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Crowding-in and Crowding-out Effects of Public Investments in the Portuguese Economy

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Abstract

This study analyses the effects of public and private investment on Portuguese GDP in the period 1960-2013. After a brief review of the literature based on works developed primarily in the context of VAR analyses, such as those by Pereira and Andrzej (2005), and Afonso and St Aubyn (2008), an alternative econometric strategy is proposed. The use of VAR models to estimate the magnitude of crowding-in and crowding-out effects associated with these two components of investment has not been robust. So, we opted for the use of ADL models to estimate the behavioral equations of four variables: output, private investment, public investment, and the real exchange rate. For each of the four equations considered in this study the methodology of Krolzig-Henry (2001, 2005) was applied. Additionally, we also estimate a system of simultaneous equations by the SUR method and calculate the multipliers of the exogenous variables, represented by the current external transfers and the short-run nominal interest rate. Additionally, we tested a model with the first three equations of the system, using the real exchange rate as an exogenous variable. The results point to the existence of a complementarity between private investment and public investment rather than any idea of substitutability. Public investment has positive effects on output and on private investment. The appreciation of the real exchange rate does not have a very significant impact on private and public investment, but it does have a long-lasting negative effect upon output, confirming the presence of a Dutch-disease phenomenon in the Portuguese economy.

JEL Classification: C32, E22, E62.

Keywords: Crowding-in, crowding-out, Portuguese Economy, private investment, public investment, ADL and SUR.

1. Introduction

Historically, the Portuguese economy has been characterised by severe economic growth problems, particularly evident when its performance is compared in terms of per capita Gross Domestic Product (GDP) with its major trading partners within the current European Union (EU). Some of the determinants of this evolution are: i) the existence of serious distortions in financial markets, which led to a reduced volume of private investment; ii) the deficient transportation infrastructures, whether road, rail or sea which make it very difficult to trade and develop the industrial structure of the country; iii) the persistence of successive fiscal imbalances caused by an inefficient tax base, and which have contributed to low productivity and inefficient public investment in the economy; and iv) a trend appreciation of the real exchange rate, in particular in recent years, which has hampered the already traditionally low competitiveness of the Portuguese economy.

Given these problems, the entry of Portugal in 1986 to the European Economic Community (EEC)¹ was presented as an opportunity² to implement major reforms in the goods and services, and job markets, and to develop modern physical infrastructure such as roads, highways, ports, airports and railways, all essential to the desired growth in output. The co-financing and transfer programmes accruing to Portugal from the EU made it possible to make structural improvements to the Portuguese economy³, especially after 1989, thus representing a huge opportunity for both private and public investment, and simultaneously promoting output growth. These funds were added to the traditional remittances.

In this research, we analyse the crowding-in and crowding-out effects of public investment on private investment, and GDP of the Portuguese economy in the period 1960-2013. To this end, the behaviour of variables such as GDP; Private Gross Fixed Capital Formation (GFCF); State GFCF and the real effective exchange rate based on unit labour costs (a measure of competitiveness of the economy) are studied. Additionally, we consider the nominal short-term interest rate, in order to integrate the cost of financing, and a variable called ‘external funds’, which is the sum of the structural and cohesion funds with remittances, as a means of evaluating the importance of the external current transfers.

¹ Current European Union.

² After the gold of Brazil in the nineteenth century and the large flows of remittances from the 60s and 70s of the twentieth century.

³ Approximately 95 million Euros per day.

Based on the econometric behaviour of these variables, it should be possible to discover whether private and public investment are substitutes for, or complementary to, output growth. We also analyse the influence of financial costs, external funds, and real exchange rate on private and public investment in Portugal and, consequently, on output. Real exchange rate may have a negative influence on output leading to the presence of a Dutch-disease phenomenon in the Portuguese economy.

We estimate a set of single equations by using ADL (Autoregressive Distributed Lag) models, as well as a system of simultaneous equations by the SUR (Seemingly Unrelated Regression) method. Furthermore, we calculate multipliers for external funds, interest rate, and real exchange rate.

We intend to address some problems associated with VAR (Vector Autoregressive) models. In fact, the use of VAR models, although common, is not always accompanied by the indication of the module of the roots of the associated matrix and we cannot know whether the system is stable; frequently the estimations are performed with first-differences, with no reference to ECM (Error Correction Model) processes, thus causing inefficiency if they are co-integrated; and the same VAR type and order is estimated for different countries, ignoring country specifics. We overcome these limitations by adopting the econometric strategy of Henry and Krolzig (2001, 2005) of using individual equations and by estimating a simultaneous equation model based on these individual equations.

The present paper is structured in four sections, including the introduction. Section 2 provides a brief review of the literature concerning the crowding-in and crowding-out effects of private and public investment. Section 3 presents the data, the econometric strategy adopted for the empirical work, and discusses the results obtained. Finally, section 4 presents the main conclusions.

2. Crowding-in and Crowding-out effects: Brief Literature Review

As indicated, we try to evaluate the effects of public and private investment on the Portuguese economy. These effects are seen in two forms: crowding-in effects, and crowding-out effects.

The crowding-out effect corresponds to a situation in which after an increase in state public investment there is a reduction in private investment and other components of aggregate expenditure (real crowding-out), that can be sensitive to changes in

interest rates (financial crowding-out). These effects are explained by the fact that resources are scarce and there exists in the economy a transmission mechanism between financial markets and goods' markets.

In fact, when policy-makers increase their spending (or reduce taxes), this increase is magnified by the income multiplier effect. The increase in aggregate expenditure will push prices higher and increase the demand for money, which in turn, will cause an increase in short-run nominal interest rates⁴. This increase in interest rates may subsequently cause a decline in private investment and other components of aggregate expenditure more prone to changes in interest rate. It is this reduction of some components of aggregate expenditure that follows the increase in public investment that is known as the crowding-out effect (Blanchard, 2008).

