

## A Brief VAR Analysis of a CAPB Shock

**Frederico Silva Leal,  
Daniel Goulão and José Azevedo  
Pereira\***

### Abstract

*The present research aims to study the macroeconomic effects of a Cyclically Adjusted Primary Balance (CAPB) shock, using a basic structural VAR for the Eurozone countries (EA19) in the period 1960-2017. According to the results, a fiscal consolidation, due to a decrease in the long-term real interest rates, is expected to stimulate private investment. Yet, it would generate a slightly negative impact on the GDP in the short-term, with an expansionist response in the medium and long run.*

**Keywords:** Fiscal Policy, VAR, Private Investment

**JEL Classification:** E62, B22, E22

Office for Economic Policy and International Affairs  
Ministry of Finance  
Rua da Alfândega n.º 5A  
1100 – 016 Lisbon  
[www.gpeari.gov.pt](http://www.gpeari.gov.pt)

\* The opinions expressed in the article are the responsibility of the authors and may not coincide with those of the institution. All errors and omissions are the responsibility of the authors.

### 1. Introduction

Following the Keynesian theory, an expansionary fiscal policy is expected to create a positive dynamic on aggregate demand, giving favourable conditions for private initiatives (crowding-in effect), and stimulating the economic growth. However, due to competitive, financial and fiscal conditions, the opposite scenario may exist.

In this sense, this article attempts to better analyse the macroeconomic effects of fiscal policy. In particular, it tries to evaluate the impact of a fiscal consolidation, on private investment (% of GDP) and on real GDP within the Eurozone. As an indicator of fiscal consolidation it will be used the cyclical adjusted primary balance (CAPB), as it eliminates all the factors that may change the fiscal consolidation independently of the government policy, namely interest payments and cyclical component.

For that, based on Pina and St. Aubyn (2006) and on Afonso and St. Aubyn (2008), a 5-variable structural VAR will be used to compute the impulse response functions in the short and long run. Thus, it will be possible to assess the existence of a crowding in or crowding out effect provided by fiscal expansions.

The paper is organised as follows. In section two, it is presented a short literature review of the economic theory underlying fiscal shocks and their main transition channels. Section three shows some data and stylized facts, and section four explains the methodology applied in this article. The section five presents the estimation outputs and section sixth the main conclusions.

Finally, in Appendix II we will complement our essay assessing the reaction of the policy maker in response to an exogenous GDP shock.

## 2. Literature Review

According to the Keynesian theory, stressing the need of government intervention, an expansionary fiscal policy increases the aggregate demand generating a positive effect on the economic activity. Specifically, a demand shock will lead to a dynamic process - fiscal multiplier –, which concludes in an increase in GDP. The positive impact of an expansionary fiscal policy, through an increase in salary of civil servants, goods and services consumption, public investment or a reduction of tax rates, among others, is greater in an economy with no inflationary pressures and no liquidity constraints. In this context, the policy maker has tools to use as stabilizer instruments, in order to soften the business cycle, namely it may manage public expenditure and tax revenue to influence household's income and behaviour. As a result, a fiscal consolidation in a negative economic cycle is expected to result in a recessive impact on employment and on GDP (Bernheim, 1989).

The existence of automatic stabilizers and interest expenditure may lead to a misperception of the type of fiscal policy. Indeed, we could be towards a contractionary fiscal policy and at the same time having an increase of the Government Budget Balance as it depends on the economic cycle. Auerbach and Gorodnichenko (2012) observed that the cyclically adjusted primary balance (CAPB) should be used as a proxy to properly assess the fiscal policy. The CAPB consists in the Government Budget Balance (GBB) cyclically corrected (through the output gap) and net of public debt interest expenditure.

Despite the relative acceptance of the Keynesian perspective and the impact of the aggregate demand in the short-run in normal conditions in the economic literature, the accumulation of negative GBB, and the consequent public debt growth might deteriorate the financing conditions. Namely, the public debt may reach a level in which the risk of default arises, and, therefore, the sovereign interest rate increases. The interconnectivity between the private and public sectors may lead to an increase in the private sector interest rate. Hence, a non-linear relationship between public debt and economic growth is perceived (Elmendorf and Mankiw, 1999; Reinhart and Rogoff, 2010).

