Chart 3

**NARRATIVE MEASURE FOR TAX CHANGES ENACTED**

This measure is based on the work of Gil et al. (2019) and summarises tax changes enacted in Spain by different public institutions. The chart shows that this variable captures the impact on tax revenue of particularly important fiscal measures, such as the 2007 reduction in personal and corporate income tax (Law 35/2006) or the tax increases adopted as part of the austerity packages implemented in May 2010, August and December 2011 and July 2012.

1 AS A RATIO OF GDP



SOURCE: Banco de España.



Specifically, the three variables used in the model are public investment, private investment and a measure of tax policy. Public and private investment are identified via the National Accounts items relating to gross fixed capital formation by general government and non-financial corporations, respectively.<sup>12</sup> For the tax policy variable, the narrative approach is followed (Gil et al., 2019). The first step is to prepare the variable by compiling the tax measures adopted in Spain over time. This is done using a set of diverse sources, all of which stem from public institutions (budget laws, annual and monthly bulletins from the State tax revenue service and Banco de España reports). The next step is to calculate the impact on revenue (as a proportion of GDP) of each of these measures in the quarter immediately after their introduction. The timeline of the resulting variable is shown in Chart 3.<sup>13</sup>

As has been indicated, the model's identification strategy is based on assuming sign restrictions in some of the contemporaneous relationships between the structural

12 When defining this variable, certain considerations must be taken into account. Specifically, the boundary between public and private investment is sometimes blurred. For instance, public infrastructure investment is not always undertaken by agents in the general government institutional sector but in some cases by State-owned enterprises. In addition, the distinction between public and private investment is sometimes determined by accounting conventions, meaning there are occasionally reclassifications between the two. For instance, some public investments undertaken through public-private partnerships (PPP) are ultimately considered private investments. This article uses the measure of public investment based on the National Accounts definition, although it is corrected for reclassifications between the investment implemented by general government and that made by non-financial corporations, without affecting the total economy's capital stock.

13 The timeline of this variable reflects the impact on tax revenue of particularly important fiscal measures, such as the 2007 reduction in personal and corporate income tax (Law 35/2006) and the tax increases adopted as part of the austerity packages implemented in May 2010, August and December 2011 and July 2012. See Gil et al. (2019) for a detailed description.

Table 1

**SUMMARY OF IDENTIFYING RESTRICTIONS**

	Structural innovations		
	Public investment	Private investment	Public revenue
Public investment residual	+	+	+
Private investment residual		+	-
Public revenue residual	+	-	+

**SOURCE:** Banco de España.

innovations and the model variables.<sup>14</sup> In particular, it is assumed that a positive shock in the fiscal variable, i.e. a tax measure that increases tax revenue per unit of output, gives rise to an increase in public investment and a reduction in private investment. The rationale for the first of these two effects is that, once they have decided to increase the tax burden, budgetary authorities have greater leeway to raise public expenditure and, therefore, public investment. Second, it is assumed that the higher level of taxation acts as a disincentive for private investment projects; hence the sign is negative in this case.

As for the effects of a positive public investment shock on the other two variables, first, it is assumed that it will give rise to an increased tax burden, in order to balance public finances in response to the higher expenditure. Second, the sign of the impact of public investment on private investment is left open, given that determining that sign is precisely the object of this article.

Lastly, for a positive private investment shock, it is assumed that the sign of the impact on public investment is positive, in line with the existing empirical literature.<sup>15</sup> The effect on the tax burden is taken to be negative, since the increased investment leads to a broadening of tax bases, meaning that to attain a certain level of tax revenue, tax rates can be lowered. The sign restrictions used in the model are summarised in Table 1.

## Results

The effect on private investment of a public investment shock is obtained by estimating the model for the period from 1995 Q1 to 2019 Q4.<sup>16</sup> Specifically that impact, shown in Chart 4.1 for an unexpected 1 percentage point (pp) increase in the rate of change of public investment, has a positive sign. Therefore, our results

14 This type of identification strategy for vector autoregression models has been used widely in different macroeconomic studies. See Mountford and Uhlig (2009) and Fry and Pagan (2011).

15 Specifically, Kamps (2005) shows how an increase in aggregate demand (possibly stemming from higher private investment) leads to an increase in public investment.