In contrast, the crowding-in effect⁵ is seen when there is an increase in private investment as a result of increased public investment, as for example, through the construction or improvement of physical infrastructure such as roads, highways, water and sanitation, ports, airports, and railways. Indeed, as is mentioned by Afonso and St Aubyn (2008)⁶, the importance of public investment is usually highlighted in the implementation of expansionary fiscal measures, promoting the growth of potential output, which creates conditions to encourage increased productivity and a greater level of private investment, especially when the latter is subjected to adverse shocks. Thus, the confirmation of the existence of crowding-in effects in an economy may be a very relevant argument for rejecting austerity plans in recession times⁷.

In recent years there has been a renewed and growing interest in the study of these phenomena, and not surprisingly, there is a vast theoretical and empirical literature on the subject. However, it is not our intention in this paper to make an exhaustive and detailed analysis of this literature but rather to undertake a focused review in keeping with our analysis of output and private investment of the Portuguese economy.

⁴ Interest rates may also increase through the emission of public debt to finance the increase in government expenditure. It is therefore, not surprising that in recent times, following the current economic and financial crisis and the revision of the Stability and Growth Pact (SGP), there have been some proposals by policy-makers to reduce or even eliminate some public investments. The Portuguese case is very illustrative of this reality if we look at what has been set out in paragraph no 6 of *Memorando de Políticas Económicas e Financeiras* sent to Portugal under the Financial Assistance Program to the country (Governo de Portugal, 2011: 2).

⁵ See, for example, Aschauer (1989a) and Hatano (2010).

⁶ Which in this section we will follow.

⁷ Again, the Portuguese case can be a good example to test this reality, which demonstrates the relevance and actuality of this paper.

Applying a VAR analysis, Aschauer (1989a) tried to measure the effects of public investment on aggregate economic activity (output) as well as the effects of public investment on private investment. The conclusion of the study indicate that for the United States, public investment has a global crowding-in effect on private investment and that public and private investment (capital) can be seen as complementary. In this context, from the viewpoint of economic policy, the fundamental question is what conditions are required for public investment to be productive and, therefore, contribute positively to economic growth via private investment decisions. Aschauer (1989b) goes further, arguing that the observed decrease in productivity in the United States in the 1970s was due largely to the decline in public investment. This idea is also shared by Mundell (1990).

Based on a panel of 14 OECD countries Argimon, González-Páramo and Roldán (1997) also confirm the existence of a crowding-in effect on private investment through public investment, via the positive impact of infrastructure on the productivity of private investment.

Other studies also attempted, in the context of a VAR methodology, to analyse the effects of public investment on economic output. Such was the case of Mittnik and Neumann (2001) who estimated a VAR model with GDP, private investment, public investment, and public consumption for six industrialised countries. The results of their study indicate that public investments tend to have positive effects on the output, with no evidence of the presence of crowding-out effects. In turn, Voss (2002), taking as variables the GDP, public investment, private investment, real interest rates, and the price deflator of private and public investment, estimated a VAR model for the United States and Canada for the period 1947-1996 and concluded that shocks on public investment have crowding-out effects on private investment. Following the same methodology, Kamps (2004) and Perotti (2004) analysed not only the effects of public investment on output, but also on the labour market, concluding that the presence of crowding-in effects is seen especially in employment.

More recently, Andrade, Duarte and Berthomieu (2006) analysed the role of public expenditure on economic growth for the case of European Union countries. Taking as a reference the model of Barro (1989), and the period from 1960 to 2002, the authors used panel and time series data, and a wide range of econometric methods, including the co-integration estimation methods of Kao and Chiang (2000), and the generalised method of moments (GMM), and concluded that a positive relationship exists between public expenditure and output. The thesis defended by Avila and

Strauch (2003), of the presence of a negative relationship between the level of public expenditure and GDP, was not confirmed by the analysis of these authors for the case of EU countries.

In turn, Sonaglio, Braga and Campos (2010) observed the existence of crowding-out effects (substitution) between public investment and private investment in the Brazilian economy for the period 1995-2006. Using a Vector Error Correction (VEC) method, the authors found that interest rate, tax rate, and average price of capital goods had a negative effect on investment, thus indicating that fiscal policies that aim at reducing taxation, promotion of capital goods production, and reduction of interest rates may positively influence investment and promote sustained economic growth⁸.

Based on the pioneering work undertaken by Aschauer (1989a, 1989b), Hatano (2010) also investigated the effects of public investment on private investment using the Japanese economy as its case⁹. The results of his study reveal co-integration of private and public capital and the estimation results allowed him to conclude the presence of crowding-in effects (complementarity) between public investment and private investment.

In relation to studies involving the Portuguese economy, those conducted in the last fifteen years by Esteves (1998), Pereira (2000, 2001), Pereira and Andraz (2001, 2003 and 2005), Afonso and St Aubyn (2008), and Afonso and Sousa (2009)¹⁰ are of interest.

The exploratory analysis¹¹ developed by Esteves (1998) is somewhat curious because of the historical period covered, that being Portugal, 1879-1910. The author estimates a model using three Stages Least Squares (3SLS) in order to analyse how the public debt crisis of the 1890s contributed to the existence of crowding-out effects in the Portuguese economy. Specifically, the author tries to test the existence of a positive relationship between nominal interest rate (taken as cost of capital) and the real changes in domestic public debt. The results indicate evidence of moderate of crowding-out. In

⁸ Using a panel of 145 countries for the period 1960-2007, Furceri and Sousa (2009) also seem to suggest that government expenditures produce important crowding-out effects that negatively affect consumption and private investment.