According to the neoclassical approach - where households and firms face an intertemporal consumption and investment decision over the life cycle – a shock in public demand might produce recessive pressures. An

excessive capital demand and a deterioration in public finances - leading to a rise on interest rates-, would inhibit investments and stimulate savings (Bernheim, 1989). In addition, since agents face an intertemporal maximization problem, a marginal increment in their income would not generate a significant impact on their current consumption (Diamond, 1965). Also, an inter-generational altruistic utility function, as considered in the Ricardian approach is one of the assumptions for the life cycle theory. Again, a temporary income shock will result in a quasi-neutral real economic impact (Bernheim, 1989).

The neoclassical theory defends that only supply shocks have the ability to promote economic growth in the long run - as it changes the steady-state -, in opposite to demand shocks as suggested by the Keynesian theory.

The type of impact in the economic activity depending on the type of fiscal policy, namely public investment applied and financing instrument (tax revenues or public debt), is also studied in the literature. The State' financing needs financed through public debt or tax revenues, may lead to a decrease in private investment, through a direct substitution or an increase in interest rates and consequently disincentive to private investment. In this specific case, we are facing a crowding-out of private investment due to expansionary fiscal policy.

However, some categories of public investment (and under some conditions) may generate favourable conditions for private initiatives. The improvement of infrastructures and business conditions could be a factor of private investment productivity increase. In this case we are facing crowding-in effect of public investment (Afonso and St. Aubyn, 2008).

Moving to the main empirical contributions in the literature regarding the impact of fiscal policy and economic activity, contradictions are commonly observed.

In the core article of Blanchard and Perotti (2002), the results seemed to be consistent with the Keynesian theory, namely, private consumption appears to slack with an increase in taxation, and driven by government spending. Using a SVAR model for the US economy (1960-1997) they obtained a government expenditure multiplier of 0.84 in the short run, and surpassing the unit (cumulative multiplier) in the long run. The more recent literature is giving more focus on the non-linearity of the fiscal multiplier, depending on time and country specific

characteristics. According to Brinca et al (2016), the macroeconomic effects of a fiscal expansion seem to be higher when facing a liquidity constraint scenario due to a higher marginal propensity to consume. Auerbach and Gorodnichenko (2012) defends that the effect is also dependent on the business cycle, being more effective during recessions than expansions. More recently, Afonso and Leal (2018), using a SVAR model for the Eurozone countries, supported those studies, obtaining higher multipliers in periods of recessions and for indebted countries.

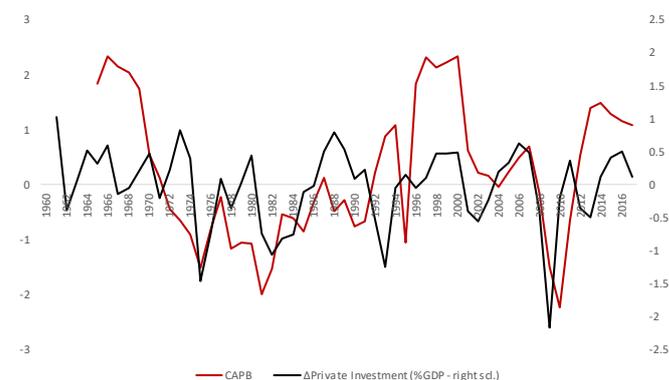
On the contrary, Ilzetski et al (2011) observed that for countries with public debts over 60% of GDP, the fiscal multipliers are not statically different from zero, and with a long-run recessive impact on the economy. It follows from the dissociation of the effectiveness of the fiscal and the risk premium.

Aschauer (1989) studied the effects of the fiscal policy, namely public investment, on the economic activity, assessing whether public investment crowds in or crowds out private investment. In a study on the US economy, he conclude that public investment had an overall crowding-in effect on private sector, and public and private capital can be seen as complementary. However, others like Voss (2002) obtained opposite results. Using the same methodology for the US and Canada in the period 1947-1996, he conclude that innovations to public investment crowd out private investment.

