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PUBLIC INVESTMENT, ECONOMIC PERFORMANCE AND BUDGETARY CONSOLIDATION: VAR EVIDENCE FOR THE FIRST 12 EURO COUNTRIES

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In a period of heightened concern about fiscal consolidation in the euro area, a politically expedient way of controlling the public budget is to cut public investment. A critical question, however, is whether or not political expediency comes at a cost, in terms of both long-term economic performance and future budgetary contention efforts. First, common wisdom suggests that public investments have positive effects on economic performance although the empirical evidence is less clear. Second, it is conceivable that public investment has such strong effects on output that over time it generates enough additional tax revenues to pay for itself. Obviously, it is equally plausible that the effects on output although positive are not strong enough for the public investment to pay for itself.

In this paper, we investigate these issues empirically for the first twelve countries in the euro area using a vector auto-regressive approach. We conclude that the euro countries can be gathered in four groups according to the nature of the economic and budgetary impact of public investment. The first group includes Austria, Belgium, Luxembourg, and Netherlands, where the economic effects are either negative or positive but very small and, therefore, cuts will be harmless for the economy and effective from a budgetary perspective. The second group includes Finland, Portugal, and Spain, where public investment does not pay for itself and, therefore, cuts are an effective tool of budgetary consolidation although they are harmful for the economy. The third group includes France, Greece, and Ireland where public investment just pays for itself and therefore cuts are not an effective way of achieving long-term budgetary consolidation and are harmful for the economy. Finally, the fourth group includes Germany and Italy, where public investment more than pays for itself and, therefore, cuts are not only harmful for the economy but also counterproductive from a budgetary perspective.

Keywords: Public Investment, Economic Performance, Budgetary Consolidation, Euro Area
JEL classification: C32, E62, H54

* All errors are the responsibility of the authors.

1. INTRODUCTION

Fiscal consolidation has been one of the most difficult economic challenges for the countries in the euro area. For these countries, market pressures, international commitments and ultimately the threat of financial sanctions in the context of the Maastricht Treaty and the Stability and Growth Pact, place serious constraints on the public budget and on the ability of the domestic authorities to run public deficits. Indeed, under the Stability and Growth Pact these countries are obligated to maintain budgetary positions close to balance and the so-called Excessive Deficit Procedures can be launched if the deficit exceeds 3% of the GDP or the public debt exceeds 60% of the GDP[1]. Naturally, then, the existence and persistence of substantial public deficits and large public debts, often well in excess of these reference values, have become in recent years a matter of great concern for several countries. France, Germany, Greece, Italy, and Portugal, are currently the subject of ongoing Excessive Deficit Procedures while Netherlands is just recovering from a similar situation.

One of the policy questions raised by the fiscal rules of the Maastricht Treaty and the Stability and Growth Pact was the extent to which public investment would be reduced due to the fact that governments would have to finance the bulk of their capital expenditures out of current tax revenues. Typically, under a golden rule type of argument, while current government spending should be financed by taxation, capital spending should be financed with debt. Under close to balanced budget rules, however, governments are very limited in their ability to use debt-financing as a way of smoothing the burden of public investments over time. Evidence for the United States[2] suggests that states that maintain separate capital and current expenditure budgets spend more on capital than states using unified budgets and that states that borrow to finance investment tend to have a higher level of investment than states that do not.

The issue of how public investment may be affected by these fiscal rules is exacerbated under the current budgetary situation in countries with high deficit and/or high public debt to GDP ratios. A casual look at the data[3] suggests that although public investment has been and is projected to be relatively constant in the euro area, there has been in recent years or it is projected for the near future a steady decline in public investment in the cases of Germany, Greece, and Portugal, countries currently facing serious budgetary challenges as well as Netherlands, a country that is just recovering from its own budgetary problems.

There is no escaping the fact that for most countries the bulk of public spending is in the form of compensation of employees and social benefits and transfers, both difficult

[1] See, for example, Buti, Franco, and Ongena (1998) and Morris, Ongena, and Schuknecht (2006) for detailed discussion of these institutional issues.

[2] See, for example, Poterba (1995).

[3] See, for example, the Statistical Annex of the European Economy (2006).

to control, and that public opinion is steadfast against tax hikes. Faced with these budgetary pressures and political constraints, the margin of maneuver is very limited and cuts in public investment have often been regarded, at least implicitly, as the easy way out. Indeed, unlike the effects of reductions in other types of spending or of tax hikes, the effects of cuts in public investment take some time to reverberate through the economy. Therefore, they are particularly expedient from a political perspective. A critical question, however, is whether or not political expediency comes at a cost, first in terms of long-term economic performance and second in terms of future budgetary consolidation efforts.

The first possible cost of cuts in public investment is in the form of losses in economic performance. Indeed, it is a common view that public investment tends to improve long-term economic performance. At an empirical level, however, evidence as to the magnitude and even the sign of such effects is less clear[4]. Furthermore, in more developed countries where the role of the private sector in the provision of infrastructures is expected to increase and where there may exist a trend toward smaller government, the link between public investment and long-term economic performance is less clear even at the conceptual level. At any rate, whether or not reductions in public investment will lead to undesirable effects in terms of long-term economic performance is a matter to be decided empirically.