⁹ Inspired by the works of Aschauer, many other studies have been developed for specific-countries. As we said, it is not our purpose to analyse this literature exhaustively. However, we leave here the reference to some of these studies, such as Merriman (1990) also for Japan, Berndt and Hansson (1992) for Sweden, Shah (1992) for Mexico, Lynd and Richmond (1993) for the UK, Seitz (1994) for Germany, Sturm and de Haan (1995) for the Netherlands, Otto and Voss (1996) for Australia, and Pereira and Roca (1999) for Spain.

¹⁰ Again, among these, we will review those with conclusions more relevant to our analysis.

¹¹ As designated by the author.

fact, in the medium term, the relationship between the interest rate and the change in debt fades completely.

In turn, Pereira and Andr  z (2005) investigate the effects of public investment in transportation infrastructures such as national roads, municipal roads, highways, ports, airports and railways, on output, private investment, and employment in Portugal in the period 1976-1998, i.e. in the post-Revolution of April 1974 to the date when Portugal joined the Euro Zone. The choice of this period is purposeful, in that the authors seek to take account of the large volume of structural and cohesion funds received by Portugal.

Using a VAR model and a simulation analysis of shocks, the authors conclude that public investments have a strong positive effect on output, private investment, and employment. The results show in particular that one Euro in public investment increases output in the long-run by 9.5 Euros, which corresponds to a rate of return of 15.9%. The public sector would thus collect 3.3 Euros in future tax revenues for each Euro spent in public infrastructure. In turn, for each Euro invested in the public sector, private investment increases by 8.1 Euros¹². For each millions of Euros of public investment, 230 additional jobs would be created. Moreover, public investment in transportation infrastructures would increase long-run labour productivity. So, there would be strong long-run budgetary benefits resulting from public investments in the form of increased future tax revenues.

In this perspective a strategy based on investments in public infrastructure is perfectly justifiable insofar as the improvements in infrastructure contribute not only to a greater output and employment growth, but also to a better budgetary position through a higher tax revenue in the future. Pereira and Andr  z (2005) conclude that investments in public infrastructures are crucial for the Portuguese growth strategy.

Using a methodology similar to that used by Pereira and Andr  z (2005), Afonso and St Aubyn (2008) also estimated macroeconomic return rates associated with public and private investments for seventeen countries (fourteen EU countries plus Canada, Japan and the United States) for the period 1960-2005.

They show that public investment had contractionary effects on output in five countries, particularly in Belgium, Canada, the Netherlands, Ireland, and the UK, with the simulation analysis of shocks (impulse response functions) indicating that positive impulses in public investment led to a decline (crowding-out) in private investment. In

¹² Everything seems to indicate the existence of a strong complementarity between public and private investment, that is to say, for the presence of crowding-in effects in the Portuguese economy.

turn, for eight countries - Austria, Denmark, Finland, Greece, Portugal, and Sweden - there were expansionary (crowding-in) effects on private investment following public investments.

Afonso and St Aubyn (2008) also found that with the exceptions of Finland, Italy, and Sweden, the partial rate of return from public investment was positive. In turn, taking into account the induced effect on private investment, the total rate of return associated with public investment was generally lower, with the exception of France, and negative for the cases of Austria, Finland, Greece, Portugal, and Sweden, countries where the increase in GDP was not sufficiently high to offset the total investment effort. On the other hand, the private investment impulses, have always been expansionary in GDP terms, although public investment has responded positively to private investment in only three cases (Belgium, Greece and Sweden).

3. Empirical Analysis

The empirical study is presented in this section. We begin by presenting the database, the econometric strategy, the estimates for each equation and finally a simultaneous equation model with 4 and 3 equations and the respective multipliers.

3.1. Data Base

The period is from 1960 to 2013. The variables were taken from the macroeconomic data base of the European Commission, AMECO, from the statistics of the Bank of Portugal, and also from the Services Directorate for Economic and Financial Affairs of the Ministry of Foreign Affairs. This database will be made available to those who request it from the authors.

The variables that ultimately are part of our models are: ig , public investment - logarithm ($\log$) of Government GFCF; ip , private investment - $\log$ of private GFCF; y , output - $\log$ of GDP; tcr , real exchange rate - $\log$ of the real effective exchange rate based on unit labour costs; etj , interest rate - $=(1 + r)$, with r the nominal short-term interest rate; and sf , external current funds - the $\log$ of the sum of the structural and cohesion funds with remittances. Variables, beyond the interest rate, are measured at constant prices.

3.2. Econometric Strategy

The strategy followed in the literature of this subject is not always rigorous. The use of VAR models is not accompanied by an indication of the module of the roots associated with the matrix of the VAR and hence, the stability of the model cannot be checked; impulses are not presented with the respective confidence intervals; and estimations are made with first differences without any reference to ECM processes which makes them inefficient when the variables are integrated processes of order 1 (I(1)). Also the fact that some studies test hypotheses that relate to several countries weakens the usefulness of VAR models when a country has quite particular national perspectives to consider.

To respond to these problems we tested the stationarity of our variables, which emerged as I(1), meaning that we could choose to study the co-integration or estimate VAR models that integrate the dynamics of the evolution of these variables. Generally, co-integration was rejected by the Johansen test, and where it was not, the roots of the VAR-associated matrix were outside the unit circle. This means the process was not stationary. The application of VAR models to our data was not very robust. Reducing the VAR to Near-VAR models leads in practice to the abandonment of the characteristics of interdependence of these models. Thus, we opted for the use of ADL (augmented distributed models) models for the variables that we want to represent. For each equation we applied the methodology of Hendry-Krolzig, Hendry, D F and H-M Krolzig (2001), and Hendry, D F and H-M Krolzig (2005).