### 3. Some Stylized Facts

The following graphs illustrate the data used, namely the values of the euro area member states before and after the start of EMU (1960-2017) as a weighted average. The sample used for this charts can be seen in the Appendix I.

**Figure 1 - CAPB and Private Investment Fluctuations (weighted averages)**

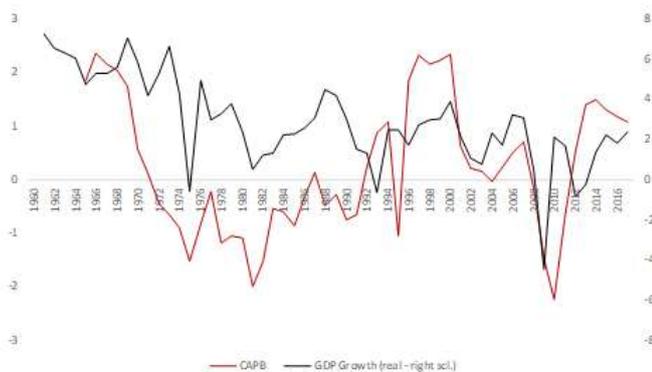


Source: EC, Ameco Database

The Figure 1 illustrates the CAPB and the private investment (change in percentage of GDP) fluctuations along the period in analysis. According to the evolution of these variables, it seems to be a positive correlation pattern between the two variables. An improvement/deterioration of the CAPB seems to be linked with a growth/reduction of the private investment. At same time, a fall in public investment is linked. One possible reason might be substitution effect, i.e., an increase of the CAPB trough public investment may stimulate private investment to catch the resources and fill the unoccupied space in the economy. Although less clear, in the period before the creation of the EMU a crowding out effect can also be perceived.

Note that since the EMU creation, the member states (jointly in a single market and currency union) became more homogenous in what concerns the business cycle and the private sector, and therefore easier to analyse. The less robust link in the period before the creation of the EMU might result from the sample composition along the years and from idiosyncratic factors of each country, as different productive structures, catching up processes or severe crisis.

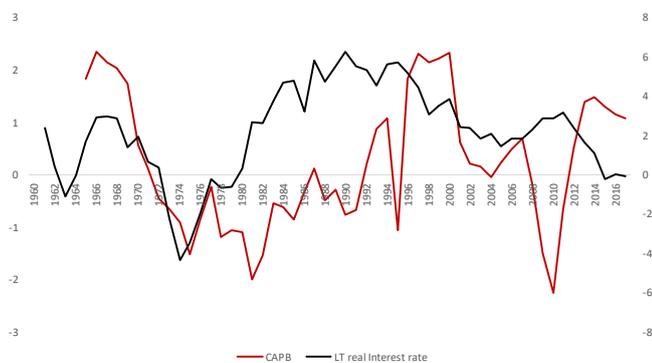
**Figure 2** - CAPB and GDP Growth Fluctuations (weighted averages)



Source: EC, Ameco Database

Figure 2 shows the correlation between the CAPB and the nominal GDP growth rate. The correlation is also positive. An increase in the GDP growth rate is concomitant with a CAPB improvements, and the other way around is also observed. Moreover, the relationship between the CAPB, private investment and the GDP growth have similar patterns along the period in analysis. A possible root for this nexus is the interest rate pattern, i.e., the monetary transmission mechanism.

**Figure 3** - CAPB and LT Interest Rate (weighted averages)



Source: EC, Ameco Database

There is an inverse relationship between the CAPB and the long-term interest rate justifying the choice of this variable as a transmission channel between fiscal policy and private investment and GDP growth. This relation is clearer in the period 1986 – 98 and after 2008.

