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The impact of investment in Public Private Partnerships on Public, Private investment and GDP in Portugal

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Abstract

In this paper we test the macroeconomic impact of investment in public-private partnerships, public and private investment in Portugal through a VAR model with four variables: public and private investment, PPP investment and GDP, to the period 1998-2013. An assessment of crowding-in / crowding-out effects of investment in PPPs is carried out. We also proceed to the calculation of macroeconomic rates of return on investment in PPP, public investment and private investment. The results show that public and private investment has a positive effect in GDP while investment in PPP reduces the Portuguese GDP. In what concerns to crowding-in/crowding-out effects an increase in PPP investment crowds-out both in private and public investment, while public investment presents a crowding-in effect both in private investment and in investment in PPP; and private investment shows the same crowding-in effect both in investment in PPP and in public investment.

1. Introduction

In the 1980s and 1990s an extensive privatization program took place in the countries of Western Europe. These privatizations were motivated by the idea that the private sector shows higher efficiency standards in the management of companies in comparison to public management. However, they remained some reservations about the private sector capacity to ensure the management of natural monopolies and large infrastructure with high sunk costs more efficiently than the public sector.
In the latter case, Public-Private Partnerships (PPP) imposed itself, more recently, as alternatives for financing investment projects traditionally funded by taxation and executed in the sphere of public sector.

This paper studies the impact of investment in Public Private Partnerships on public and private investment and GDP in Portugal. The focus on Portugal is due to two main reasons. On the one hand, Portugal is the European country that, between 1990 and 2009, has spent the higher amount of money in PPP in percentage of its GDP (10.55%), representing 7% of the value expended in European PPPs and being the third largest PPP market by value in Europe. See table 1 and figure 1. On the other hand, the memorandum of understanding for Portugal demanded a study of the impact in the country's economy of the investment made in PPPs.

Being so, an assessment of crowding-in / crowding-out effects of investment in PPPs is carried out. Additionally, we proceed to the calculation of macroeconomic rates of return on investment in PPP, public investment and private investment aimed at quantifying the impact of each of these components of investment in GDP.

Macroeconomic theory suggests that an increase in investment in PPPs in public investment can have two opposite effects on private investment, Aschauer (1989b) and Mittnik and Neumann (2000). On the one hand, an increase in public investment in PPPs is partly funded in the capital markets, which would lead to a reduction in the funds available to private investors and to an increase in interest rates charged by lenders. This would lead to a decrease in the rate of return on private investment, thus causing crowding-out of this. Conversely, an increase in public investment in PPPs can create more favorable conditions for investment by the private sector, especially through the development of road infrastructure, railway, airports, among others. In this case, there is crowding-in in private investment.

From a macroeconomic point of view, it is important to have a criterion for assessing the desirability of the investment financed through PPPs, by contrast to public investment and private investment.

The main novelty of this paper is the use of a VAR-model technology applied to investment in PPPs with four variables: PPP investment, public investment, private investment and GDP. This type of model enables to identify a shock to a variable, which is an independent innovation that may occur in other variables. It also has the advantage of allowing the evaluation of the dynamic effects of all variables in the analysis and overcome the issue of endogeneity of the regressors.

The paper is organized as follows. Section 2 briefly reviews general literature about PPP and studies that have applied a VAR approach to study the impact of public and private investment on the economy. Section 3 describes the econometric methodology underlying our empirical application, namely, VAR specifications, macroeconomic rates of return and the computation of crowding-in and crowding-out effects. Section 4 discusses the empirical results of this study. Section 5 summarizes the main findings.

2. Literature Review

The term PPP has been used more frequently in the literature since the 90s. *"The public-private partnerships (PPP) phenomenon has been with us for a long time. The phrase first became used by a specialist audience in the 1970s, and books were being written about such partnerships even in the 1980s (e.g. Rose, 1986), although it was the 1990s before it was widely recognized, when the Private Finance Initiative was launched by the John Major administration in the UK, and the acronyms 'PPP' became common currency. However, the actual phenomenon goes much further back into history."* Bovaird (2010). And it is used to refer to different types of contracts between the public and private sector. Argy (1999).

However there is some consensus in what concerns the key elements of a PPP. Being so, and as it can be found in Livro verde para as parcerias público-privadas (2004), the main elements that characterize a PPP are:*"(…) the relatively long duration of the relationship, involving cooperation between the public partner and the private partner (…); (…)the method of funding the Project, in part from the private sector, sometimes by means of complex arrangements between the various players(…); (…)the distribution of risks between the public partner and private partner(…).*

Other definitions can be found in Van Ham e Koppenjan (2001) and Iossa and Martimort (2008).