The estimation of the equations of the product, the private and public investment and the real exchange rate allowed us to answer the question of whether public investment is crowding-out private investment. Subsequently, we estimated, a simultaneous equations model with these variables using the SUR methodology (seemingly unrelated regressions), and calculated the multipliers of the model's exogenous variables. We used two systems: one with 4 endogenous variables (equations 1-4), and another with 3 endogenous variables (equations 1-3). With these two models we also try to answer to the question of crowding-out.

The following behavioural hypotheses were considered:

$$y = \beta_0^y + \beta^y(L) \cdot y + \alpha^y(L) \cdot ip + \gamma^y(L) \cdot ig + \lambda^y(L) \cdot tcr + \phi^y(L) \cdot etj + \mu^y \quad (1)$$

$$ip = \beta_0^{ip} + \beta^{ip}(L) \cdot y + \alpha^{ip}(L) \cdot ip + \gamma^{ip}(L) \cdot sf + \phi^{ip}(L) \cdot etj + \mu^{ip} \quad (2)$$

$$ig = \beta_0^{ig} + \beta^{ig}(L) \cdot y + \alpha^{ig}(L) \cdot ig + \gamma^{ig}(L) \cdot sf + \phi^{ig}(L) \cdot etj + \mu^{ig} \quad (3)$$

$$tcr = \beta_0^{tcr} + \beta^{tcr}(L) \cdot tcr + \alpha^{tcr}(L) \cdot ip + \gamma^{tcr}(L) \cdot ig + \phi^{tcr}(L) \cdot sf + \lambda^{tcr}(L) \cdot etj + \mu^{tcr} \quad (4)$$

$\alpha(L)$, $\beta(L)$, $\gamma(L)$ e $\phi(L)$ represent polynomials lags. We consider that output depends on public and private investment, the level of competitiveness of the economy, measured by the real exchange rate, and financing costs represented by the interest rate. Private investment is considered to be dependent on the level of output, financing costs and external transfers. The same is admitted for public investment. Finally, we take the real exchange rate determined by the level of investment, external transfers and interest rate.

3.2.1. 2SLS Individual Equations

In this section we present the main results associated with the two-stage least square estimation (2SLS) of ADL equations, the behaviour of which was previously reported, namely: (1) output equation; (2) private investment equation; (3) public investment equation, and (4) real exchange rate equation.

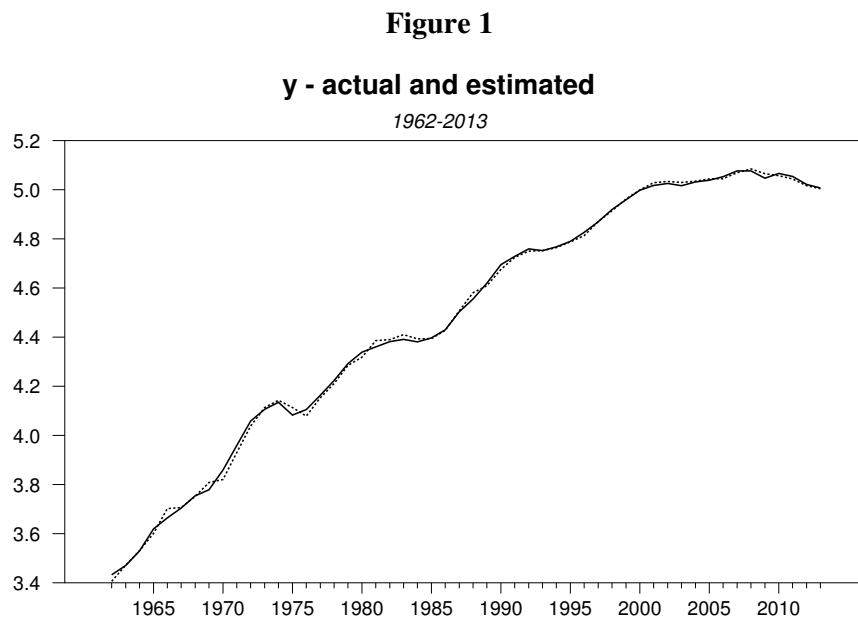
(1) Output Equation

Table 1 - Output Estimation

Var	Coefficient	S.E.	T	NS	Other Indicators
y_1	0.899	0.030	29.45	0.00	sigma=0.018
Constant	1.094	0.224	4.89	0.00	J-Spec.(2)=0.380 [0.83]
Ip	0.163	0.026	6.26	0.00	Over.(2)=0.03 [0.98]
ip_1	-0.097	0.034	-2.89	0.01	B-P(1)=1.48 [0.22]
Ig	0.055	0.019	2.93	0.00	ip=ip_1: F(1,45)=7.22 [0.01]
ig_1	-0.047	0.022	-2.15	0.04	ig=ig_1: F(1,45)=0.33 [0.57]
Tcr	-0.116	0.029	-3.97	0.00	ADF_t=-8.0 [<0.01]
Etj_1	-0.268	0.076	-3.54	0.00	ADF_Z=-55.0 [<0.01]

In Table 1¹³ the value of the standard deviation of the estimated error is shown to be very small, less than 2%. The table also shows that there are no problems of autocorrelation of errors, the Hansen test allows the use of the instruments taken for the estimation, the auxiliary equation does not reject the null hypothesis of no correlation between the instruments and the errors, no problem of auto-correlation of order 1 was detected, and finally the two ADF tests, the t and the Z tests, reject the null of unit root in the errors of this estimation. The null of the sum of lagged and current regression coefficients of private investment is rejected but not the null of the sum of the regression coefficients of public investment. So we can conclude that a positive effect of private investment on output is experienced, and we cannot reject the null of the influence of public investment on output. Output is negatively affected by the real exchange rate and the interest rate. These results match the a priori expectation. We should note that in terms of this equation we reject any idea of substitutability between private and public investment.