It seem to have gain a new importance after 2000. Benefiting from the creation of the EMU, with low interest rates, and the absence of exchange rate risk, the

long-term interest rate should reflect the country specific characteristics that are reflected in the risk premium. According to the definition of Barbosa and Costa (2010, p 144), the risk premium corresponds to the "return required by investors for the risk that future cash flows will be different from the agreed due to the occurrence of a default". Since the beginning of the financial crisis, the fiscal variables became one of the mains determinant of the long-term financing costs (Afonso and Leal, 2017).

#### 4. Methodology

This article aims to verify the impact of a CAPB shock on the economic activity, namely on private investment and ultimately on GDP. For that purpose, it will be used a SVAR methodology for the period 1960-2017, in order to assess the impulse response function of a shock in the fiscal policy. Following Pina and St. Aubyn (2006) and Afonso and St. Aubyn (2008) specification, it will be used as economic variables: the CAPB; the private investment to GDP ratio; the long term real interest rate; the unemployment rate (percentage of active population), and the logarithm of output (real terms) to compute a VAR model as follows.

$$X_t = c + \sum_{t=1}^T A_t X_{t-t} + \varepsilon_t$$

$$X_{it} = [\Delta CAPB_{it} \Delta LTIR_{it} \Delta PrivI_{it} \Delta U_{it} \Delta Y_{it}]$$

$$\varepsilon_{it} = [\varepsilon_{it}^{CAPB} \varepsilon_{it}^{LTIR} \varepsilon_{it}^{PrivI} \varepsilon_{it}^U \varepsilon_{it}^Y]$$

Here, the  $X_t$  represents a vector of endogenous variables,  $c$  is the vector for intercepts terms,  $A_t$  is the autoregressive matrix and  $\varepsilon_t$  the random disturbances, which includes the OLS residuals. The matrix is composed by the five above-mentioned variables. The chosen VAR order used in the estimation was chosen respecting the roots of characteristic polynomial, to satisfy the stability condition.

Using the autoregressive lag polynomial and the correlated error terms ( $u_t$ ) to compute the structural uncorrelated shocks ( $\varepsilon_t$ ), the model was designed using a recursive identification based on the Cholesky decomposition of the variance-covariance matrix of the reduced-form VAR shocks. The imposed restrictions implies that a first order shock would not react contemporaneously to any other shock in the system. The second variable reacts contemporaneously to the previous

variable fluctuation, and so on, until the last variable, which will respond to all the others. In this context, the variables present the following sequence: CAPB, LT interest rate, private investment, unemployment rate, and lastly, the output.

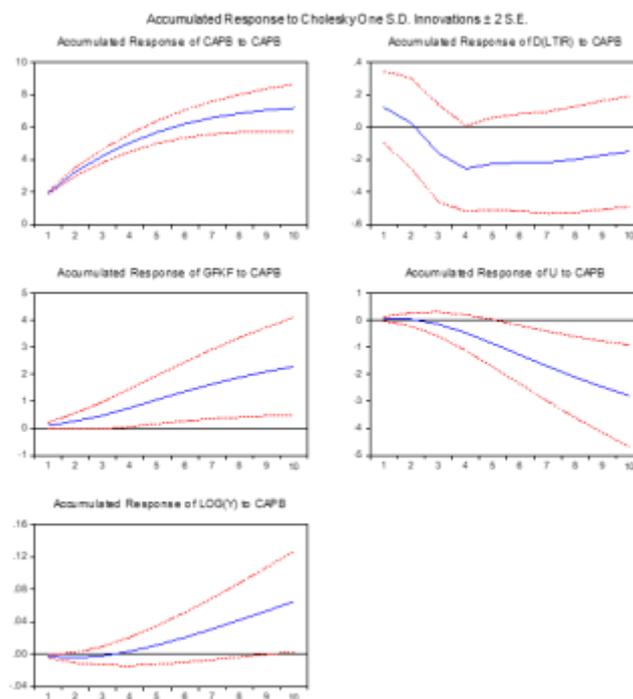
$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ \alpha_{LTIR\ CAPB} & 1 & 0 & 0 & 0 \\ \alpha_{Privl\ CAPB} & \alpha_{Privl\ LTIR} & 1 & 0 & 0 \\ \alpha_{U\ CAPB} & \alpha_{U\ LTIR} & \alpha_{U\ Privl} & 1 & 0 \\ \alpha_{Y\ CAPB} & \alpha_{Y\ LTIR} & \alpha_{Y\ Privl} & \alpha_{Y\ U} & 1 \end{bmatrix} \begin{bmatrix} u_{it}^{CAPB} \\ u_{it}^{LTIR} \\ u_{it}^{Privl} \\ u_{it}^U \\ u_{it}^Y \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{it}^{CAPB} \\ \varepsilon_{it}^{LTIR} \\ \varepsilon_{it}^{Privl} \\ \varepsilon_{it}^U \\ \varepsilon_{it}^Y \end{bmatrix}$$

