PUBLIC DEFICITS AND INFLATION, SOME MORE RESULTS FOR PORTUGAL

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1 — Introduction

This paper intends to evaluate the existence of a relation between public deficits and inflation using quarterly data for Portugal. In theory this link can be explained either through aggregate demand or via the monetization of the deficit.

This relation is modelled using reaction functions (1) whose general specification can be written as $P = (..., Def, ...)$ or as $M^S = f(..., Def, ...)$, whether one is trying to validate directly or indirectly the impact of the deficit on inflation and where M^S, *Def* and P are respectively some sort of measure for the money supply, the deficit and inflation.

The results for Portugal, for the period 1978:2 1994:4, allow us to accept the absence of effects of the deficit upon the money supply or even upon the monetary base. It is however possible to validate the existence of a direct effect of the deficit on inflation, which corroborates the findings of other papers [see Santos (1992)] and of other approaches [Afonso (1992, 1993)].

The paper is organised as follows: section 2 deals with some theoretical considerations concerning the public deficits-inflation issue; section 3 reviews several specifications for the money and inflation equations tested elsewhere in economic literature; section 4 presents some results for Portugal and section 5 concludes the paper. All data sources are listed in the annex.

2 — Some theoretical considerations

2.1 — The keynesian view

The relation between public deficits and inflation can be explained by a keynesian point of view or by a monetarist approach.

Public deficits, through changes in public spending or in taxes, have a direct effect in aggregate demand. Simultaneously, the increase of public debt, due to a larger indebtment of the general Government, causes the increase of wealth (2). This increase of wealth, reflected in the fact that the public holds more financial

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(1) Another approach, commonly used in the literature, is based upon the estimation of autoregressive vectors and the use of causality tests, for a review of these models see Afonso (1992). The use of Granger-causality tests for Portugal can also so be seen in Afonso (1993).

(2) Public debt should be included in wealth, as explained for instance by Blanchard (1985).

assets in his portfolio, will generate higher levels of consumption, more aggregate demand and also an increase in the price level.

This trend of thought is quite in line with the keynesian ideas nicely explained by Barro (1978) and Feldstein (1982). Briefly, an excess of aggregate demand, at a higher level of supply, would rise the price level along an hypothetical curve of aggregate supply with a positive slope.

2.2 — The monetarist approach

On the other hand, due to the existence of high levels of budget deficits, the monetary authority feels constrained to increase the money supply in order to mitigate the effects that the deficits might have on the interest rate level. To keep on issuing new internal public debt, in order to finance a larger deficit, the Treasury must offer attractive (which means high) interest rates to the public. The increase of money supply may well occur when the Central Bank buys, directly or indirectly (if possible), some portion of the public debt issued by the Treasury.

By allowing monetary policy to accommodate significant budget deficits the authorities allow also the possible increase in the price level. This kind of temptation has yet another bonus to the Treasury and to the Government, since the unexpected high level of inflation makes it possible to reduce the real value of the stock of public debt.

This is obviously a monetarist explanation since the increase in the money supply, essential to finance the deficits, ends up in the inevitable rise of inflation. Some authors, for instance Miller (1983), sustain that even if there is no increase in the money supply, the sole increase of interest rates would result, through an effect of crowding out, in a smaller real growth of the economy and, with the same money supply, the price level eventually would have to rise.

2.3 — The long-run arithmetic

The several methods of financing the deficits and their impact on inflation are also an issue that has received some attention by economic literature. Basically one has to assess which is the method of deficit financing that is less likely to produce a rise in the price level. That is, evaluate if financing budget deficits using public debt may, in the long run, produce more inflation than financing the budget through a sustained monetary growth. The seminal work for this topic is the well known article of Sargent and Wallace (1981) about the «unpleasant monetarist arithmetic» ([3]).

The main idea underlying Sargent and Wallace's theory is that financing deficits through public debt may, in the long-run, be more damaging for inflation than allowing for monetary growth right from the start. Their assumption however,

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([3]) For a presentation and discussion of the problem of the «unpleasant monetarist arithmetic», as well as for some calculations for Portugal see Afonso (1992).

is only valid if the real interest rate implicit in public debt is higher than the economy real growth rate.