Broadbent and Laughlin (1999) were pioneers in this field of investigation, raising five main questions for the study of PPPs in England, namely: *"Is PFI a form of privatisation of the public sector? What is the nature of PFI and who is regulating its application? How are definitions of PFI in terms of value for money and risk transfer derived and operationalised? How are PFI decisions made in different areas of the public sector and what are the effects of these decisions? What is the merit and worth of PFI?"*

The question of *value for money* (VfM) has been largely discussed in what concerns to PPPs. Hodge and Greve (2008) argue that *"Value for Money is a purposely vague concept and one designed to reorient the language of debate away from traditional concerns such as choosing the "cheapest" competitive construction bid which meets the public interest, towards discussion of whole-of-life costs, risk transfers and risk-adjusted discounted rates for specific large projects."*

The studies carried out to evaluate PPPs performance were, until now, mainly of a microeconomic nature and come to very different conclusions. Pollit (2002) says that *"in*

a sample of ten major PFI case evaluations undertaken, the best deal was probably obtained in every case, and good value for money was probably achieved in eight of the ten cases." Pollock, Shaoul and Vickers (2002), Monbiot (2002), Bloomfield, Westerling and Carey (1998), Greve (2003) and Walker and Walker (2000) studied PPPs in the United Kingdom, United States, Europe and Australia, respectively and were unanimous in concluding that PPP where not the best option if VfM is taken into account.

Also in what concerns econometric studies related to PPPs Hammami, Ruhashyankiko and Yehoue (2006) carried out a first attempt *"to analyze the determinants of PPPs in infrastructure projects using the World Bank's Private Participation in Infrastructure (PPI) database on projects for developing countries during 1990-2003".*

Presently, the *focus* of investigation related to PPP has been changing. In fact, a new purpose is to understand the reasons why governments choose PPPs to investment in public infrastructures. *"In other words, our renewed agenda items should tackle why governments choose to introduce PPP despite the fact that projects can be financed through traditional methods"* Greve e Hodge (2008). In 1996 Terry said that *"Private financing promised a way to provide infrastructure without increasing the public sector borrowing ratio."* In this context, Hodge (2002) calls the attention to the fact that the duration of a PPP can cover more than one parliamentary term and Flinders (2005) argues that *"Governments continue to display such an apparently blind commitment to PPPs."*.

More recently Greve and Hodge (2008) up dated the study carried by Broadbent and Laughlin (1999). In their opinion the most relevant questions related to PPPs are: *1. What is the merit/worth of PPPs? 2. In what circumstances do PPPs provide an effective and efficient tool for governments in terms of simply VfM [value for money] and innovation? 3. In what circumstances do PPPs provide governments with a successful governance tool to overcome traditional governance failures? 4. How can PPPs be best regulated in the public interest in future? 5. What role to date have Auditors General undertaken in PPP evaluation, and how might we meta-summarize their assessment to date? 6. Why and how are PPPs promoted in some jurisdictions and not others? 7. What is the nature and consequence of a global "PPP industry"? 8. What is the place of PPPs in development activities? 9. What is the next chapter for PPPs and what are the implications?*

This paper analyses the investment in PPP in a macroeconomic perspective since it studies the aggregated effects of investment in PPP in other macroeconomic aggregates, such as, public investment, private investment and GDP. An assessment of

crowding-in / crowding-out effects of investment in PPPs is carried out and macroeconomic rates of return on investment in PPP, public investment and private investment were calculated and aimed at quantifying the impact of each of these components of investment in GDP.

In fact, since Aschauer's (1989a, 1989b) there has been interest in analyzing the effects of public investment on aggregate economic activity and also to investigate whether public investment crowds-in/crowds-out private investment.

Voss (2002) and Mittnik and Neaumann (2001) estimated the effects of public investment on GDP and the crowding-in/crowding-out effects using a VAR approach. Voss (2002) estimated a VAR model with GDP, public investment, private investment, the real interest rate, and deflators of private and public investment, for the US and Canada, for the period of 1947-1997 and concluded that public investment crowds-out private investment. Mittnik and Neaumann (2001) used a VAR model with GDP, private investment, public investment and public consumption for six industrialized economies. They concluded that public investment tends to exert positive effects on GDP, and that there is no evidence of crowding-out effects.

Pereira and Andraz (2005) used data for Portugal between 1976 and 1998 and using a VAR-model considering private-sector output, employment and investment and public investment. Empirical results at the aggregate level indicate that public investment positively affects private investment, employment and output.

More recently, Afonso and StAubyn (2009) using annual data from 14 European Union countries, Canada, Japan and United States evaluated the macroeconomic effects of public and private investment with a VAR analysis. The results point to the existence of positive effects of public investment and private investment on output. On the other hand the crowding-in effect of public investment on private investment vary across countries, while the crowding-in effects of private investment on public investment is more generalized.