The second possible cost of cuts in public investment is in the form of losses of future tax revenues. Indeed, to the extent that public investment increases output in the long-term, it also expands the tax base and, therefore, increases tax revenues. It is conceivable that public investment has such strong effects on output, that over time it generates enough additional tax revenues to pay for itself, a possibility that underlies golden rule arguments. It is equally plausible that the effects on output, although positive, are not strong enough for the public investment to pay for itself. In the first case, cuts in public investment hurt long-term economic performance and make the future budgetary situation worse. In the second case, cuts in public investment hurt long-term economic performance without hurting the future budgetary situation.

In this paper, we address these issues from an empirical perspective in the context of the twelve euro area countries. Our objective is to determine empirically the long-term economic effect of public investment in these countries and, if these effects are positive, to what extent they are large enough for public investment to pay for itself. Accordingly, countries can fall in one of four groups: countries for which public investment cuts are harmless; countries for which they hurt the economy without hurting future budgetary consolidation efforts; countries for which they hurt the economy but they just pay for themselves and are, therefore, unnecessary from a budgetary perspective; and finally, countries for which cuts in public investment may turn out to be not only harmful for the economy but also counter-productive in the long-term from a budgetary perspective. To

[4] See, for example, IMF (2004).

identify which scenario applies in each country is fundamental to assess the impact, and ultimately the wisdom, of any cuts in public investment.

Our empirical analysis follows a vector auto-regressive/error correction mechanism approach (VAR/ECM), which relates output, employment, private investment, and public investment. This approach highlights the dynamic feedbacks among the different variables and captures both direct and indirect channels (through its effects on employment and private investment) through which public investment affects output. The specifics of the identification and measurement of the effects of public investment follow the approach developed by Pereira (2000, 2001) in the context of the analysis of the effects of public investment in infrastructure in the US and was inspired by the literature on the effects of monetary policies.

From a methodological perspective, this paper is also akin to the growing body of research attempting to estimate the macroeconomic effects of distinct fiscal policies through the use of vector autoregressive models (VAR), models routinely used to evaluate the effects of monetary policy[5]. Overall, VAR models have clearly become the instrument of choice in the debate on the macroeconomic impact of fiscal policy as well as the debate on the effect of infrastructures and, methodologically, this paper comes in the confluence of these two bodies of literature.

2. DATA AND PRELIMINARY EMPIRICAL RESULTS

2.1. Data

In this paper we consider the twelve countries in euro area: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. The variables considered are output (Y), employment (L), private gross fixed capital formation or private investment (I_p) and gross fixed capital formation of the government or public investment (I_g). All variables are measured in millions of constant 2000 euros except for employment, which is measured in thousand of employees.

We use annual data for the period 1980-2003. With very few exceptions, the data was obtained from the National Accounts as published by the OECD (2005) and available at http://www.oecd.org/topicstatsportal/0,2647,en_2825_495684_1_1_1_1_1,00.html. In the case of employment and/or public investment for Greece, Ireland, Luxembourg, and Spain, the OECD dataset was complemented for the earlier years with data from the Statistical Annex of the European Economy (1999), available at http://ec.europa.eu/economy_finance/publications/statistical_en.htm.

[5] See Kamps (2005) for a discussion of estimates of the effects of public investment and Perotti (2004) for a review of the macroeconomic effect of various tax policies.

Table 1. Public Investment as a percentage of the GDP (%)

	1980-84	1985-89	1990-94	1995-99	2000-03	1980-2003
Austria	3.9	3.3	3.1	2.3	1.3	2.8
Belgium	4.0	2.4	1.8	1.7	1.7	2.4
Finland	3.7	3.6	3.4	2.9	2.8	3.3
France	3.2	3.3	3.5	3.0	3.0	3.2
Greece	2.7	3.1	3.0	3.4	3.9	3.2
Germany	3.1	2.6	2.6	2.0	1.7	2.4
Ireland	4.8	2.7	2.2	2.6	3.9	3.2
Italy	3.4	3.4	2.9	2.3	2.3	2.9
Luxembourg	5.5	4.1	4.8	4.5	4.6	4.7
Netherlands	3.4	2.9	2.9	2.9	3.3	3.1
Portugal	4.2	3.3	3.7	4.1	3.7	3.8
Spain	2.6	3.7	4.4	3.3	3.5	3.5

Some basic details of the public investment data are presented in Table 1. Over the sample period, public investment ranges from 2.4% of the GDP for Belgium and Germany to 4.7% in Luxembourg with most countries around the 3.0% of the GDP. Moreover, in the last decade, on average, Greece, Ireland, and Netherlands seem to have increased their efforts in the are of public investment while the public investment to GDP ratios have declined noticeably in Austria, Germany, and Portugal.

The possibility of structural breaks was incorporated in to the statistical procedures for different countries. In the case of Germany, in order to accommodate the reunification process we considered a dummy variable centered around 1991. In addition, dummies relating to the date of joining the EU were considered for Portugal and Spain, centered around 1986, and for Austria and Finland, centered around 1995. In no case, however, were these dummies statistically significant according to either simple significance tests or BIC tests in the case of the VAR specifications. Accordingly, we concluded that in our framework of analyzes of fiscal policies, joining the EU did not represent a structural break for these countries.