The fact that the Government ultimately will have to issue money, when the public has no more ability to absorb new debt, under the risk of making the debt/GDP ratio unsustainable, appears therefore as «unpleasant» to the monetarist theories. This is understandable since the efficacy of any monetary rule concerning the money supply, independent of budget deficits, would fade away eventually. We are therefore facing a trade-off between inflation today and inflation in the future.

3 — Some analytical specifications

In this section we outline some specifications tested by several authors in order to evaluate the relation between public deficits and inflation.

3.1 — Indirect relation through money supply

The first specification presumably known for this kind of empirical relationship was suggested and tested by Barro (1977, 1978). The author's idea was to evaluate the effects of the deficit on inflation through the variation of the money stock. The empirical tests were performed using the following money growth rate equation:

(1) $$m_t = a_0 + a_1 m_{t-1} + a_2 m_{t-2} + a_3 u_{t-1} + a_4 g_t + a_5 def_t$$

where:

$m_t = \log (M_t/M_{t-1})$;
$u_t = \log [U_t/(1-U_t)]$;
$def_t = B_t/(P_t Y_t^*)$;
$g_t = \log (G_t) - \log (G_t)^*$;

where $(G_t)^*$ follows an adaptive adjustment process (4) given by:

(2) $$\log (G_t)^* - \log (G_{t-1})^* = \beta [\log (G_t) - \log (G_t)]^*$$

with:

M_t — nominal average money stock for the four quarters;
U_t — unemployment rate;
G_t — real expenditure of the Government;
B_t — end of the year nominal public deficit;
P_t — GNP deflator;
Y_t^* — trend value of real GNP.

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(4) In Barro (1978) words «log $(G_t)^*$ is a distributed lag of current and lagged values of log (G_t)» (pp. 577).

It was possible to conclude from the results that public spending seems to be the more important in the money equation than the deficit measure itself.

Another specification, inspired by the one tested by Barro, was used by Hamburger and Zwick (1981). The unemployment rate, whose coefficient was not statistically different from zero, was not included and public spending was also used as a percentage of the trend value of nominal output. The model can be written as:

(3) $$m_t = a_0 + a_1\, m_{t-1} + a_2\, g_t + a_3\, def_t$$

where we have:

$$g_t = G_t/(P_t\, Y_t^*);$$

and also:

$$m_t = \log\,(M_t/M_{t-1});$$
$$def_t = B_t/(P_t\, Y_t^*);$$

with:

M_t — nominal average money stock for the four quarters;
G_t — nominal Government expenditures, quarterly averages;
B_t — nominal public deficit, quarterly averages;
P_t — GNP deflator;
Y_t^* — trend value of real GNP.

With this correction, more consistency between public deficit and public spending is accomplished, since both variables are included in the equation as a percentage of potential nominal GNP (5). A correction is also made in order to align the frequency of these two variables with the money stock since the authors use, in both cases, averages of quarterly data.

Yet another possibility was advanced by Allen and Smith (1983), using the variation of the public debt stock as a measure for the deficit and the monetary base instead of the money stock. As a matter of fact, the use of the monetary base may eventually be an easier channel to assess the Central Bank behaviour when the Treasury chooses to finance the budget deficits through the issuing of public debt. The model used by the authors was, on a quarterly basis:

(4) $$b_t = c_0 + \sum_{i=1}^{n} c_i\, b_{t-i} + d_1\, g_t + d_2\, div_t$$

where:

$$b_t = \log\,(MB_t/MB_{t-1});$$
$$g_t = G_t/(P_t\, Y_t^*);$$
$$div_t = (D_t - D_{t-1})/(P_t\, Y_t^*);$$

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(5) «It is convenient to call the GNP deflator times trend real GNP 'potential nominal GNP'» [Dwyer (1985), pp. 669)].

with:

MB_t — monetary base;
G_t — nominal public spending;
D_t — stock of public debt;
P_t — GNP deflator;
Y_t^* — trend real GNP.