### 5. Estimation and Results

In the following SVAR estimation, the sample is composed by EA19 panel data for the period 1960-2017 and it was considered a 3-year lag (Hannan-Quinn information criterion). The data source was the AMECO EU Database.

Additionally, was considered the long-term real interest rate (LTIR) difference-to-difference to satisfy the stability condition (unit root test). The diagnostic tests for both variables and estimations can be seen in the appendixes, as well as the data description.

Figure 4 - Accumulated Response Functions to a CAPB shock



Firstly, one can observe that with the exception for the long-term real interest rate, whose confident level rise doubts about its sign and magnitude (suggesting that it may not be the only transmission channel between the CAPB and private investment), the result gives us a strong clue regarding the orientation of the macroeconomic effects of a CAPB shock.

In this SVAR exercise, when facing a 2 s.d. innovation in the cyclical adjusted primary balance on the Eurozone countries, both private investment and GDP seem to have a positive response in the medium and long-run. As expected, the long-term interest rate will fall in average with an improvement of CAPB due to a lower risk premium, affecting positively the investment level. Consequently, the unemployment rate will decrease following the private investment increase and the GDP increases. Therefore, the economy converges for a new steady state, in which the private investment and the adjusted primary balance increases, and the unemployment rate decreases.

With an almost null impact on the first year, a 1 p.p. improvement on the CAPB is expected to generate an increase of 0.24 p.p. in private investment after 3 years. On the other hand, the short-term shock on GDP growth is slightly negative (about -0.002 p.p) and became increasing positive since the 4th year. In a similar way, a

positive shock on CAPB has a small positive impact on unemployment rate that would start decreasing in the 3rd year.

Hence, the SVAR, despite supporting the principles of the Keynesian theory in the short run, concludes for a crowding-out effect of the public expenditure on private investment in the medium and long run. In addition, a sound and stable fiscal policy is correlated with an increase on GDP.

Thus, it is perceived that a deterioration (improvement) of the fiscal balance might jeopardize (sustain) the private initiative, and consequently inhibit (stimulate) the economic growth. In this model, the result is explained by the improving of the financing conditions of the European economy by reducing interest rates in the medium and long term

However, regarding the interest rate, the estimation is not sufficiently robust to determine with certainty the sign of the variable change and magnitude. In addition, the short-term effect seems to differ from the long-term paths. In particular, a first effect of fiscal consolidation is a reduction of inflation through reducing aggregate demand. Therefore, the higher rigidity of the nominal interest rate in the short term may result in an increase of the real interest rate. In appendix VI, is presented a brief analysis of the LT real interest rate impulse response function (IRF), identifying the role of the inflation rate.

Nevertheless, a fiscal consolidation results in a reduction of the LT real interest rate (diminishing the liquidity constraints) and inflation in the medium and long term, which are two main condition to maximize the fiscal multipliers effects.

## 6. Conclusions

In this study, we gave a brief survey on the expected macroeconomic effects of fiscal shocks according to different theoretical perspectives, identifying possible transmission channels and their pattern on the Eurozone countries in the period 1960-2017. Thus, the macroeconomic response function was assessed through a SVAR model.