Table 2. Augmented Dickey-Fuller Unit Root Tests

	series	lags	deterministic component	τ		series	lags	deterministic component	τ
Austria	y	1	constant and trend	-2.1640	Belgium	y	0	constant and trend	-3.0196
	l	2	constant and trend	-2.9236		l	1	constant and trend	-2.6827
	ip	0	constant and trend	-2.7722		ip	1	constant	-2.2208
	ig	0	none	-1.6057		ig	0	constant	-2.3161
	Δy	0	constant	-4.0050**		Δy	0	constant	-3.7955**
	Δl	1	constant	-3.4440*		Δl	0	constant	-3.6261*
	Δip	0	constant	-4.0258**		Δip	0	constant	-4.4391**
	Δig	0	none	-4.1252**		Δig	0	none	-3.6173**
Finland	y	1	constant and trend	-3.1520	France	y	1	constant and trend	-2.7460
	l	1	constant and trend	-3.5287		l	1	constant and trend	-2.9794
	ip	0	constant	-1.3986		ip	1	constant and trend	-3.4760
	ig	0	constant	-1.8838		ig	0	none	1.8996
	Δy	1	none	-2.0019*		Δy	0	constant	-3.1012*
	Δl	1	none	-2.8719**		Δl	1	none	-2.1511*
	Δip	1	none	-2.9491**		Δip	1	none	-2.0318*
	Δig	0	none	-4.9669**		Δig	0	none	-3.4784**
Germany	y	1	constant and trend	-1.6900	Greece	y	0	constant	3.4604
	l	0	constant and trend	-1.7196		l	0	constant and trend	-3.6982
	ip	1	constant and trend	-1.7890		ip	0	constant and trend	-1.2990
	ig	1	constant and trend	-1.8585		ig	0	constant and trend	-2.4768
	Δy	1	constant	-2.9779*		Δy	0	constant and trend	-4.3415*
	Δl	0	none	-3.9041**		Δl	0	constant	-7.7649**
	Δip	0	none	-2.8458**		Δip	0	constant and trend	-5.5877**
	Δig	0	none	-2.4374*		Δig	0	none	-4.8263**
Ireland	y	0	constant and trend	-2.0654	Italy	y	1	constant and trend	-1.9987
	l	1	constant and trend	-1.9148		l	1	constant and trend	-2.9500
	ip	1	constant and trend	-2.9905		ip	1	constant and trend	-3.1228
	ig	1	constant and trend	-2.0603		ig	0	constant	-2.5319
	Δy	0	constant	-3.2205*		Δy	0	constant	-3.5779*
	Δl	0	none	-2.3899*		Δl	0	none	-2.6160*
	Δip	0	none	-2.4608*		Δip	0	none	-2.9547**
	Δig	1	constant and trend	-4.0548*		Δig	0	none	-5.5951**
Luxem-	y	1	constant and trend	-2.2925	Nether-	y	1	constant and trend	-3.0786
bourg	l	1	constant and trend	-2.6252	lands	l	1	constant	-1.8407
	ip	0	constant and trend	-2.4366		ip	1	constant and trend	-2.5549
	ig	1	constant and trend	-2.9734		ig	0	constant and trend	-2.3836
	Δy	0	constant	-3.7514*		Δy	1	constant	-3.9142**
	Δl	0	constant	-3.4400*		Δl	1	constant	-6.3969**
	Δip	0	constant	-4.5147**		Δip	0	none	-2.5561*
	Δig	0	none	-2.8380**		Δig	0	none	-3.3312**

Portugal	y	1	constant and trend	-3.5977	Spain	y	1	constant and trend	-3.5682
	l	0	constant and trend	-2.5622		l	1	constant and trend	-3.5729
	ip	1	constant and trend	-3.5328		ip	1	constant and trend	-3.6074
	ig	0	constant and trend	-1.8767		ig	0	constant	-2.9204
	Δy	1	none	-1.9839*		Δy	0	constant	-3.4803*
	Δl	0	none	-3.6933**		Δl	1	none	-2.0866*
	Δip	0	none	-2.9547**		Δip	1	none	-2.0420*
	Δig	0	none	-2.6694**		Δig	0	none	-3.4578**

Note: * significant at 5% level and ** significant at 1% level.

2.2. Univariate and Cointegration Analysis

We use the Augmented Dickey-Fuller (ADF) t-test to test the null hypothesis of a unit root and the Bayesian Information Criterion (BIC) to determine the optimal number of lags and we include deterministic components when statistically significant. Test results are reported in Table 2. For all of the variables in log-levels the t-statistics are greater than the critical values, either at 5% or at 1% significance levels, and we find that, therefore, we cannot reject the null hypothesis of a unit root. When applied to the first differences of the log-levels, i.e., to the growth rates of the original variables, however, the ADF tests allow us to reject the null hypothesis of unit roots for all variables, since all the t-statistics are lower than the 5% critical values. Therefore, our conclusion is that all variables are stationary in first differences.