Niskanen (1978) presented another model for the money supply in which money reacts inversely to price changes and to product growth lagged one period. The deficit measure is now used as a proportion of money stock in a supply function for money such as:

(5) $$m_t = a_0 - a_1 y_{t-1} - a_2 p_{t-1} + a_3 (D_t/M_{t-1})$$

where:

m_t — money stock growth rate;
y_t — rate of change of real GNP;
p_t — rate of change of the GNP deflator;
M_t — level of money supply;
D_t — level of public deficit;

which allows, through the a_3 coefficient, to estimate the percentage of deficit monetization that has occurred.

Recent estimations, based on the models used by Barro (1977), Niskanen (1978) and Hamburger and Zwick (1981), where also performed by Karras (1994). His equation for the money supply was:

(6) $$m_t = a_0 + \sum_{k=1}^{k_{mm}} \alpha_{1k} m_{t-k} + \sum_{k=1}^{k_{md}} \alpha_{2k} d_{t-k} + \sum_{k=1}^{k_{my}} \alpha_{3k} y_{t-k}$$

with:

$m_t = [(M1_t - M1_{t-1})/M1_{t-1}]^*100;$
$d_t = (DEF_t/YN_t)^*100,$
$y_t = [(YR_t - YR_{t-1})/YR_{t-1}]^*100;$

and where the original data is designated as:

$M1_t$ — $M1$ money supply (end of year);
DEF_t — Government deficit (central government);
YN_t — gross domestic product;
YR_t — gross domestic product, constant prices.

The results obtained for a sample of 32 countries led the author to conclude that in general the deficits are not monetized that is, the deficits do not produce inflation via monetary expansions.

Frequently, specifications explaining money growth that include, as an exogenous variable, the measured deficit, assume implicitly that each component of the deficit has an identical effect on monetary growth. On the other hand,

and accepting the structural deficit as a synonymous for the high employment deficit, models that only use the non-cyclical component are assuming, right from the start, that the cyclical component has no effect on monetary growth. Grier and Neiman (1987) studied this question through the estimation of a money supply specification, where they used both the cyclical and non-cyclical components of the deficit:

(7) $$M_t = \sum_{i=1}^{n} \phi_i M_{t-i} + \lambda D_{t-1}$$

and:

(8) $$M_t = \sum_{i=1}^{n} \phi_i M_{t-i} + \lambda_1 SD_{t-1} + \lambda_2 Cd_{t-1}$$

with:

$M_t = [\ln (MM_t/MM_{t-1})]*400;$
$D_t = [(Div_t - Div_{t-1})/Y_t^p]*400;$
$SD_t = (D_t^{pe}/Y_t^p)*100;$
$CD_t = D_t - SD_t;$

and with:

MM_t — *M*1 aggregate;
Div_t — net stock of federal debt;
Y_t^p — nominal potential output;
D_t^{pe} — high employment deficit;
SD_t — structural deficit;
CD_t — cyclical deficit.

This kind of approach seems valid since it is quite possible that monetary authorities conduct countercyclical policies in order to smooth out the business cycle. Therefore, the cyclical component of the deficit may indeed have a significant effect on monetary growth. The Central Bank should respond either to interest rates pressures caused by the structural component of the deficit or to pressures caused by the business cycle as proxied by the cyclical deficit. However, the results seem to show that cyclical deficits have little effect on monetary growth and that structural deficits do consistently statistically cause money growth.

3.2 — Direct relation

Niskanen (1978) tested the impact of the fiscal stimulus on inflation and concluded for the impossibility of demonstrating the existence of effects of the deficit on the price level. The model uses a measure for the fiscal stimulus deduced from:

(9) $$Y_t = Y_{t-1} + g D_t$$

with:

Y_t — nominal income;
D_t — deficit;

and writing the fiscal stimulus (F_t) as:

(10) $$F_t = (Y_t - Y_{t-1})/Y_t = g\,(D_t/Y_t)$$

The equilibrium rate of inflation is given by the following equation:

(11) $$\Delta \log P_t^* = b + c\,F_t + d\,\Delta \log M_{t-1} + e\,\Delta \log M_{t-2}$$

with:

P_t — price level;
M_t — money supply;

and with P_t^* obtained through the adjustment equation:

(12) $$\Delta \log P_t - \Delta \log P_{t-1} = f\,(\Delta \log P_t^* - \log \Delta \log P_{t-1})$$

Inserting equations **(10)** and **(12)** in equation **(11)** leads to the following test equation:

(13) $$\Delta \log P_t = bf + cfg\,(D_t/Y_{t-1}) + df\,\Delta \log M_{t-1} + ef\,\Delta \log M_{t-2} + (1-f)\,\Delta \log P_{t-1}$$

A different set of results was presented by Tabellini (1988) who also tried to asses the direct relation between deficits and inflation. The author concluded that deficits have been inflationary in Italy between 1970 an 1986. The model tested was (with $n = 3, 4$):

(14) $$P_t = \sum_{i=1}^{n} (\alpha_i P_{t-i} + \beta_i m_{t-i} + \sigma_i y_{t-i} + \delta_i d_{t-i})$$

where:

$m_t = \log (M_t/M_{t-1})$;
$y_t = \log (Y_t/Y_{t-1})$;
$d_t = \log (D_t/D_{t-1})$;

and with:

P_t — CPI inflation rate;
M_t — base money;
Y_t — real output;
D_t — total public debt.

Karras (1994) also tested the direct effect of deficits on inflation and, for this author, «the empirical results uncover no evidence that deficits are inflationary» not even through aggregate demand. The reduced-form equation

for inflation, used for 32 countries, explains inflation using money, the price level and the deficit:

(15) $$p_t = b_0 + \sum_{k=1}^{k_{pp}} b_{1k}\, p_{t-k} + \sum_{k=1}^{k_{pd}} b_{2k}\, d_{t-k} + \sum_{k=1}^{k_{pm}} b_{3k}\, m_{t-k}$$

where:

$p_t = [(P_t - P_{t-1})/P_{t-1}]^*100;$
$m_t = [(M1_t - M1_{t-1})/M1_{t-1}]^*100;$
$d_t = (DEF_t/YN_t)^*100;$

and with:

$M1_t$ — $M1$ money supply (end of year);
DEF_t — Government deficit (central government);
YN_t — gross domestic product;
P_t — consumer price index.

Santos (1992), with annual data for Portugal, tried to evaluate the inflationary effects of deficits using also a direct approach. The results led him to conclude that deficits appear to have been inflationary in the period 1960-1970. The equation used for inflation was:

(16) $$P_t = a + b\, P_{t-1} + c\, IMP_t + d\, DEF_t + e\, W_{t-2} + u_1\, D_{74} + u_2\, D_{87}$$

where:

P_t — rate of inflation;
IMP_t — rate of increase of imports (national currency);
DEF_t — budget deficit (percentage of GDP, general government);
W_t — real wage unit cost (rate of increase);
D_{74} and D_{87} — dummy variables for 1974-1987.

Several other authors tested this relationship. In table 1 some of the conclusions are presented and it is interesting to note that they are quite different even if the reality studied is more or less identical.

TABLE 1

Author and date	Data	Evidence of effects	Between
Barro (1978)	A	No	Deficit and money.
Hamburger and Zwick (1981)	A	Yes	Deficit and money.
Allen and Smith (1981)	Q	Yes	Debt variation and money base.
Niskanen (1978)	A	No	Deficit and money.
Levy (1981)	Q	Yes	Debt variation and money base.
Giannaros and Kolluri (1985)	A	No	Deficit and money.
Grier and Neiman (1987)	Q	Yes	Debt variation and money.
Grier and Neiman (1987)	Q	No	Debt variation and money base.
Grier and Neiman (1987)	Q	Yes	Structural deficit and money.
Grier and Neiman (1987)	Q	Yes	Structural deficit and base money.
Afonso (1992)	Q	No	Debt variation and money.
Karras (1994)	A	No	Deficit and money.

Author and date	Data	Evidence of effects	Between
Niskanen (1978)	A	No	Deficit and inflation.
Eisner (1989)	A	No	Deficit and inflation.
Eisner (1989)	A	No	Full-employment deficit and inflation.
Giannaros and Kolluri (1985)		A	no Deficit and inflation.
Tabellini (1985)	Q	Yes	Debt variation and inflation.
Santos (1992)	A	Yes	Deficit and inflation.
Afonso (1992)	Q	Yes	Debt variation and inflation.
Karras (1994)	A	No	Deficit and inflation.