3. Econometric Methodology

3.1 VAR specification

A four variable VAR model was estimated. The variables included in the VAR are the logarithmic growth rates of real Public Private Partnerships investment (IPPP), real public investment (IPub), real private investment (IPriv) and real output (Y).The list of concessions used to calculate the PPP investment can be seen in Table 2. Public investment was calculated by the difference between the Gross Fixed Capital Formation series (GFCF) from Public Administration and the investment from reclassified PPP as belonging to Public Administration. In what concerns to private investment it results from the difference between the GFCF made by the private sector and the investment from the non-reclassified PPP.

The VAR model can be presented as:

$$X_t = c + \sum_{i=1}^{p} A_i X_{t-1} + \varepsilon_t \quad (1)$$

where X_t denotes the (4x1) vector of four endogenous variables given by $X_t = [\Delta logIPPP_t \quad \Delta logIPub_t \quad \Delta logIPriv_t \quad \Delta logY_t\ ]$, c is a (4x1) vector of intercept terms de, A is the matrix of autoregressive coefficients of order (4x4), and $\varepsilon_t = \left[\varepsilon_t^{Ippp} \quad \varepsilon_t^{Ipub} \quad \varepsilon_t^{Ipriv} \quad \varepsilon_t^{Y}\right]$ is a vector of random disturbances that contains the reduced form OLS residuals.

It is possible to identify orthogonal shocks, η, for each variable in (1), by imposing a set of restrictions, and to compute these orthogonal innovations via the random disturbances:

$$\eta_t = B\varepsilon_t \quad (2)$$

The estimation of (1) allows the determination of $Cov(\varepsilon)$. Therefore, with orthogonal restrictions and by means of an adequate normalization we have $Cov(\eta) = I$, where $I = (4X4)$ identity matrix , and we can write:

$$Cov(\eta_t) = Cov(B\varepsilon_t) = BCov(\varepsilon_t)B' \quad (3)$$

$$I = BCov(\varepsilon_t)B' \quad (4)$$

B has 16 parameters that need to be identified, since B is a square (nXn) matrix, which in this case has dimension four. From (4) only 12 parameters can be determined, by imposing orthogonality, essentially from the four variances and from the eight covariances. Four more restrictions are needed for the complete identification of the model. The use of a Choleski decomposition of the matrix of covariances of the residuals,

which requires all elements above the principal diagonal to be zero, provides the necessary additional six restrictions, an the system is then exactly identified.

It can be imposed a lower triangular structure to B^{-1},

$$B^{-1} = D = \begin{bmatrix} d_{11} & 0 & 0 & 0 \\ d_{21} & d_{22} & 0 & 0 \\ d_{31} & d_{32} & d_{33} & 0 \\ d_{41} & d_{42} & d_{43} & d_{44} \end{bmatrix} \quad (5)$$

which makes possible to write the residuals ε_t as a function of the orthogonal shocks in each of the variables:

$$\varepsilon_t = D\eta_t$$

The variables in the VAR were ordered from what is theoretically considered the most exogenous variable to the least exogenous one, with PPP investment ordered first, followed by public investment, private investment and output. Being so, a shock in PPP investment may have an instantaneous effect on all the other variables. However, PPP investment does not respond contemporaneously to structural disturbances in the other variables. A shock in public investment, the second variable, does not have an instantaneous impact on PPP investment, only on private investment and output. In fact, this ordering implies that private investment responds to PPP and public investment in a contemporaneous way, but not to shocks to the other variables. Indeed, one can recall that governments typically announce their spending and investment plans in advance. Therefore, economic agents can incorporate this information in their decisions.

3.2 Macroeconomic rates of return

Six different rates of return were computed based on the results from impulse response functions:

- the partial rate of return of investment in PPP;
- the partial rate of return of public investment;
- the partial rate of return of private investment;
- the rate of return of total investment originated by an impulse to PPP investment;

- the rate of return of total investment originated by an impulse to public investment;
- the rate of return of total investment originated by an impulse to private investment;

The partial rate of return of investment in PPP is computed as in Pereira (2000). Following an orthogonal impulse to investment in PPP the long-run accumulated elasticity of *Y* with respect to investment in PPP*, IPPP,* was computed deriving from the accumulated impulse response functions of the VAR:

$$\varepsilon_{IPPP} = \frac{\Delta logY}{\Delta log\ IPPP}$$

This long-run elasticity is the ratio between the accumulated change in the growth rate of output and the accumulated change in the growth rate of PPP investment.

It is known that:

$$\frac{\Delta Y}{\Delta IPPP} = \varepsilon_{IPPP} \frac{\bar{Y}}{\overline{IPPP}}$$

Being so, the partial rate of return of investment in PPP is obtained by solving:

$$(1 + r)^{20} = \frac{\Delta Y}{\Delta IPPP}$$

Note that it is not possible to decompose the variation of the product that is due separately to a change in investment in PPP and the consequent change in public investment and / or private investment. Thus, the isolated reading of the partial rate of return can bias the analysis of the total impact in the product of a variation of investment in PPP. We used 20 years to compute both rates of return as we assumed an average life of 20 years for a capital good.