In Figure 1¹⁴ we have the actual and estimated values obtained with this equation.



¹³ In the first column we have the explanatory variables; in the second the coefficient values; in the third the standard-errors associated with the estimated coefficients; in the fourth the T values; in the fifth the probability values associated with the T; and finally in the last column some other statistical information, the standard error of the estimation, the Hansen J-specification test and its order, the over-identification test of instruments as an LM test and its order, the Breusch-Godfrey LM test for auto-correlation of order 1, and the ADF tests with the “t” and the “Z” statistics are usually the last tests. In this Table two other tests are presented: for the null sum of two regression coefficients. If not indicated the tests are always Chi-squared tests.

¹⁴ The continuous trace corresponds to actual values.

Output estimated values are very close for different periods and different cycle moments to actual values as was reflected on the sigma value of the estimation.

(2) Private Investment Equation

Table 2 – Private Investment Estimation

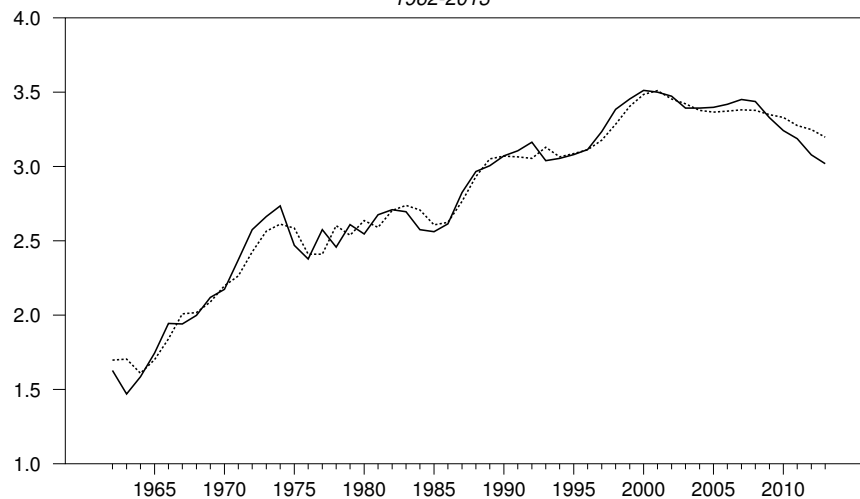
Var	Coefficient	S.E.	T	NS	Other Indicators
ip_1	0.691	0.064	10.71	0.00	sigma=0.089
Constant	1.230	0.345	3.57	0.00	J-Spec.(2)=7.29 [0.063]
sf	0.156	0.038	4.10	0.00	Over.(3)=0.00 [1.00]
Etj_1	-1.385	0.403	-3.44	0.00	B-P(1)=2.39 [0.12]
					ADF_t=-5.6 [<0.01]
					ADF_Z=-41.6 [<0.01]

In terms of fitted values this equation is slightly inferior to the output equation. Certainly, we should draw attention to these values given the great difficulty always associated with the estimation of private investment values. The Hansen test deals with any problem of over-identification rejecting any result at the 5% level, and no problems associated with a poor choice of instruments concerning the errors, with the autocorrelation of errors of order 1, and stationarity, are presented in this estimation. The influence of financial costs and external funds is obvious - the two have a key role in explaining private investment in Portugal.

Figure 2

ip - actual and estimated

1962-2013



In Figure 2 we can check the good fit of investment to the current severe restriction policy measures and the decrease in economic confidence by economic agents in the late years. Fit values are higher than those actually registered since 2010.

(3) Public Investment Equation

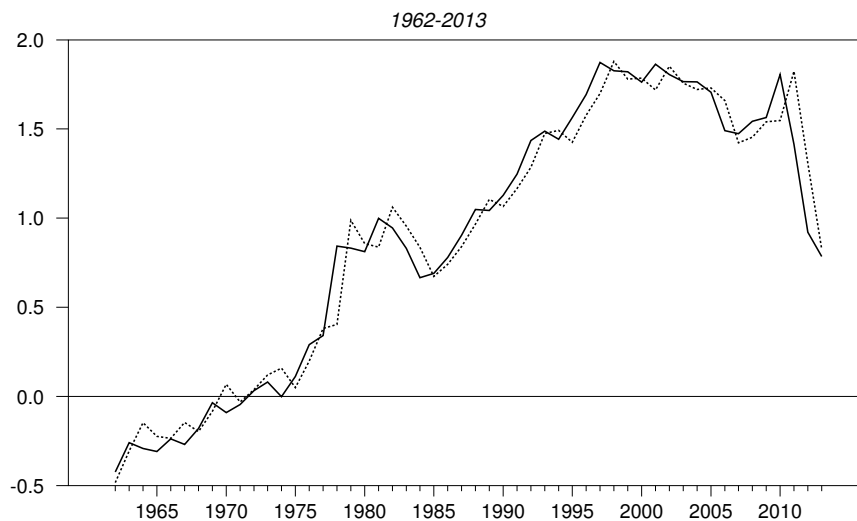
Table 3 – Public Investment Estimation

Var	Coefficient	S.E.	T	NS	Other Indicators
ig_1	1.173	0.139	8.42	0.00	sigma=0.142
ig_2	-0.241	0.133	-1.81	0.08	J-Spec.(3)=2.26 [0.52]
sf_1	0.011	0.005	2.28	0.03	Over.(3)=0.00 [1.00]
					B-P(1)=0.55 [0.46]
					ADF_t=-8.81 [<0.01]
					ADF_Z=-49.6 [<0.01]

The average error of the estimate is now higher (14%), which reflects an important component of the discretionary behaviour of this variable. Apart from being an auto-regressive process of order 2, public investment depends on external funds. The null hypothesis for the coefficient of this variable is rejected at the level of 5% (2.7%, more precisely). Again we have no problems of over-identification, autocorrelation of errors, or of stationarity of the errors.