Q — quartely data.
A — annual data.

4 — Empirical validation for Portugal

4.1 — Effects through money supply

Using the available data, on a quarterly basis for the period 1978:2-1994:4, some estimations were performed in order to evaluate the inflationary effect of the public deficits in Portugal.

The models tested for money supply used, as independent variables, the variation of public debt, public spending and several lags of money stock. Its general form is given by the following equation:

$$\textbf{(17)} \qquad M_t = a + \sum_{i=1}^{4} b_i M_{t-i} + \sum_{i=0}^{4} c_i G_{t-i} + \sum_{i=1}^{4} d_i D_{t-i}$$

where:

$M_t = \log (M2_t / M2_{t-1})$;
$G_t = CC_t / (YP90_t)$;
$D_t = \log (DIV_t - DIV_{t-1})$;

with:

$M2_t$ — M2 monetary aggregate (end of quarter);
DIV_t — stock of direct internal public debt (end of quarter);
CC_t — public spending at current prices;
$YP90_t$ — trend value of real GDP (6) (at 1990 prices).

An attempt was made to estimate (7) a specification similar to expression **(17)**, replacing the money stock by the monetary base. The results were not statistically significant and therefore are not presented in the text. Concerning

(6) A full description of the variables used in the estimations can be seen in the annex.
(7) All regressions reported were run using the TSP (version 4.2A) statistical package, some tests were also performed using the RATS (version 4.10) statistical package.

the money supply specification, four of the best performing models are presented in table 2.

TABLE 2

Money supply specifications, equation (17)

	Independent variables coefficients, t statistics in parenthesis					R^2, DW, h
	Lags					
	0	1	2	3	4	
Model 1:						
Constant	0.0238 (2.544)					$R^2 = 0.5564$
m.....			0.1323 (1.233)		0.5381 (4.742)	$DW = 1.6021$
g	–0.0796 (–2.528)					$h = 1.4965$
d		–0.0260 (–1.751)				
Model 2:						
Constant	0.0296 (3.640)					$R^2 = 0.5527$
m.....					0.5853 (5.432)	$DW = 1.5492$
g	–0.0946 (–3.247)					$h = 1.7338$
d		–0.0198 (–1.414)				
Model 3:						
Constant	0.0298 (3.720)					$R^2 = 0.5569$
m.....					0.5832 (5.460)	$DW = 1.5626$
g		–0.0983 (–3.352)				$h = 1.6790$
d		–0.0201 (–1.437)				
Model 4:						
Constant	0.0240 (2.565)					$R^2 = 0.5556$
m.....		0.1256 (1.188)			0.5503 (4.940)	$DW = 1.8419$
g.....	–0.0800 (–2.541)					$h = 0.5225$
d.....		–0.0247 (–1.695)				

The results suggest that the variation of public debt has some effect on the money supply and the same is true for public spending. However, the impact of the deficit proxy is small in magnitude and has also a negative effect on money

supply, that is, an increase in public debt causes, after one quarter, a contraction of the money supply. A similar relation can be observed between money supply and public spending either contemporaneously or also after one quarter.

Deficit monetization seems quite difficult to validate only from these results. The inverse relation may nevertheless be interpreted as a response from the monetary authorities in order to mitigate the eventual inflationary effect of increases in public spending.

4.2 — Direct effects on inflation

The direct effect of deficits was tested using also a reaction function. The independent variables selected were the price level, the change of public debt, a monetary aggregate and the output real growth. Generally, the test equation can be written as:

$$\textbf{(18)} \qquad P_t = a + \sum_{i=1}^{4} b_i P_{t-i} + \sum_{i=1}^{4} c_i M_{t-i} + \sum_{i=1}^{4} d_i D_{t-i} + \sum_{i=1}^{4} e_i Y_{t-i}$$

where:

$P_t = CPI3H_t/100$;
$M_t = \log (M2_t/M2_{t-1})$;
$D_t = \log (DIV_t/DIV_{t-1})$;
$Y_t = \log (Y90_t/Y90_{t-1})$;

with:

$CPI3H_t$ — quarterly average of the monthly year-on-year consumer price index observations;
$M2_t$ — $M2$ monetary aggregate (end of quarter);
DIV_t — stock of direct internal public debt (end of quarter);
$YP90_t$ — trend value of real GDP (at 1990 prices).