According to the results, the long-term real interest rate fall facing a fiscal improvement, which generates a positive impact on private investment, a decrease on the unemployment rate following private investment. In addition, despite a slightly negative impact on GDP in the short-run, a CAPB improvement produces an expansionary response on the medium and long run.

Summarizing, the article has three main results. First, the estimation supports that a fiscal shock has a Keynesian effect on the short run. Second, fiscal consolidation provides a healthy environment for private investment by allowing the stabilization of the debt market and reducing the cost of financing. Lastly, fiscal consolidation by reducing inflationary pressures and liquidity constraints is expected to increase the effectiveness of fiscal policy instruments in the short run.

## References

- Afonso, A. and Leal, F. S. (2018). "Fiscal Multipliers in the Eurozone: A SVAR Analysis", REM Working Paper 047-2018;
- Afonso, A. and Leal, F. S. (2017). "Sovereign yield spreads in the EMU: crisis and structural determinants", ISEG Economics Department Working Paper No. WP 09/2017/DE/UECE;
- Afonso, A. and St.Aubyn, M. (2008). "Macroeconomic Rates of Return of Public and Private Investment: Crowding-In and Crowding-Out Effects", ECB Working Paper No. 864;
- Aschauer, D. (1989). "Does public capital crowd out private capital?" *Journal of Monetary Economics* 24 (2): 171-188;
- Auerbach, A. J. and Gorodnichenko, Y. (2011). "Fiscal Multipliers in Recession and Expansion", NBER Working Paper Series, No. 17447;
- Barbosa, L. and Costa, S. (2010). "Determinantes dos spreads soberanos na área do euro no contexto da crise económica e financeira." *Boletim Económico | Banco de Portugal* (Autumn): 143-164;
- Bernheim, B. D. (1989). "A Neoclassical Perspective on Budget Deficits" *Journal of Economic Perspectives*, vol. 3, No. 2: 55-72;
- Blanchard, O. and Perotti, R. (2002). "An Empirical Characterization of the Dynamic Effects of Changes in

Government Spending and Taxes on Output” *The Quarterly Journal of Economics*, vol. 117, No. 4: 1329-1368;

Brinca, P., Holter, A. H., Krussel, P. and Malafry, L. (2016). “Fiscal multipliers in the 21st century” *Journal of Monetary Economics*, vol. 77: 53-69;

Diamond, P. (1965). “National Debt and Neoclassical Economic Growth.” *American Economic Review*, 55: 1125-1150;

Elmendorf, D. W. and Mankiw, G. N. (1999). “Government debt.” *Handbook of Macroeconomics 1*: 1615-1669;

Ilzetski, E., Mendoza, E. G. and Végh, C. A. (2011). “How Big (Small?) are Fiscal Multipliers?”. IMF Working Paper, WP/11/52;

Pina, A. and St. Aubyn, M. (2006). “How should we measure the return on public investment in a VAR?” *Economics Bulletin 8 (5)*: 1-4;

Reinhart, C. M. and Rogoff, K. S. (2010). “Growth in a time of debt.” *American Economic Review* 100(2): 573-578;

Voss, G. (2002). “Public and private investment in the United States and Canada.” *Economic Modelling* 19: 641-664.

## Appendixes

### Appendix I – Descriptive Statistics

	CAPB	LTIR	GFKF	U	Y
	Cyclically Adjusted Primary Balance	Long term real interest rate	Private Investment	Unemployment rate	GDP
	% potential GDP	% (rate)	% GDP	% of labor force	million euros
Mean	0.4	2.4	19.2	8.4	485.6
Median	0.5	2.4	18.8	7.8	183.5
Maximum	9.2	24.4	33.8	27.5	2918.8
Minimum	-27.3	-12.4	7.7	0.8	5.4
Std. Dev.	3.0	3.6	3.5	4.6	649.0
Skewness	-1.3	0.4	0.4	1.1	1.8
Kurtosis	14.2	8.2	4.4	4.7	5.3
Sum	240	1536	12032	5252	304953
Sum Sq. Dev.	5750	8074	7616	13416	264000000
Observations	628	628	628	628	628

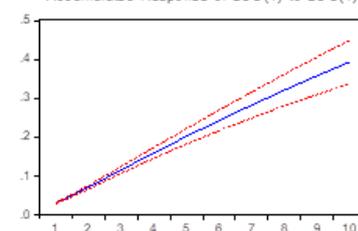
### Appendix II – Fiscal Policy Orientation

After analysing the macroeconomic effects of a CAPB shock, it would be interesting to analyse the inverse relation.