Having established that all variables are integrated of order one, we now test for cointegration. We use the Engle-Granger procedure which is less vulnerable than the Johansen procedure to the small sample bias toward finding cointegration when it does not exist[6]. Following the standard Engle-Granger procedure, we perform four tests, each one with a different endogenous variable. This is because it is possible that one of the variables enters the cointegrating relationship with a statistically insignificant coefficient. We apply the ADF t-test to the residuals of the different regressions. The optimal lag structure is chosen using the BIC and we include deterministic components when statistically significant. Test results are reported in Table 3. We find that for eight of the twelve countries the test statistics are higher than the 5% critical values, and therefore, in no case can we reject the null hypothesis of a unit root in the residuals of the estimated equations. For the remaining four countries the same is true for three of the four tests. Accordingly, we do not find evidence of cointegration among the variables for any of the countries.

[6] See, for example, Gonzalo and Lee (1998) and Gonzalo and Pitarakis (1999).

Table 3. Engle-Granger Cointegration Tests

	series	lags	deterministic component	τ		series	lags	deterministic component	τ
Austria	*y*	0	none	-5.0476**	Belgium	*y*	0	none	-1.7831
	l	0	none	-3.0438		*l*	1	constant and trend	-2.1700
	ip	0	none	-2.9241		*ip*	1	none	-2.4532
	ig	0	none	-0.9016		*ig*	0	none	-3.2693
Finland	*y*	0	none	-1.9655	France	*y*	1	none	-3.8643*
	l	1	none	-2.3151		*l*	1	none	-2.8686
	ip	0	none	-2.2358		*ip*	1	none	-3.3047
	ig	0	none	-3.6338		*ig*	0	none	-1.9413
Germany	*y*	1	none	-2.1962	Greece	*y*	1	none	-1.8327
	l	0	none	-2.8733		*l*	1	none	-1.6837
	ip	0	none	-2.7409		*ip*	0	none	-3.2850
	ig	1	constant and trend	-1.8089		*ig*	1	none	-2.1993
Ireland	*y*	1	none	-3.7552*	Italy	*y*	0	none	-3.5456
	l	1	constant and trend	-2.3600		*l*	1	none	-3.0700
	ip	1	constant and trend	-3.9666		*ip*	1	none	-2.6647
	ig	1	none	-2.9720		*ig*	0	none	-3.5930
Luxem-	*y*	0	none	-3.1033	Nether-	*y*	1	constant and trend	-6.7414**
bourg	*l*	0	none	-2.7550	lands	*l*	1	none	-2.4545
	ip	0	none	-2.8259		*ip*	1	none	-3.6703
	ig	0	none	-2.0626		*ig*	0	constant and trend	-1.7230
Portugal	*y*	0	none	-2.4692	Spain	*y*	1	none	-3.6792
	l	0	none	-2.6020		*l*	1	none	-3.2559
	ip	0	none	-2.5581		*ip*	1	none	-2.7651
	ig	0	none	-2.5932		*ig*	0	none	-2.2444

Note: *significant at 5% level and ** significant at 1% level.

2.3. VAR Specification and Estimation

We have determined that all of the variables in log-levels are stationary in first differences and that they are not cointegrated. Accordingly, we follow the standard procedure in the literature and estimate VAR models using growth rates of the original variables, i.e., of output, employment, private investment, and public investment.

The model specifications are determined using the BIC. The test results, which are reported in Table 4, suggest that the best specification, for France, Ireland, and Spain is a VAR model of first order with a constant term and trend, while for Austria, Belgium, Finland, Germany, Greece, Luxembourg, and Netherlands only a constant is selected. Finally, for Italy, and Portugal a VAR model of first order without deterministic terms is selected.

Table 4. BIC Tests for VAR Specification

	none	constant	constant and trend
Austria	-28.9738	-29.4947	-29.3539
Belgium	-28.0111	-28.3200	-28.0939
Finland	-26.2306	-27.1945	-26.8386
France	-31.8392	-31.9318	-32.4584
Germany	-26.2893	-26.7745	-26.7496
Greece	-25.5974	-25.6692	-25.4467
Ireland	-25.3622	-25.7527	-26.1137
Italy	-29.6693	-29.4912	-29.5403
Luxembourg	-26.1629	-26.1713	-25.9908
Netherlands	-30.3700	-30.3921	-30.1413
Portugal	-26.4936	-26.2872	-26.2368
Spain	-28.4013	-28.9699	-29.1168

Details of the VAR estimates are omitted here for the sake of brevity but are readily available upon request. The only point worth mentioning here is that the matrices of contemporaneous correlations among the estimated residuals tend to show a block diagonal pattern with low contemporaneous correlation between innovations in public investment and the remaining variables. To illustrate the point, only 6 of the 36 estimated contemporaneous correlations between innovations in public investment and private variables exceed 0.40 in absolute value. They occur in the cases of Germany, Greece, Luxembourg, Netherlands, and Portugal. In turn, 26 of the 36 contemporaneous correlations among private variables exceed 0.40 in absolute value. This pattern is consistent with evidence in the literature[7] and suggests that innovations in public investment and private sector variables are for most part statistically uncorrelated. This is important because it implies the orthogonalization strategies to be discussed below will not be overly imposing on the estimates of the long-term effects of public investment.