The partial rates of return of public and private investment were computed using the same technology mention above.

Following Pina and St.Aubyn (2006) the rate of return of total investment originated by an impulse to PPP investment was obtained as a solution for:

$$(1+r)^{20} = \frac{\Delta Y}{\Delta IPPP + \Delta IPub + \Delta IPriv}$$

$$= \frac{1}{\left(\varepsilon_{IPPP}\frac{Y}{IPPP}\right)^{-1} + \left(\varepsilon_{IPub}\frac{Y}{IPub}\right)^{-1} + \left(\varepsilon_{IPriv}\frac{Y}{IPriv}\right)^{-1}}$$

That is, following a shock in investment in PPP both the direct impact of this shock and the indirect impact through changes taking place in public and private investment that result of this shock in PPP investment, are taken into account.

The rate of return of total investment originated by an impulse to public and private and investment were computed using the same technology mention above.

3.3 Crowding-in and crowding-out effects

The marginal effects of PPP investment on public investment and on private investment were derived, respectively, from:

$$\frac{\Delta Ipub}{\Delta IPPP} = \frac{\varepsilon_{IPPP}}{\varepsilon_{Ipub}}\frac{\overline{Ipub}}{\overline{IPPP}}$$

and

$$\frac{\Delta Ipriv}{\Delta IPPP} = \frac{\varepsilon_{IPPP}}{\varepsilon_{Ipriv}}\frac{\overline{Iprıv}}{\overline{IPPP}}$$

This way it is possible to check for the existence of crowding-in or crowding-out effects of PPP investment on public and private investment. These same effects were computed, following the same technology, for changes on public and private investment.

4.Empirical Results

4.1 Data

Annual data was used from 1998 to 2013 for the Portuguese economy. All variables are presented at constant prices. GDP was transformed into real values using the price deflator of GDP. The price deflator of the general government gross fixed capital formation was used to transform both the investment in PPP and the public investment into real values, and the price deflator of the gross fixed capital formation of the private sector to transform private investment. The data sources for the investment in PPP are UTAP, Brisa and INE.

4.2 VAR estimation

All variables used in the VAR are in logarithmic growth rates and in first differences of the original values. The unit root analysis showed that these first differenced variables are stationary, I(0) time series. See table 3 for unit root test statistics.

The Akaike and the Schwartz information criteria were used to select the VAR order used in the estimation. Taking into account the length of the data used in the VAR and those tests, a parsimonious model with only one lag were choose to avoid the use of too many degrees of freedom. The null hypothesis of normality of the VAR residuals was not rejected. The diagnostic tests for normality are presented in table 4. For a *p-value* of 5% the null hypothesis of no serial correlation of the residuals cannot be rejected as can be seen in table 4.

4.3 Rates of return

The information on accumulated responses of all VAR variables to a shock in investment in PPP and in public and private investment is presented in table 5. A 95 percent confidence band around estimates is also included and the figures in bold represent the cases where those confidence bands include positive or negative values only. The conclusion is that impulses in investment in PPP have no statistically significant effects on the other variables, at 95 percent level. On the other hand, impulses to private and public investment have a positive and significant impact on output.

The results for the output elasticity and the partial and total rates of returns of an impulse in investment in PPP, public and private investment, for the period of available data, are presented in table 6, 7 and 8, respectively. These three types of investment present a

positive output elasticity, with the output elasticity of private investment (0.3998) being higher than the output elasticity of public investment (0.1743) and investment in PPP (0.0026).

Both public and private investments present a positive partial and total rate of return, being the total rate of return of public investment (0.0491) superior to the total rate of return of private investment (0.0332). In the case of the investment in PPP this rate of return cannot be calculated once its partial rate of return is negative.

4.4 Crowding-in and crowding-out effects

The results for the crowding-in and crowding-out effects for the investment in PPP, public and private investment are presented in table 9, 10 and 11 respectively. Investment in PPP presents a crowding-out effect both in public and private investment, being the magnitude of the crowding-out effect on private investment (-2.1166) higher than in public investment (-0.4005). On the other hand, public investment crowds-in both in private investment and investment in PPP, showing a higher impact in private (0.9317) than in investment in PPP (0.3425). Finally, private investment presents also *a* crowding-in effect in both investment in PPP and public investment, with the impact in the investment in PPP(0.1011) being slightly higher than in public investment (0.0918).