Figure 3

ig - actual and estimated



In Figure 3 it is clear that there has been an over-estimation of investment in recent years: public authorities are making efforts to reduce public expenditure, and investment expenditure is more flexible than current expenditure.

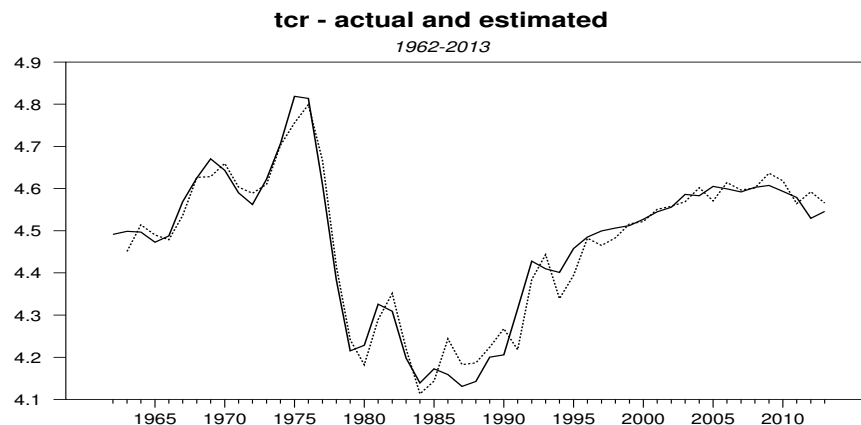
(4) Real Exchange Rate Equation

Table 4 – Real Exchange Rate Estimation

Var	Coefficient	S.E.	T	NS	Other Indicators
tcr_1	1.373	0.125	11.0	0.00	sigma=0.040
tcr_2	-0.969	0.184	-5.27	0.00	J-Spec.(2)=3.23 [0.199]
tcr_3	0.313	0.109	2.86	0.01	Over.(2)=0.00 [1.00]
Constant	1.721	0.362	4.75	0.00	B-P(1)=1.37 [0.24]
ip_1	0.111	0.031	3.62	0.00	ADF_t=-6.31 [<0.01]
ig_1	-0.086	0.023	-3.71	0.00	ADF_Z=-44.61 [<0.01]
Etj	-0.635	0.138	-4.60	0.00	

We see in Table 4 that the fitted values are very close to actual values: the average error is only 4%. The estimation has no problems of over-identification of the instruments, of autocorrelation of order 1 of errors, or of stationarity of the errors. The real exchange rate depends positively on private investment and on reductions in the interest rate. Public investment is negatively associated with the real exchange rate. This result confirms the presence of the Dutch-Disease phenomenon in the Portuguese economy, where private investments depend positively on external funds and on decreases in the interest rate (equation (2)), and where they also have a strong component of non-tradable goods leading to increased values of the real exchange rate – a loss of competitiveness of the Portuguese economy (Andrade and Duarte, 2013).

Figure 4



In Figure 4 we can see the high degree of adherence of fitted to actual values. It is noteworthy that abrupt changes occur in the estimation over the years considered.

In conclusion, from the individual equations we should stress the complementary role of public investment in respect of private investment. In fact, public investment does not adversely affect private investment and output; rather the reverse occurs since public investment has a non-negative direct effect on output and has also influences external competitiveness, thereby creating conditions for private investment, and consequently promoting a positive impact upon output.

3.2.2. Simultaneous Equation Models

With these equations we are able to build a model for equations where the endogenous variables are the output, the private investment, the public investment, and the real exchange rate; and the exogenous variables are the external funds, and the interest rate (M4). We then propose a second model in which the real exchange rate is an exogenous variable and not an endogenous one as in the the first model (M3).

To establish the greater importance of the exogenous variables over the endogenous ones, we calculate the values of multipliers. These values correspond to the evolution resulting from an isolated shock of 100% in the original value of the exogenous variable in 2008. For the interest rate the new value considered was $1+2x_r$. In Tables 5 and 6 we have the multipliers for the model with 4 endogenous variables.

Table 5 – Multipliers for External Funds (M4)

ENTRY	M_Y	M_IP	M_IG	M_TCR
2008:01	0.0176	0.1079	0.0000	0.0000
2009:01	0.0166	0.0746	0.0077	0.0120
2010:01	0.0134	0.0516	0.0090	0.0240
2011:01	0.0098	0.0356	0.0087	0.0264
2012:01	0.0071	0.0246	0.0081	0.0199
2013:01	0.0055	0.0170	0.0073	0.0113

Table 6 – Multipliers for Interest Rate (M4)

ENTRY	M_Y	M_IP	M_TCR
2008:01	0.0034	0.0000	-0.0294
2009:01	-0.0152	-0.0641	-0.0404
2010:01	-0.0107	-0.0443	-0.0341
2011:01	-0.0078	-0.0306	-0.0218
2012:01	-0.0060	-0.0212	-0.0129
2013:01	-0.0046	-0.0146	-0.0096

External funds have an important influence on private investment and, consequently, on output. A 100% increase in external funds would lead to a growth of 23.4% and 4.8% on private investment and output, respectively, at the end of the third period after the increase. The effect lasts longer for private investment than for output. Output growth is not higher due to the negative effect exerted by the appreciation of the real exchange rate. The effect on public investment is positive but limited, 4% in 6 years. At the end of 6 years the effect on the evaluation of the real exchange rate is considerable, at 8.4%.