3. ON THE IDENTIFICATION AND MEASUREMENT OF THE EFFECTS OF INNOVATIONS

3.1. Identifying Innovations in the Public Investment Variables

In order to determine the effects of public investment we use the impulse-response functions associated with the estimated VAR models. In determining these effects it is important to consider innovations in public investment that are not contemporaneously

[7] See, for example, Pereira and Andraz (2003).

correlated to shocks in the other variables. In dealing with this issue, we draw from the approach in the monetary policy literature[8]. This approach was adapted in Pereira (2000, 2001) to the analysis of public investment in infrastructures in the United States.

Ideally, the identification of exogenous shocks to public investment would result from knowing what fraction of the government appropriations is due to purely non-economic reasons. The econometric counterpart to this idea is to imagine a policy function, which relates the rate of growth of public investment to the relevant information set. In our case, the relevant information set could include the past and current observations of the growth rates of the private sector variables. The residuals from this policy function reflect the unexpected component to the evolution of public investment and are uncorrelated with other innovations.

In the central case, we assume that the relevant information set for the public sector includes past but not current values of the other variables. This is equivalent, in the context of the standard Choleski decomposition, to assuming that innovations in public investment lead innovations in the other variables. This means that we allow innovations in public investment to affect the other variables contemporaneously, but not the reverse. We have two reasons for making this our central case. First, it is reasonable to assume that the private sector reacts within a year to innovations in public investment decisions. Second, it also seems reasonable to assume that the public sector is unable to adjust public investment decisions to innovations in the private variables within a year. This is due to the time lags involved in information gathering and decision-making. Despite the imminent plausibility of this central case scenario, when reporting the effects of public investment we consider all twenty-four possible orderings of the variables within the context of the Choleski decomposition and present the corresponding range of results in Table 6.

The policy functions are reported in Table 5. Our empirical results suggest that in the cases of Austria, Belgium, Portugal, and Spain public investment is statistically exogenous at the 10% level, i.e., changes in public investment do not respond to lagged changes in private-sector variables. This is not the case, however, for the remaining countries. In fact, in Finland, Greece, and Luxembourg, public investment responds to changes in employment while in France, Ireland, and Netherlands public investment responds positively to changes in private investment. Finally, public investment responds significantly to changes in output in the cases of France, Germany, and Netherlands. The endogeneity of public investment in these cases can be understood as reflecting the use of public investment as a countercyclical tool reacting to changes in the private sector variables as well as the fact that financing public investment is easier when the tax base is expanding. In any case, the important point is that for eight of the twelve countries public investment is not an exogenous variable.

[8] See, for example Christiano, Eichenbaum and Evans (1996), Christiano, Eichenbaum and Evans (1999), and Rudebush (1998).

Table 5. Policy Functions for Public Investment

	constant	trend	Δ*ig*(-1)	Δ*ip*(-1)	Δ*l*(-1)	Δ*y*(-1)
Austria	-0.0066	-	0.0121	-0.2442	2.0533	-1.2599
	(-0.1108)		(0.0478)	(-0.3215)	(0.4274)	(-0.4472)
Belgium	0.0209	-	0.2377	0.2635	0.1162	-2.5449
	(0.3782)		(0.9014)	(0.4682)	(0.0379)	(-0.8859)
Finland	0.0154	-	-0.5156	-0.2485	2.7997	0.3343
	(0.4468)		(-2.0519)**	(-0.5312)	(1.6790)*	(0.2459)
France	0.1192	-0.0037	0.0817	0.9188	3.3286	-4.2032
	(2.2166)**	(-1.4086)	(0.3155)	(1.9840)*	(1.2238)	(-2.1101)**
Germany	-0.0656	-	0.1088	-0.1129	0.1216	2.4901
	(-2.3212)**		(0.4697)	(-0.2069)	(0.4793)	(1.5589)
Greece	0.0778	-	0.0513	0.2539	-3.3502	-1.1904
	(2.1611)**		(0.2055)	(0.6979)	(-2.0061)**	(-0.7819)
Ireland	-0.2216	-0.0121	0.8116	0.8835	-1.3060	0.2687
	(-0.0241)	(-0.2196)	(4.0717)**	(2.4059)**	(-0.7208)	(0.1726)
Italy	-	-	-0.3881	1.3534	0.1764	-1.4590
			(-1.5572)	(1.8295)*	(0.0778)	(-1.0625)
Luxembourg	-0.0314	-	0.1083	0.4034	4.5012	-0.1335
	(-0.8854)		(0.5836)	(2.0650)**	(2.0482)**	(-0.1733)
Netherlands	-0.0313	-	-0.0433	-0.1636	-0.2023	2.5350
	(-1.1855)		(-0.1684)	(-0.3923)	(-0.3077)	(1.7347)*
Portugal	-	-	0.0070	0.4614	2.1096	-0.6718
			(0.0327)	(1.3500)	(1.3569)	(-0.6128)
Spain	-0.0345	-0.0053	-0.0115	-0.8925	-2.3049	7.8235
	(-0.2727)	(-1.0218)	(-0.0459)	(-0.9394)	(-0.6092)	(1.5454)

Notes: t-statistics in parenthesis. * significant at 10% level and ** at 5% level.

3.2. Measuring the Effects of Innovations in the Public Investment Variables

We consider the effects of one-time one-percentage point innovations in the rates of growth of public investment. We expect these innovations to have temporary effects on the growth rates of the other variables which by definition will translate into permanent effects on the levels of these variables.