5.Conclusions

Investment in PPP leads to a crowding-out effect both in private and public investment and has a negative impact on GDP. In fact, the partial rate of return of an investment in PPP is negative and the total rate of return associated with investment in PPP cannot be calculated since the accumulated gross growth rate in twenty years is negative.

Public investment presents a crowding-in effect in private investment and in investment in PPP. In fact, in the presence of a positive shock in public investment, the impulse response functions show a positive initial impact in both investment in PPP and GDP. The output elasticity of public investment is positive. The partial rate of return of public investment is greater than its total rate of return due to the fact that in the presence of a shock in public investment the response from the private investment and investment in PPP leads to an increase in output.

Finally, private investment crowds-in both in investment in PPP and in public investment. The output elasticity of private investment is positive. The partial rate of return of private investment is higher than its total rate of return taking into account that the response of both public investment and investment in PPP to a shock in public investment is positive.

The results that point to the existence of crowding-out in private and public investment in consequence of investment in PPP, together with a negative partial rate of return of PPPs are evidence that investment in PPP in Portugal, which involved almost exclusively the construction and operation of road infrastructures, is not the most efficient method of financing this kind of investment and / or have facilitated the expansion of road infrastructures beyond the social optimum. In fact, the investment through PPPs does not appear to be the kind of investment leading to the higher productivity that the Portuguese economy needs for a sustained increase in its export capacity and to allow for the correction of the accumulated external imbalances. Empirical results do also support the idea that this kind of investment should have undermined the capacity of private agents and the public sector to carry on their investment activities.

These conclusions are obviously conditioned to the information used, to the analyzed concessions and to the size of the sample used, time period and frequency. In fact, to estimate this VAR model only 16 annual observations (1998-2013) are available. Using one constant, four variables and one lag it implies estimating 5 parameters with only 14 observations. This means less than 3 observations per parameter. This number of observations is relatively small in order to conclusions to be drawn from the model with a high level of robustness. This small number of observations is also reflected on the impulse response functions shown in Figures 2, 3 and 4. In much cases the impulse response functions are statistically not different from zero.

With respect to the VAR model other specifications were tested, that included variables such as the total amount of taxes at constant prices, the long-term interest rate and the level of employment, with no impact on the final results.

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6.Appendix

Table 1. Total amount of investment in PPP between 1990-2009 in percentage of the 2009 GDP of each country

PT	10.55%
UK	8.38%
HU	6.39%
EL	6.05%
CY	4.52%
ES	2.77%
IE	2.5%
SK	2.02%
PL	1.39%
BE	0.97%
NL	0.8%
BG	0.73%
FR	0.71%
IT	0.55%
CZ	0.54%
AT	0.46%
DE	0.44%
FI	0.29%
SE	0.17%
DK	0%
LV	0%
MA	0%
RO	0%
SI	0%

Source: Kappeler and Nemoz (2010) and Eurostat

Tabel 2. List of concessions used to calculate the PPP investment

Concession
Road sector
Concessão Lusoponte
Concessão Norte
Concessão Oeste
Concessão Brisa
Concessão Litoral Centro
Concessão Beira Interior
Concessão Costa de Prata
Concessão Algarve
Concessão Interior Norte
Concessão Beiras Litoral e Alta
Concessão Norte Litoral
Concessão Grande Porto
Concessão Douro Litoral
Concessão Grande Lisboa
Concessão Túnel do Marão
Subconcessão Transmontana
Subconcessão Douro Interior
Subconcessão Baixo Alentejo
Subconcessão Baixo Tejo
Subconcessão Litoral Oeste
Subconcessão Algarve Litoral
Subconcessão Pinhal Interior
Healthcare sector
H. Braga - Gestão do Estabelecimento
H. Braga - Gestão do Edifício
H. Cascais - Gestão do Estabelecimento
H. Cascais - Gestão do Edifício
H. Loures - Gestão do Estabelecimento
H. Loures - Gestão do Edifício
H. V Franca - Gestão do Estabelecimento
H. V Franca - Gestão do Edifício
Rail sector
Metro Sul Tejo
Fertagus
Defence sector
SIRESP

Table 3. Autocorrelation test: Durbin-Watson and Unit root tests, variables in first diferences: Augmented Dickey-Fuller

	Durbin-watson	Augmented Dickey-Fuller	
		t-Statistic	Critical value
dlog (Y)	2.1585	-5.5407	-2.7406
dlog(IPPP)	1.0277	-2.9548	-2.7406
dlog(Ipub)	1.9275	-2.8271	-2.7406
dlog(Ipriv)	2.0737	-4.8176	-2.7406

Note: critical values are for 1% level. No tendency or interception was adopted.