The increase on the interest, amounting to double its value, is responsible for a decrease in output of 4%, in private investment of 17.5%, and in the real exchange rate of 12.8%. This last result reduces the decrease in output motivated by the great decrease in investment. Due to the relation between the interest rate and real exchange rate, the effect of the rise in this variable on output is positive in the first year. Changes in interest rate do not affect public investment in our model. Changes in external funds lead us to assume that private and public investment are complementary both in their contribution and in their response to shocks, rather than being substitutable.

In Table 7 we have the results for the M3 model, concerning the shock on external funds, and in Table 8 the results of the shock on interest rate (first columns), and on the real exchange rate (last two columns).

Table 7 – Multipliers for External Funds (M3)

ENTRY	M_Y	M_IP	M_IG
2008:01	0.0176	0.1079	0.0000
2009:01	0.0179	0.0746	0.0077
2010:01	0.0174	0.0516	0.0090
2011:01	0.0165	0.0356	0.0087
2012:01	0.0154	0.0246	0.0081
2013:01	0.0143	0.0170	0.0073

Table 8 – Multipliers for Interest Rate and Real Exchange Rate (M3)

ENTRY	M_Y	M_IP	ENTRY	M_Y
2008:01	0.0000	0.0000	2008:01	-0.0803
2009:01	-0.0229	-0.0641	2009:01	-0.0722
2010:01	-0.0216	-0.0443	2010:01	-0.0649
2011:01	-0.0201	-0.0306	2011:01	-0.0583
2012:01	-0.0186	-0.0212	2012:01	-0.0525
2013:01	-0.0170	-0.0146	2013:01	-0.0472

Comparing the multipliers of the two models we see that the effects of external funds on private and public investment (Table 5 and 7) are the same. The effects on output are now much higher because the real exchange has not been endogeneised with its negative effects on output. For the same reason the multiplier of interest rate is now greater on output (Table 6 and 8) due to the fact we are not considering the effects of the interest rate on the devaluation of the real exchange rate. Considering the last model (M3) the effect of a shock on the real exchange rate is substantial: doubling its value will produce a decrease of 8% in the first year and after 5 years the decrease will be still of 4.7%.

In short, once again we are witnessing a dynamic evolution of the economy in which private and public investments are complementary and in no way substitutes.

4. Conclusion

With this study we have analysed the effects of public and private investment on the output of the Portuguese economy in the period 1960-2013. By modelling output we know whether private and public investment are complementary (crowding-in effects), or substitutes (crowding-out effect). It was also our aim to evaluate the influence of financial costs, external funds, and real exchange rate on private and public investment in Portugal.

Contrary to the majority of studies conducted on this topic we have not used a VAR model since the estimation of such a model would not be robust. Instead, we opted for the estimation methodology proposed by Henry and Krolzig (2001, 2005), and for simultaneous equations models using ADL and 2SLS methodology.

The empirical study confirms the presence in the Portuguese economy of a complementarity (crowding-in) effect between private investment and public investment, and not a substitutability (crowding-out) effect. It was also possible to see that shocks (appreciation) in the real exchange rate did not have an impact on private or public investment, but rather, led to a long-lasting negative effect, thereby confirming the presence of the Dutch-disease phenomenon in the Portuguese economy.

Financial costs and external funds played a role in explaining private investment in Portugal and therefore, the output evolution. In turn, public investment depended on external funds, which could be explained by the relevant importance of the various co-financing programmes carried out in recent years in the Portuguese economy within the framework of structural and cohesion funds from EU.

Our conclusion confirms the presence of a crowding-in effect of public investment on private investment and as a consequence, its positive effect on output. Another result is the absence of negative effects of public investment on economic competitiveness.

References

- Afonso, A. and M. St. Aubyn (2008), “Macroeconomic Rates of Return of Public and Private Investment: Crowding-in and Crowding-out Effects”, Working Paper Series, No. 864, European Central Bank, February.
- Afonso, A. and R. M. Sousa (2009), “The Macroeconomic Effects of Fiscal Policy”, Working Paper Series, No. 991, European Central Bank, January.
- Andrade, J. S. and A. P. Duarte (2013), “The Dutch Disease in the Portuguese Economy”, Estudos do GEMF, No. 05, Faculdade de Economia da Universidade de Coimbra.
- Andrade, J. S.; Duarte, A. and C. Berthomieu (2006), “Le rôle de la dépense publique dans la croissance: le cas des pays de l’Union européenne”, *Économie Appliquée*, tome LIX, No. 2, pp.29-64.
- Argimón, I.; González-Páramo, J. and J. Roldán (1997), “Evidence of Public Spending Crowding-out from a Panel of OECD Countries”, *Applied Economics*, Vol. 29, No. 8, pp. 1001-10.
- Aschauer, D. A. (1989a), “Does Public Capital Crowd out Private Capital?”, *Journal of Monetary Economics*, Vol. 23, No. 2, pp. 177-200.