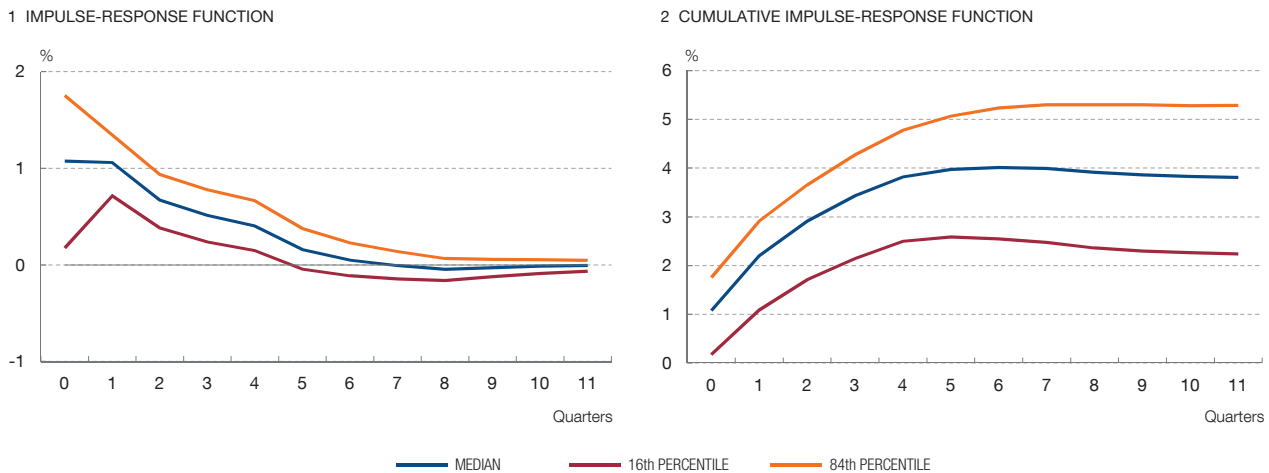
16 The model is specified in log differences and includes four lags.



Chart 4

**RESPONSE OF PRIVATE INVESTMENT TO AN INCREASE IN PUBLIC INVESTMENT**

Estimates based on a structural vector autoregressive model which includes information on public investment, private investment and public revenue. The results suggest that, on average, increases in public investment in Spain tend to generate a positive effect on private investment.



SOURCE: Banco de España.



suggest that the channels conducive to public investment having a positive effect on private investment in the short term, discussed in the introduction, prevail over the channels working in the opposite direction. The contemporaneous response of private investment stands at around 1%, although that estimate comes with considerable uncertainty, as evidenced by the response percentiles. The duration of that response is somewhat more than one year. Chart 4.2 shows the cumulative response, which stands at approximately 4% after four quarters.

As discussed above, different signs are found in the literature when it comes to estimating the short-term relationship between public and private investment. This article presents one approach to the problem, but it is worth examining the sensitivity of the results to the assumptions made. To check the robustness of these estimates, four additional exercises are conducted using different datasets and identification strategies compared with the baseline model. First, a model is estimated in which private productive investment is replaced by investment in capital goods. In the second model estimated, the fiscal measures variable is replaced by public sector revenues.<sup>17</sup> Third, the variable indicating the direction of fiscal policy is replaced by

17 The rationale for the first robustness check lies in the different definitions of private investment. In particular, while the measure of private productive investment used is constructed in-house by the Banco de España, and may be affected by classification criteria that lack economic substance, investment in capital goods is a measure published by the National Statistics Institute (INE by its Spanish acronym) and refers to a more specific concept of investment. In the same vein, the second robustness check seeks to control for possible measurement errors with respect to the Spanish economy's fiscal position.

Table 2

**MODEL ESTIMATES**

Type of specification	Effect on impact	Cumulative effect (a)
Baseline specification	1.07	3.82
Robustness 1: using investment in capital goods	1.57	4.71
Robustness 2: using public sector revenues	1.54	3.13
Robustness 3: using monetary policy information	1.43	2.46
Robustness 4: assuming public investment has a positive impact on private investment	1.19	3.96

**SOURCE:** Banco de España.

**NOTE:** the table shows the effect, on the impact and cumulatively, on private investment in the event of a 100 bp shock in public investment.