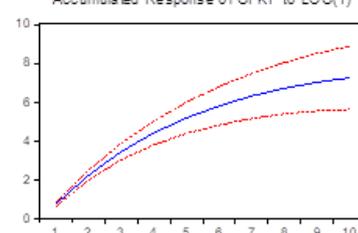
To assess the orientation of the fiscal policy according to the rhythm of economic growth, in this appendix, we used a 3 variables SVAR. Therefore, we applied an exogenous GDP shock, observing the CAPB impulse response function, controlling the investment level as a transmission channel.

Accumulated Response to Cholesky One S.D. Innovations  $\pm$  2 S.E.

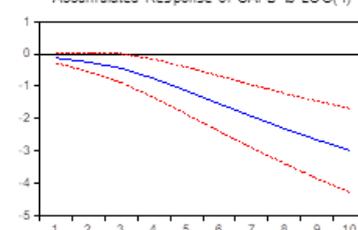
Accumulated Response of LOG(Y) to LOG(Y)



Accumulated Response of GFKF to LOG(Y)



Accumulated Response of CAPB to LOG(Y)

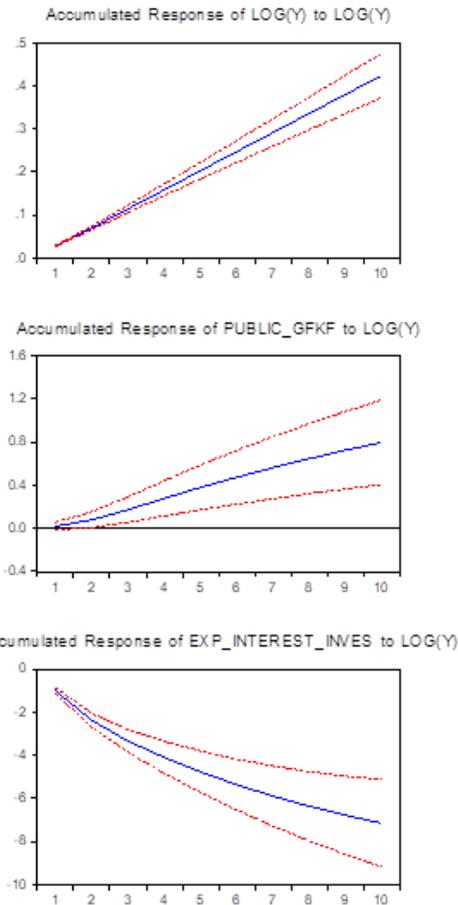


According to the estimation, in response to a GDP increase, both investment and CAPB seem to have a pro-cyclical response. This result might jeopardize the stability function of fiscal policy, where the Government tends to stimulate the economic activity when the growth is higher.

Since the public investment is sometimes used as a margin to control the budget execution, it is expected to increase during periods of economic strong economic growth, being a possible reason for the pro-cyclical orientation of fiscal policy.

Thus, we assessed the behaviour of both public investment and public expenditure net of interest and investment, in response to an exogenous GDP shock.

Accumulated Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



According to the results, facing a positive GDP shock, the public investment increases, which shows the use of public investment as a budgetary margin. In addition, the total net expenditure tends to decrease due to the automatic stabilizers (counter-cyclical behavior of the remaining expenditure).

Thus, giving both estimations, we believe that the pro-cyclical behavior of fiscal policy might be partially explained by the pro-cyclical use of public investment.