Table 4. Residual normality tests

Component	Skewness	Chi-sq	df	Prob.
1	1.222453	3.486915	1	0.0619
2	-0.072623	0.012306	1	0.9117
3	1.074501	2.693956	1	0.1007
4	-0.028190	0.001854	1	0.9657
Joint		6.195031	4	0.1850

Component	Kurtosis	Chi-sq	df	Prob.
1	4.036431	0.626610	1	0.4286
2	2.229281	0.346505	1	0.5561
3	4.694197	1.674344	1	0.1957
4	2.001411	0.581688	1	0.4457
Joint		3.229147	4	0.5202

Component	Jarque-Bera	df	Prob.
1	4.113525	2	0.1279
2	0.358811	2	0.8358
3	4.368300	2	0.1126
4	0.583542	2	0.7469
Joint	9.424178	8	0.3078

Table 5. Accumulated responses to shocks in PPP, public and private investment

Accumulated responses of	Shock to investment in PPP			Shock to Public Investment			Shock to Private Investment		
	-2 S.E.	CENTRAL	+2 S.E	-2 S.E.	CENTRAL	+2 S.E	-2 S.E.	CENTRAL	+2 S.E
IPPP	**0,0675**	**0,3804**	**0,6933**	-0,0318	0,2513	0,5344	-0,1333	0,2914	0,7161
IPub	-0,1158	-0,0291	0,0576	**0,0627**	**0,1403**	**0,2179**	-0,0631	0,0507	0,1645
IPriv	-0,065	-0,0274	0,0102	-0,0116	0,0233	0,0582	**0,0499**	**0,0982**	**0,1465**
Y	-0,0158	0,001	0,0178	**0,0092**	**0,0245**	**0,0398**	**0,0182**	**0,0393**	**0,0604**

Table 6. Partial and total rates of returns originated by an impulse in investment in PPP

Impulse response functions acumulated results	
ΔlogY	0,0010
Δlog Ipriv	-0,0274
ΔlogIPub	-0,0291
Δlog IPPP	0,3804
ε_{IPriv}	-0,0365
ε_{IPub}	-0,0344
ε_{IPPP}	**0,0026**
$\overline{Y}/\overline{IPriv}$	5,5245
$\overline{Y}/\overline{IPub}$	33,7169
$\overline{Y}/\overline{IPPP}$	250,0058
ΔY/ΔIPriv	-0,2017
ΔY/ΔIPub	-1,1588
ΔY/ΔIPPP	0,6582
$\frac{\Delta Y}{\Delta IPPP + \Delta IPub + \Delta IPriv}$	-0,2325
Rate of return	
Parcial rate of return	**-0,0207**
Total rate of return	**-**

Table 7. Partial and total rates of returns originated by an impulse in public investment

Impulse response functions acumulated results	
ΔlogY	0,0245
Δlog IPriv	0,0233
Δlog Pub	0,1403
Δlog IPPP	0,2513
ε_{IPriv}	1,0507
ε_{IPub}	**0,1743**
ε_{IPPP}	0,0974
$\bar{Y}/\overline{IPriv}$	5,5245
$\bar{Y}/\overline{IPub}$	33,7169
$\bar{Y}/\overline{IPPP}$	250,0058
ΔY/ΔIPriv	5,8047
ΔY/ΔIPub	5,8779
ΔY/ΔIPPP	24,3432
$\frac{\Delta Y}{\overline{\Delta IPPP + \Delta IPub + \Delta IPriv}}$	2,6077
Rate of return	
Parcial rate of return	**0,0926**
Total rate of return	**0,0491**

Table 8. Partial and total rates of returns originated by an impulse in private investment

Impulse response functions acumulated results	
ΔlogY	0,0393
Δlog IPriv	0,0982
Δlog IPub	0,0506
Δlog IPPP	0,2915
ε_{IPriv}	**0,3998**
ε_{IPub}	0,7755
ε_{IPPP}	0,1347
$\bar{Y}/\overline{IPriv}$	5,5245
$\bar{Y}/\overline{IPub}$	33,7169
$\bar{Y}/\overline{IPPP}$	250,0058
ΔY/ΔIPriv	2,2089
ΔY/ΔIPub	26,1464
ΔY/ΔIPPP	33,6843
$\frac{\Delta Y}{\overline{\Delta IPPP + \Delta IPub + \Delta IPriv}}$	1,9207
Rate of return	
Parcial rate of return	**0,0404**
Total rate of return	**0,0332**

Table 9. Crowding-in or crowding-out effects resulting from an impulse in the investment in PPP

$\varepsilon_{\mathrm{IPriv}}$	-0,0365
$\varepsilon_{\mathrm{IPub}}$	-0,0344
$\varepsilon_{\mathrm{IPPP}}$	0,0026
Ipriv	29298,4375
Ipub	5217,2500
Ippp	997,9375
Crowding-in or crowding-out effects resulting from an impulse in the investment in PPP	
ΔIpriv/ΔIPPP	**-2,1166**
ΔIpub/ΔIPPP	**-0,4005**