The long-term elasticities of the different variables with respect to public investment as well as the corresponding ranges of variation are reported in Table 6. Long-term is defined as the time horizon over which the growth effects of innovations disappear, i.e., the accumulated impulse-response functions converge. These elasticities represent long-term accumulated percentage point changes per one percentage point long-term accumulated change in public investment.

Table 6. Long-term Accumulated Elasticities with Respect to Public Investment

		output	employment	private investment
Austria	central case	0.005	-0.018	-0.008
	range of variation	[-0.024;0.031]	[-0.040;0.009]	[-0.085;0.117]
Belgium	central case	0.003	-0.004	-0.254
	range of variation	[-0.004;0.044]	[-0.007;0.022]	[-0.281;-0.003]
Finland	central case	0.049	0.047	0.263
	range of variation	[-0.194;0.056]	[-0.251;0.056]	[-0.534;0.293]
France	central case	0.111	0.057	0.271
	range of variation	[-0.001;0.111]	[-0.019;0.057]	[-0.127;0.271]
Germany	central case	0.133	0.355	0.252
	range of variation	[-0.072;0.133]	[-0.193;0.355]	[-0.193;0.252]
Greece	central case	0.151	-0.002	0.181
	range of variation	[-0.070;0.151]	[-0.002;0.004]	[-0.522;0.181]
Ireland	central case	0.109	0.137	0.151
	range of variation	[-0.027;0.109]	[0.040;0.137]	[-0.216;0.151]
Italy	central case	0.197	0.148	0.095
	range of variation	[-0.473;0.339]	[-0.076;0.159]	[-0.551;0.355]
Luxembourg	central case	-0.023	-0.153	-0.123
	range of variation	[-0.193;0.107]	[-0.223;-0.028]	[-0.901;0.143]
Netherlands	central case	-0.197	-0.331	-0.773
	range of variation	[-0.197;0.009]	[-0.331;0.038]	[-0.773;-0.136]
Portugal	central case	0.125	0.059	0.776
	range of variation	[-0.479;0.125]	[-0.174;0.059]	[-0.155;0.776]
Spain	central case	0.071	0.110	0.150
	range of variation	[0.024;0.096]	[0.048;0.142]	[-0.030;0.318]

In Tables 7 and 8 we report marginal product figures. These figures measure the change in million euros in output and private investment and the number of jobs created per one million euros in accumulated change in public investment. We obtain the marginal products by multiplying the average ratio of the private sector variable to public investment for the last ten years, by the corresponding elasticity. The choice of average ratio for the last ten years is designed to reflect the relative scarcity of public investment without letting these ratios be overly affected by business cycle factors. In turn, rates of return are calculated from the marginal product figures by assuming a life horizon of twenty years for public capital assets. These are the rates which, if applied to one euro over a twenty-year period, yield the value of the marginal products. They are adjusted to accommodate a linear depreciation rate of 5%, which is implicit in the life horizon of twenty years.

4. ON THE ECONOMIC AND BUDGETARY EFFECTS OF PUBLIC INVESTMENT

4.1. On the Economic Effects of Public Investment

Estimation results reported in Table 7 suggest that public investment has a positive effect on both employment and private investment in most countries. Public investment crowds out employment in the long term in Austria, Belgium, Luxembourg, and Netherlands and very marginally in Greece. For the remaining countries the long-term elasticities of employment with respect to public investment range from 0.047 for Finland to 0.148 for Italy. In terms of job creation the countries that seem to benefit the most are Ireland, Italy, Portugal, Spain, and, in particular, Germany. In general, however, both the elasticities and the marginal products tend to be small. This is consistent with the view that in the long-term employment is mostly determined by exogenous labor supply conditions.

We find that public investment crowds out private investment again in the cases of Austria, Belgium, Luxembourg and Netherlands. For the remaining countries we find positive effects with long-term elasticities ranging from 0.095 in the case of Italy to 0.776 in the case of Portugal. The largest complementarity effects between public and private investment can be found in Finland, France, Germany, and, in particular, Portugal. This is an important result in that the issue of whether public investment crowds out or crowds in private investment is important in itself. Our finding of crowding in for most countries suggests that cut in public investment in these countries will affect output negatively in the long-term. If for no other reason, this is so because cuts in public investment will reduce private capital accumulation and thereby long-term output.

Finally, estimation results reported in Table 8 suggest that public investment has positive and important effects on output for most countries. Luxembourg and Netherlands show a negative long-term elasticity while Austria and Belgium show negligible positive elasticities. It is important to note that these are the only countries where we estimate that public investment crowds out both employment and private investment. This shows that for these countries any positive scale effects of public investment on output are neutralized by the negative substitution effects on the other inputs. For the remaining eight countries the long-term elasticities of output with respect to public investment range from 0.049 in Finland to 0.197 in Italy. The largest marginal products are estimated for Germany, and Italy, with rates of return in excess of 10% and to a lesser degree for France, Ireland, and Portugal, with rates of return on the 6% to 7% range.