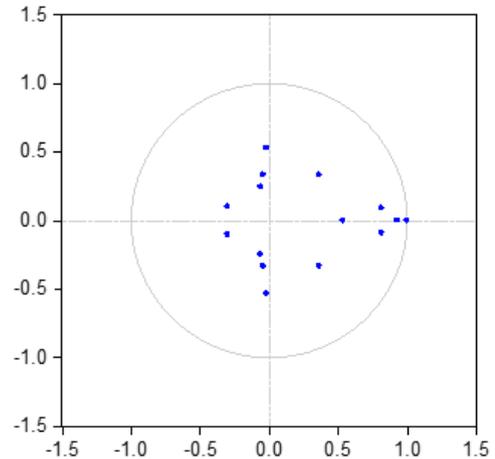
For the next investigations, it may be interesting to study with more attention the crowding-out effects of public investment.

**Appendix III – Variables Unit Root Test**

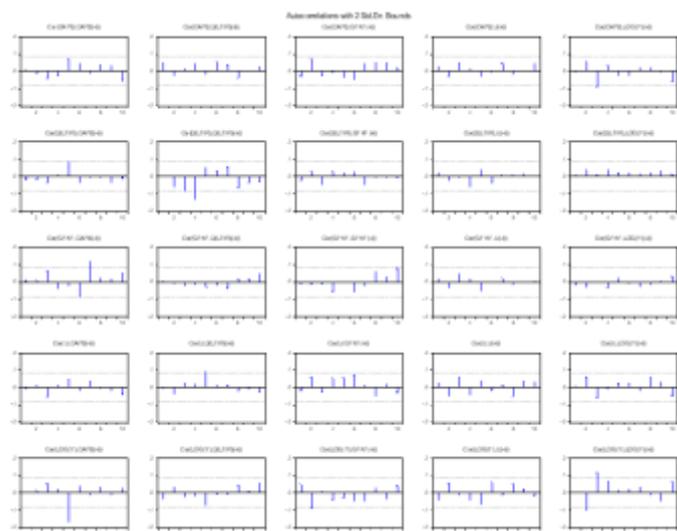
CAPB				
Method	Statistic	Prob.	Cross-sections	Obs
Null: Unit root (assume s common unit root process)				
Levin, Lin & Chu t	-3.61368	0.0002	19	686
LTIR				
Method	Statistic	Prob.	Cross-sections	Obs
Null: Unit root (assume s common unit root process)				
Levin, Lin & Chu t	-0.73482	0.2312	19	651
D(LTIR)				
Method	Statistic	Prob.	Cross-sections	Obs
Null: Unit root (assume s common unit root process)				
Levin, Lin & Chu t	-13.5673	0.0000	19	631
GFKF				
Method	Statistic	Prob.	Cross-sections	Obs
Null: Unit root (assume s common unit root process)				
Levin, Lin & Chu t	-2.62475	0.0043	19	719
U				
Method	Statistic	Prob.	Cross-sections	Obs
Null: Unit root (assume s common unit root process)				
Levin, Lin & Chu t	-3.29931	0.0005	19	803
Y (logarithm)				
Method	Statistic	Prob.	Cross-sections	Obs
Null: Unit root (assume s common unit root process)				
Levin, Lin & Chu t	-8.85189	0.0000	19	817

**Appendix IV– AR Root Graph**

Inverse Roots of AR Characteristic Polynomial



**Appendix V–** Correlogram (10 lags)



**Appendix VI–** The long term real interest rate IRF

In this appendix, in order to understand the positive response of the real interest rate in the short-run and its large confidence interval, a 3 variables SVAR was applied. Here, the inflation rate (Consumer Price Index – IPC - in differences) was controlled to properly assess its role on the interest rate IRF. Thus, it is possible to observe that an improvement of CAPB tends to decrease the inflation rate, what might justify the positive short run response of the real interest rate in the figure 4, as the nominal rate tends to be more inelastic.

In addition, controlling the inflation response, the LT real interest rate reacts negatively both in the short and medium term. It is also perceived that the confidence interval became tighter, making possible a proper assessment of the signal of its response function since the third year.

Accumulated Response to Cholesky One S.D. Innovations  $\pm$  2 S.E.