The results show that deficits are somehow relevant to explain inflation. From the three models presented in table 3, the deficit proxy coefficients are all positive and always statistically significant for the first lag. Even if the size of those coefficients is small, the null hypothesis of excluding simultaneously the two lags of the deficit variable, is rejected at the five per cent level in model 1 and at the ten per cent level in model 2, as shown bellow by the values of the F statistics:

$$H_0 : d_1 = d_2 = 0 \begin{cases} \textit{Model } 1 \\ F(2,61) = 3{,}197 \\ (\textit{significant at } 4{,}783\ \%) \\ \\ \textit{Model } 2 \\ F(2,60) = 2{,}406 \\ (\textit{significant at } 9{,}88\ \%) \end{cases}$$

TABLE 3

Reaction functions for inflation, equation (18)

	Independent variables coefficients, *t* statistics in parenthesis				R^2, *DW*, *h*
	Lags				
	1	2	3	4	
Model 1:					
p	0.9815 (23.707)				R^2 = 0.9132
m		−0.3145 (−2.013)		0.2266 (1.653)	*DW* = 1.4846
d	0.0468 (2.315)	0.0309 (1.544)			*h* (alternative) = 2.0310
y	–				
Model 2:					
p	1.1654 (9.546)	−0.1963 (−1.599)			R^2 = 0.9153
m		−0.2576		0.2306 (1.704)	*DW* = 1.8943
d	−0.0419 (2.079)	0.0246 (1.222)			*h* (alternative) = −0.4828
y	–				
Model 3:					
p	1.0566 (17.923)			−0.1119 (−1.810)	R^2 = 0.9169
m		−0.2067 (−1.279)		0.2805 (2.007)	*DW* = 1.6578
d	0.0477 (2.406)	0.0266 (1.351)			*h* (alternative) = 0.8954
y	−0.1715 (−1.151)				

5 — Conclusions

Using quarterly data for the period 1978:2-1994:4 some reaction functions were tested in order to evaluate the inflationary effect of public deficits in Portugal. Test results for an indirect relation through money supply did not conclusively show the existence of deficit monetization over the period. Direct modelling of the deficit inflation relation however, does not permit to set aside the hypothesis that public deficits have, in some way, positively contributed to inflation. These results are compatible with other studies made for Portugal [Santos (1992), Afonso (1992, 1993)], for different period samples and also with different data frequency.

ANNEX

Data used in the estimations:

M2 — *M2* monetary aggregate (end of quarter);
DIV — stock of direct internal public debt (end of quarter);
CC — public spending at current prices;
Y90 — GDP at 1990 prices;
CPI3H — quarterly average of the monthly year-on-year Consumer Price Index observations; and
YP90 — trend value of real GDP (at 1990 prices).

The trend value of real GDP was calculated over the sample period as a linear time trend. The method used was a regression on a time trend where we regress the real GDP on an intercept and time:

$$YP90_t = \alpha + \beta^* t + \varepsilon_t$$

Data sources:

CPI3H — consumer price index, National Institute of Statistics;
M2, *DIV* — quarterly bulletins of Bank of Portugal;
Y90, *CC* — quarterly national accounts, National Institute of Statistics:

1986-1994, QNA, base 1986;
1977-1985, QNA, base 1977.

Data for the *Y90* and *CC* variables, for the period 1977-1985, was calculated by recursively applying backwards, the year-on-year quarterly change rates of the QNA (quarterly national accounts) based on the PSNA (Portuguese system of national accounts)-77, to the 1986 level values from the QNA based on the new PSNA-86. This ad hoc solution had to be used since the NIS did not update the QNA previously to 1986 using the new annual PSNA-86.

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