Table 7. Long-term Effects on Employment and Private Investment

	Employment		Private Investment	
	Elasticity	Number of Jobs	Elasticity	Marginal Productivity
Austria	-0.018	-21	-0.008	-0.094
Belgium	-0.004	-3	-0.254	-2.723
Finland	0.047	30	0.263	1.480
France	0.057	32	0.271	1.377
Germany	0.355	367	0.252	2.531
Greece	-0.002	-2	0.181	0.932
Ireland	0.137	84	0.151	0.989
Italy	0.148	129	0.095	0.689
Luxembourg	-0.153	-33	-0.123	-0.466
Netherlands	-0.331	-219	-0.773	-4.594
Portugal	0.059	68	0.776	4.354
Spain	0.110	81	0.150	0.933

Table 8. Long-term Effects on Output

	Elasticity	Marginal Productivity	Rate of Return
Austria	0.005	0.277	-6.2
Belgium	0.003	0.192	-7.9
Finland	0.049	1.700	2.7
France	0.111	3.627	6.7
Germany	0.133	7.013	10.3
Greece	0.151	4.307	7.6
Ireland	0.109	3.727	6.8
Italy	0.197	8.631	11.4
Luxembourg	-0.023	-0.514	-
Netherlands	-0.197	-6.549	-
Portugal	0.125	3.235	6.0
Spain	0.071	2.096	3.8

From the standpoint of the central motivation of this paper, our results imply that in the cases of Austria, Belgium, Luxembourg, and Netherlands cuts in public investment would be relatively harmless for the economy in the long-term. This is good news for all of these countries in that they all face moderate public deficits and all have implemented over the last decade or have contemplated to implement in the near future cuts in public investment as a share of GDP. On the other hand, our results are clearly bad news for the remaining countries. In particular, for Germany, Greece, France, Italy and Portugal, where public deficits are high and persistent and the temptation to cut public investment is the strongest. Indeed, in Germany, Greece, and Portugal a clear reduction in public

investment has already happened in the last few years and/or is scheduled to continue for a few more years. Our results suggest that these cuts will have harmful effects on the long-term economic performance of these countries. Finally, for Finland, Ireland, and Spain, the current budgetary situation is comfortable and no cuts in public investment have happened or are currently projected for the near future. In fact, in the cases of Ireland and Spain public investment has been and is projected to continue to increase as a share of the GDP. For these countries, the success of budgetary consolidation is opening the doors to public investments that will help long-term economic performance.

4.3. On the Budgetary Impact of Public Investment

Having established which countries seem to benefit the most from public investment and conversely which ones would lose the most from cuts in public investments we now turn to the potential long-term budgetary impact of these investments. To understand the issue we need to recognize that a positive effect of public investment on output in the long term also means an increased tax base and, therefore, increased tax revenues in the long term. It is, therefore, conceivable that over time public investment has such strong effects on output that it generates enough additional tax revenues to pay for itself. It is equally plausible that the effects on output although positive are not strong enough for public investment to pay for itself. In the first case, cuts in current public investment not only hurt long-term growth but also make the future budgetary situation worse. In the second case, such cuts hurt long-term output prospects but help the budgetary situation in the long-term.

To measure the potential revenue effects of the public investments in each country, we consider from the Statistical Annex of the European Economy (2006), the average effective tax rate on output, the sum of direct and indirect tax revenue as a percentage of GDP, for the period 1994 to 2003. We exclude from the effective tax rate computations actual social contributions and miscellaneous revenues. Also, we consider this ten-year period to capture the economic conditions at the end of the sample period while at the same time avoiding business cycle effects. The average effective tax rates are reported in the second column of Table 9 while the revenue effects of public investment are reported on the third column.

Our empirical results have clear taxonomic implications in that the euro countries can be gathered in four groups. In the first group are Austria, Belgium, Luxembourg, and Netherlands, countries in which public investment does not seem to have positive economic effects and, therefore, does not seem to generate any significant tax revenue effects. For this group, cuts in public investment are not harmful for the economy and are clearly helpful from a budgetary perspective. In the second group are Finland, Portugal, and Spain, countries in which public investment has positive effects in the economy but does not pay for itself. For these countries cuts in public investment are harmful for the economy but have positive long-term budgetary effects. In the third group are France, Greece, and Ireland, countries for which public investment seems to exactly pay for itself. For these countries, cuts in public investment are harmful for the

Table 9. Long-term Effects on Tax Revenues

	Marginal Productivity	Effective Tax Rate	Equilibrium Tax Rate	Tax Revenues
Austria	0.277	0.268	-	0.074
Belgium	0.193	0.299	-	0.058
Finland	1.700	0.328	0.588	0.558
France	3.627	0.247	0.276	0.894
Greece	4.307	0.231	0.232	0.995
Germany	7.322	0.230	0.137	1.650
Ireland	3.727	0.289	0.268	1.078
Italy	8.631	0.286	0.116	2.469
Luxembourg	-0.514	0.295	-	-
Netherlands	-6.549	0.234	-	-
Portugal	3.235	0.229	0.309	0.740
Spain	2.096	0.212	0.477	0.445

economy and neutral from a long-term budgetary perspective. In the fourth group are Germany and Italy, countries for which public investment seems to more that pay for itself. For these countries, the strategy of using cuts in public investment as an instrument to achieve budgetary consolidation is harmful for the economy and counterproductive from a budgetary perspective.