**a** Cumulative effect after four quarters.

a monetary policy variable and it is assumed that the identification relationships described above are unchanged.<sup>18</sup> All three robustness checks yield estimates of the effect of public investment on private investment similar to those obtained under the baseline model in terms of the direction, intensity and duration of the effect. Lastly, the baseline model is estimated again, but this time assuming, a priori, that public investment has a positive impact on private investment, to assess possible changes in the intensity and duration of the effect. The estimates resulting from this exercise show no significant changes in either aspect as compared with the baseline model.<sup>19</sup> Table 2 details the estimates associated with all of the specifications considered.

A comparison of these results with those in the empirical literature reveals the broad disparity in the estimated effect of public investment on private investment. For instance, Boehm (2020), using OECD panel data and an identification based on restriction exclusions, finds that temporary public investment shocks result in a contraction in private investment. Similarly, Leeper, Walker and Yang (2010) estimate a general equilibrium model using data for the United States. The authors observe that delays in the implementation of public investment could crowd out private investment in the short term.<sup>20</sup> Pereira (2000), using a vector autoregressive model for the United States, estimates that a shock of 1% in public investment is associated with long-term elasticity in private investment of

18 In this exercise, it is assumed that both policies – raising taxes or interest rates – would have a contractionary effect on the economic cycle and, therefore, would be associated with similar identifying restrictions for both types of investment. However, owing to the ambiguous interplay between fiscal and monetary policy, these estimates may be used as robustness checks, but not as baseline specifications.

19 This exercise serves to confirm the magnitude of the effect of public investment on private investment, once the direction of that effect has been determined.

20 The longer the implementation delay, the greater the magnitude and duration of this effect. In terms of discounted present value, each dollar earmarked for public investment could reduce private investment by between 0.35 and 0.40 dollars, depending on the implementation delay considered.

0.23%. Hasna (2021) uses US Department of Energy data to quantify the effect of public investment in the green transition (for instance, investment to improve a building's energy efficiency). Her empirical strategy uses institutional characteristics that suggest that part of the Department of Energy's expenditure is exogenous to economic conditions. She finds that green public investment would have a positive and very high impact on economic activity in general, and on green private investment in particular.<sup>21</sup> From a broader international perspective, Abiad, Furceri and Topalova (2016) estimate an effect on the level of private investment similar to that of GDP (0.4%) after one year, likewise using a group of OECD countries and an identification strategy based on the use of fiscal variable forecast errors. Their findings suggest that the effect on private investment would be greater in countries where public spending is more efficient.<sup>22</sup> Meanwhile, Mittnik and Neumann (2001) use vector autoregression models to determine the effect of public investment on private investment in six advanced economies. The authors report that in most countries a shock of 1% on public investment is associated with a contemporaneous response of a positive sign in private investment of between 0.1% and 0.9%.

This is a broad range of estimates that includes effects of opposite sign. The estimates in this article, which suggest private investment would increase in the short run on a similar scale to the increase in public investment, would stand at the higher end of that range. However, this result may partly be explained by the type of public investment implemented in the past in Spain, with public infrastructure (associated with larger effects on potential output) playing a central, albeit decreasing, role in public measures. Any extrapolation of these estimates to the potential impact of future investment projects should, therefore, factor in an analysis of their characteristics, in dimensions such as the duration of the investment shock or the efficiency of those projects.

## Conclusion

This article underlines the disparity, both theoretical and empirical, in the effects of public investment on private investment. The divergence in the findings owes to the specific conditions in which public investment is undertaken: its duration, how it is funded, the design of the implementing projects, etc. The findings of this article contribute to this debate, suggesting that, on average, increases in public investment in Spain tend to drive private investment. This underscores the important role that

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21 Thus, a \$1 increase in such public spending could boost total green investment (public and private combined) by more than \$38 over the short term.

22 Abiad, Furceri and Topalova (2016) use data from the *Global Competitiveness Report*, a survey conducted by the World Economic Forum, to proxy the efficiency of public spending in each country. In countries with high efficiency, a shock to public investment would increase private investment as a share of GDP by around 1 pp after four years.

NGEU could play in economic development in the years ahead. It is therefore vital that the projects under this programme are selected with the utmost care, ensuring that they are consistent with the Spanish economy's medium and long-term structural transformation goals.

25.5.2022.

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