- Aschauer, D. A. (1989b), “Is Public Expenditure Productive?”, *Journal of Monetary Economics*, Vol. 24, No. 2, pp. 171-88.
- Avila, D. R. and R. Strauch (2003), “Public Finances and Long-Term Growth in Europe – Evidence from a Panel Data Analysis”, Working Paper 246, European Central Bank, Frankfurt.
- Barro, R. (1989), “A Cross-Country Study of Growth, Saving and Government”, Working Paper 2855, NBER, Cambridge, Ma.
- Bernd, E. and B. Hansson (1992), “Measuring the Contribution of Public Infrastructure in Sweden”, *Scandinavian Journal of Economics*, Vol. 94, pp. 151-68.
- Blanchard, O. J. (2008), “Crowding out”, *The New Palgrave Dictionary of Economics*, 2^a Edition.
- Esteves, R. P. (1998), “O Crowding-out em Portugal 1879-1910: uma análise exploratória”, *Análise Social*, Vol. XXXIII (151-152), No. 2^o-3^o, pp. 573-618.
- Furceri, D. and R. M. Sousa (2009), “The Impact of Government Spending on the Private Sector: Crowding-out versus Crowding-in Effects”, Documento de Trabalho, Working Paper Series, NIPE WP 6, Universidade do Minho.
- Governo de Portugal (2011), “Portugal – Memorando de Políticas Económicas e Financeiras”, May 17.
- Hatano, T. (2010), “Crowding-in Effect of Public Investment on Private Investment”, *Public Policy Review*, Vol. 6, No. 1, February.
- Hendry, D. F and J. A. Doornik (2001), *Empirical Econometric Modelling Using Pc-Give 10*, Volume I, Timberlake C. Ltd, London.
- Hendry, D. F. and H.-M. Krolzig (2001), *Automatic Econometric Model Selection*, London: Timberlake Consultants Press.
- Hendry, D. F. and H.-M. Krolzig (2005), “The properties of automatic Gets modelling”, *Economic Journal*, Vol. 115, C32-C61.
- Johansen, S. (1995), *Likelihood based inference on cointegration in the vector autoregressive model*, Oxford: Oxford University Press.
- Johansen, S. and K. Juselius (1990), “Maximum likelihood estimation and inference on cointegration – with applications to the demand for money”, *Oxford Bulletin of Economics and Statistics*, No. 4, pp. 222-34.
- Kamps, C. (2004), “The Dynamic Effects of Public Capital: VAR Evidence for 22 OECD Countries”, Working Paper 1224, Kiel Institute.
- Kao, C. and M. H. Chiang (2000), “On the Estimation and Inference of a Cointegrated Regression in Panel Data”, *Advances in Econometrics*, Vol. 15, pp. 179-222.

- Lynde, C. and Richmond, J. (1993), "Public Capital and Long-Run Costs in U.K. Manufacturing", *The Economic Journal*, Vol. 103, No. 421, pp. 880-93.
- Merriman, D. (1990), "Public Capital and Regional Output: Another Look at Some Japanese and American Data", *Regional Science and Urban Economics*, Vol. 20, pp. 437-58.
- Mittnik, S. and T. Neumann (2001), "Dynamic Effects of Public Investment: Vector Autoregression Evidence from Six Industrialized Countries", *Empirical Economics*, Vol. 26, pp. 429-46.
- Mundell, A. H. (1990), "Why Has Productivity Growth Declined? Productivity and Public Investment", *New England Economic Review*, January-February, pp. 3-22.
- Otto, G. and G. Voss (1996), "Public Capital and Private Production in Austria", *Southern Economic Journal*, Vol. 62, No. 3, pp. 723-38.
- Pereira, A. M. (2000), "Public Capital Formation and Private Investment: What Crowds in What?", *Public Finance Review*, Vol. 29, No. 1, pp. 3-25.
- Pereira, A. M. (2001), "Is All Public Capital Created Equal?", *Review of Economics and Statistics*, Vol. 82, No. 3, pp. 513-18.
- Pereira, A. M. and J. M. Andraz (2001), *Investimento Público em Infra-estruturas de Transporte em Portugal Continental*, Lisboa: Ministério do Planeamento.
- Pereira, A. M. and J. M. Andraz (2003), "Public Capital and Growth in the U.S.: a Sector-Specific Analysis", *Public Finance Review*, Vol. 31, No. 1, pp. 66-90.
- Pereira, A. M. and J. M. Andraz (2005), "Public Investment in Transportation Infrastructure and Economic Performance in Portugal", *Review of Development Economics*, Vol. 9, No. 2, pp. 177-96.
- Pereira, A. M. and O. Roca (1999), "Public Capital Formation and Regional Development in Spain", *Review of Development Economics*, Vol. 3, No. 3, pp. 281-94.
- Perotti, R. (2004), "Public Investment: Another (Different) Look", Working Paper 277, IGER.
- Seitz, H. (1994), "Public Capital and Demand for Private Inputs", *Journal of Public Economics*, Vol. 54, pp. 238-307.
- Shah, A. (1992), "Dynamics of Public Infrastructure, Industrial Productivity and Profitability", *Review of Economics and Statistics*, Vol. 74, No. 1, pp. 28-36.
- Sonaglio, C. M.; M. J. Braga and A. C. Campos (2010), "Investimento Público e Privado no Brasil: Evidência dos Efeitos *Crowding-In* e *Crowding-Out* no Período 1995-2006", *Revista EconomiA*, Vol. 11, No. 2, pp. 383-401.

- Sturm, J. and J. de Haan (1995), "Is Public Expenditure Really Productive? New Evidence for the U.S.A. and the Netherlands", *Economic Modeling*, Vol. 12, No. 1, pp. 60-72.
- Voss, G. (2002), "Public and Private Investment in the United States and Canada", *Economic Modelling*, Vol. 19, No. 4, pp. 641-64.

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