Applying these findings to the current budgetary situation we conclude that the countries facing serious budgetary situations, Germany, Greece, France, Italy, and Portugal, seem to be in different regimes as far as the economic and budgetary effects of cuts in public investment. In the case of Portugal, the strategy of using public investment cuts is harmful from an economic perspective but will be effective in terms of budgetary consolidation. In the cases of France and Greece, cuts in public investment will be harmful from an economic perspective and will do little in helping the long term budgetary situation. Finally, in the cases of Germany and Italy, cuts in public investment will be harmful from an economic perspective and will actually hinder long-term budgetary prospects.

As a final point, in the cases of France, Germany, Greece, Portugal, and Spain, one should not ignore the fact that effective tax rates are about the lowest among the different countries. This is important because any efforts to reduce tax evasion and/or tax avoidance or any other marginal changes in the tax codes may increase these rates in an important manner. To have an idea of how high the effective tax rates would have to be for public investment to pay for itself, we calculate the equilibrium effective tax rate for the different countries, which are also reported in Table 9. Our calculations suggest that such changes in tax collection are not likely to substantially affect our conclusions in that they do not seem to be within reach for any of the countries in question in the short to medium term.

5. CONCLUDING REMARKS

In this paper we address a question of the utmost importance in the context of budgetary policy in the euro area, namely, the long-term economic and budgetary effects of public investment. The impact of public investment on output is important in itself from a long-term growth perspective. It is also important from a long-term budgetary perspective. This is because a positive impact on output also represents a positive impact on the tax base and therefore, leads to the critical empirical question of whether or not public investment pays for itself in the form of future tax revenues. If it does, then current cuts in public investment spending not only jeopardize long-term growth but also make the long-term budgetary situation more difficult. If not, then only the negative long-term growth effects remain but public investment cuts do help the budgetary situation in the long-term.

In this paper we find that public investment has strong positive effect on long-term output for eight of the twelve euro area countries. We also find that public investment crowds in both employment and private investment for the same eight countries, although the long-term effects on employment tend to be small. The exceptions to these patterns are Luxembourg and Netherlands where the output effects are negative, and Austria and Belgium where the output effects are positive but very small. These four countries are also the only cases where we find negative long-terms effects on both employment and private investment, thereby, establishing the relevance of these indirect effects of public investment. As a general statement and despite the obvious differences in scope, methodology, and specifics our results have the same flavor as the results for 22 OECD countries presented in Kamps (2005). From the perspective of the focus of this paper, the conclusion is that for most countries in the euro area cuts in public investment come with a price in terms of long-term economic performance.

The picture in terms of the potential budgetary impact of public investment is more diverse. We find, that for Finland, Portugal, and Spain, public investment does not pay for itself and, therefore, cuts are an effective tool of budgetary consolidation. For France, Greece, Ireland, however, public investment just pays for itself and therefore cuts are not an effective way of achieving long-term budgetary consolidation. Finally, for Germany and Italy, public investment more than pays for itself and, therefore, cuts are not only ineffective in achieving long-term budgetary consolidation they are actually counterproductive.

Considering the current budgetary difficulties in France, Germany, Greece, Italy, and Portugal it would seem that among these countries cuts in public investment would only be helpful from a budgetary perspective in Portugal. For the other countries this strategy would be either ineffective or counter-productive from a budgetary perspective. In all cases it would be harmful from an economic perspective.

Although our results are informative in terms of the current budgetary situation their applicability is much more general. In fact, a lot of the success of the fiscal consolidation in the 1990s was attributable to an increase in the revenue to GDP ratio, a pattern that

has been reversed in recent years. Furthermore, and partly due to budgetary consolidation fatigue, after 1999 primary expenditures in the euro area have increased by more than 1% of the GDP. These facts, together with the persistently poor economic performance in the euro area in recent years make it likely that other countries will experience similar budgetary problems in the near future.

More importantly, our results have broader implications well beyond the current or future budgetary problems faced by certain euro area countries and how they will impact public investment. Indeed, as argued before, the very fiscal rules of the Maastricht Treaty and the Stability and Growth Pact have the potential to reduce public investment. This is because of the bias towards current expenditure under tax-financing of public spending. Our results suggest that to the extent that the fiscal rules themselves, independently of the specific budgetary situation, lead to a reduction of public investment, then most euro area countries will be negatively affected in terms of the long-term growth and employment performance.

Finally, it should be pointed out that our conclusions as to the potential budgetary impact of public investment are much richer than suggested by previous literature. Perroti (2004), for example, in the context of 5 highly developed OECD countries - Australia, Canada, Germany, United Kingdom, and United States, finds little evidence that public investment ever pays for itself. In fact only in the case of Germany and in the short term is public investment self-amortizing. Our results suggest that for Germany and Italy public investment more than pays for itself while for France, Greece, Ireland, it marginally pays for itself. Our results, therefore, although they do not corroborate the main message of that paper, do tend to corroborate the conjecture in that paper that its results may be less applicable to countries with lower GDP and/or public capital per capita.

The variety of results we obtain across countries as to the economic and budgetary effects of public investment establishes the need to investigate this issue at a much wider international level. More importantly, the finding that in many countries there are negative long-term budgetary effects of cuts in public investment opens the door to the question of identifying the best instruments for fiscal consolidation in each country, both in terms of their economic impact and in terms of their effectiveness in actually leading to budgetary consolidation.

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