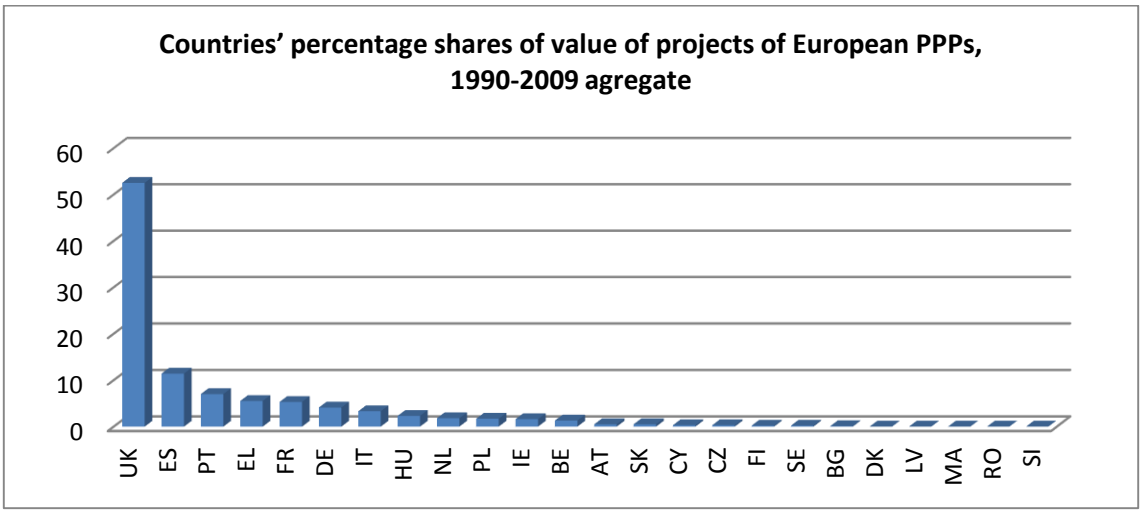
Table 10. Crowding-in or crowding-out effects resulting from an impulse in public investment

ε_{IPriv}	1,0507
ε_{IPub}	0,1743
ε_{IPPP}	0,0974
$\overline{IPrıv}$	29298,4375
$\overline{IPub}$	5217,2500
$\overline{IPPP}$	997,9375
Crowding-in or crowding-out effects resulting from an impulse in public investment	
ΔIpriv/ΔIpub	**0,9317**
ΔIppp/ΔIPub	**0,3425**

Table 11. Crowding-in or crowding-out effects resulting from an impulse in private investment

ε_{IPriv}	0,3998
ε_{IPub}	0,7755
ε_{IPPP}	0,1347
$\overline{IPrıv}$	29298,4375
$\overline{IPub}$	5217,2500
$\overline{IPPP}$	997,9375
Crowding-in or crowding-out effects resulting from an impulse in private investment	
ΔIPPP/ΔIPriv	**0,1011**
ΔIPub/ΔIPriv	**0,0918**

Figure 1. Countries' percentage shares of value of projects of European PPPs, 1990-2009 agregate



Source: Kappeler and Nemoz (2010)

Figure 2. Responses to shocks in PPP investment

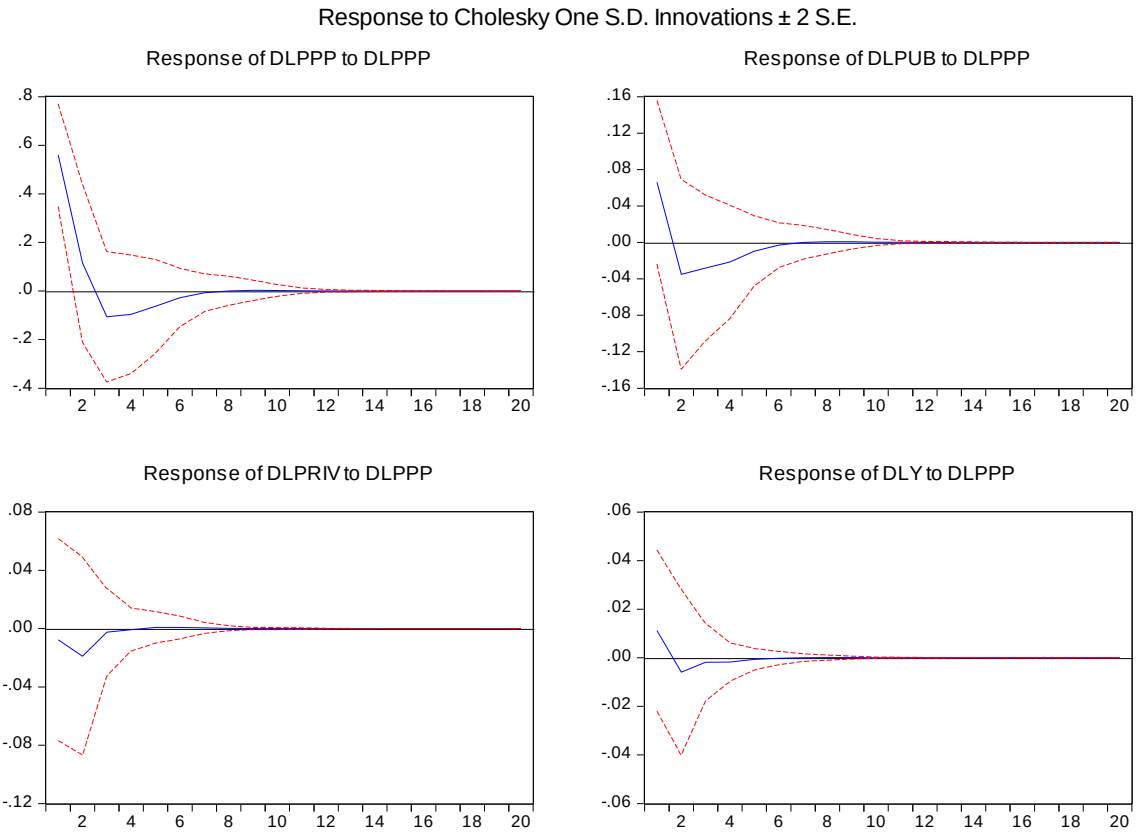


Figure 3. Responses to shocks in public investment

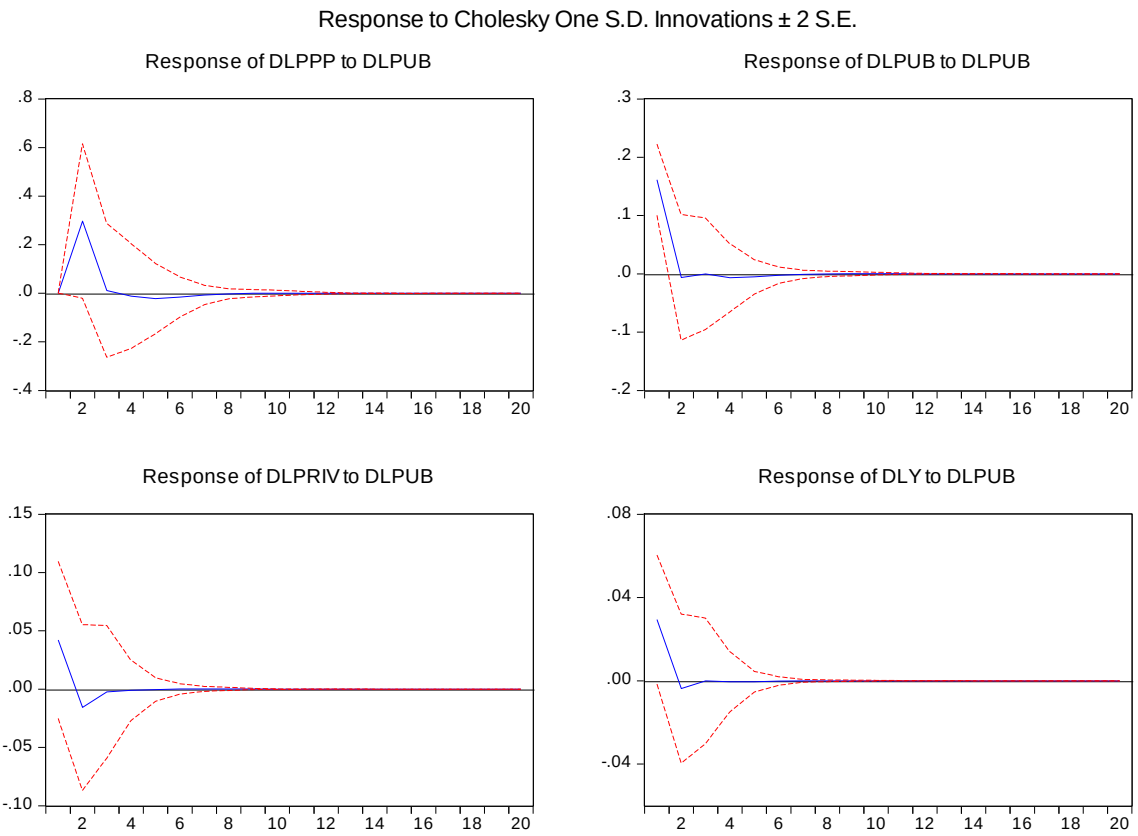


Figure 4. Responses to shocks in private investment