DEBT DYNAMICS IN GREECE

Theoretical debt dynamics

Traditional analysis of the relationship between budget deficits and debt/GDP ratios starts from a framework of some very simple Domar-type dynamic models. Domar's Theorem about stability (in a mathematical sense ,i.e. tends to some finite limit) is that, if the nominal rate of interest exceeds the nominal rate of GDP growth, the debt/GDP ratio will always explode for any deficit. Hence deficits financed by debt cannot go on indefinitely. Only if the nominal interest rate equals or is less than the nominal rate of GDP growth will the debt/GDP ratio be stable.
However, these limits apply in the long run, and possibly the very long run: for policy analysis, the path of debt/GDP ratios is more interesting. An interesting result here is that, for the debt/GDP ratio to decline, the primary surplus must exceed the product of the debt/GDP ratio and the difference between the rate of interest and the rate of growth.

The Domar method: standard version

The standard version assumes constant GDP growth; that tax and non-interest expenditure by government are both constant proportions of GDP; and that all deficits are financed by issuing debt. This system can be described:

(1) $Y_t=Y_o e^{gt}$

(2) $T_t=sY_t$

(3) $G_t=aY_t$

(3a) $G_t-T_t=(a-s)Y_t=pY_t$

where Y=nominal GDP, growing at constant rate g.
T=tax revenue
s=tax rate
G=non-interest expenditure by government
a=G as share of GDP
p=non-interest or "primary" deficit as share of GDP

(4) $dD_t/dt=G_t+rD_t-T_t$ D=debt

r=interest rate

(4a) $=pY_t+rD_t$

=Non-interest deficit+interest payments

Integrating this differential equation yields the general solution

(5) $D_t=Ce^{rt}+[pY_t/(g-r)]$

where C is the constant of integration [its actual value would depend on initial debt conditions as well as the other constants and would be given by writing t=0 in (5)].
Divide through by Y_t and use (1)

(6) $D_t/Y_t=(C/Y_o)e^{(r-g)t}+[p/(g-r)]$

The existence of a limit for D_t/Y_t generally requires strict inequality (2). If g=r and p=0 the second term on the right-hand side becomes indeterminate. If g>r [i.e. growth in Y exceeds the nominal interest rate],

(7) then $Lim[D_t/Y_t]=p/(g-r)$

But if g<r, D_t/Y_t increases without limit (if g=r, second term is infinite). This proposition is Domar's Law. For instance a primary deficit of 5 per cent of GDP and growth 2 per cent above the interest rate, would imply an ultimate debt/GDP ratio of 2.5 (i.e. 5 divided by 2).
In the period 1983-1987, nominal GDP growth in Greece exceeded the interest rate by 8 percentage points on average: a "primary deficit" of 6.8 per cent of GDP would have implied an ultimate debt/GDP ratio of 85%. (Table 1)
To see how the debt/GDP changes, differentiate (6) with respect to t:

(8) $d/dt[D_t/Y_t]=(r-g)[C/Y_o]e^{(r-g)t}$

(9) $=(r-g)[D_o/Y_o-p/(g-r)]e^{(r-g)t}$

by writing t=0 in (5) to define the constant of integration.

Examining the sign of (9), if r>g (the normal case), then (9) is negative if and only if

(10) $-p/(r-g)>D_o/Y_o \quad (D_o>0)$

That is, to get the debt/GDP ratio to decline, the primary surplus must exceed the product of the debt/GDP ratio and the difference between the rate of interest and the rate of growth of GDP. For instance, if the debt/GDP ratio is 1.5 and the rate of interest is two percentage points above the rate of growth of GDP ,then a primary surplus equal to 3 per cent of GDP will be required.

Table 1. Theoretical debt dynamics in Greece

Per cent of GDP

	1983-87 average	1984	1985	1986	1987
1.Surplus (+)/Deficit (-) of central gov.	-12.0	-10.2	-14.0	-11.4	-12.1
2.Ditto but excluding interest payments	-6.8	-5.9	-8.8	-6.1	-6.3
3.Nominal GDP growth	19.9	23.6	21.3	20.6	14.3
4.a)Average nominal interest rate(1)	11.9	11.9	15.1	10.5	10.3
b)Non-interest gov. expenditure	35.8	32.8	35.7	36.3	38.5
c)Modified tax rates(2)	27.6	25.8	25.6	28.7	30.4
5.Differential between [3] and [4a]	8.0	11.7	6.2	10.1	4.0
6.Theoretical debt/GDP ratio in limit (2/5)	0.850	0.504	1.419	0.604	1.575
7.Actual debt/GDP	0.565	0.495	0.579	0.580	0.609

(1) Defined as interest payments divided by debt

(2) Total government revenue divided by GDP plus interest payments by government

Source:F.Y Budgets,Ministry of Finance

Deficits and debt/GDP ratios:graph scenarios

The assumtions underlying the illustrative scenarios for case I are:
i) Nominal GDP increases at a constant rate (12 per cent) from 1987 onwards:
ii) The initial debt (at the beginning of 1988) is Dr. 3,874.9 billion:
iii) The interest rate is constant (14 per cent), and interest payments are defined as this interest rate multiplied by the initial debt of the year;
iv) Debt/GDP ratio is calculated as average debt (i.e.average of initial and year-end debt) divided by GDP.

Under such assumptions:
i) The primary deficit is held constant at 3.0 per cent;
ii) The primary surplus is held constant at 3.0 per cent;

The assumptions underlying the illustrative scenarios for case II are the same as in case I, exept that the interest rate is constant at 10 percent.

Under such assumptions the primary deficit is first held constant at 3.0 per cent and second, the primary surplus is held constant at 3.0 per cent.

Diagram 1. Budget balances and debt/GDP ratios: some scenarios

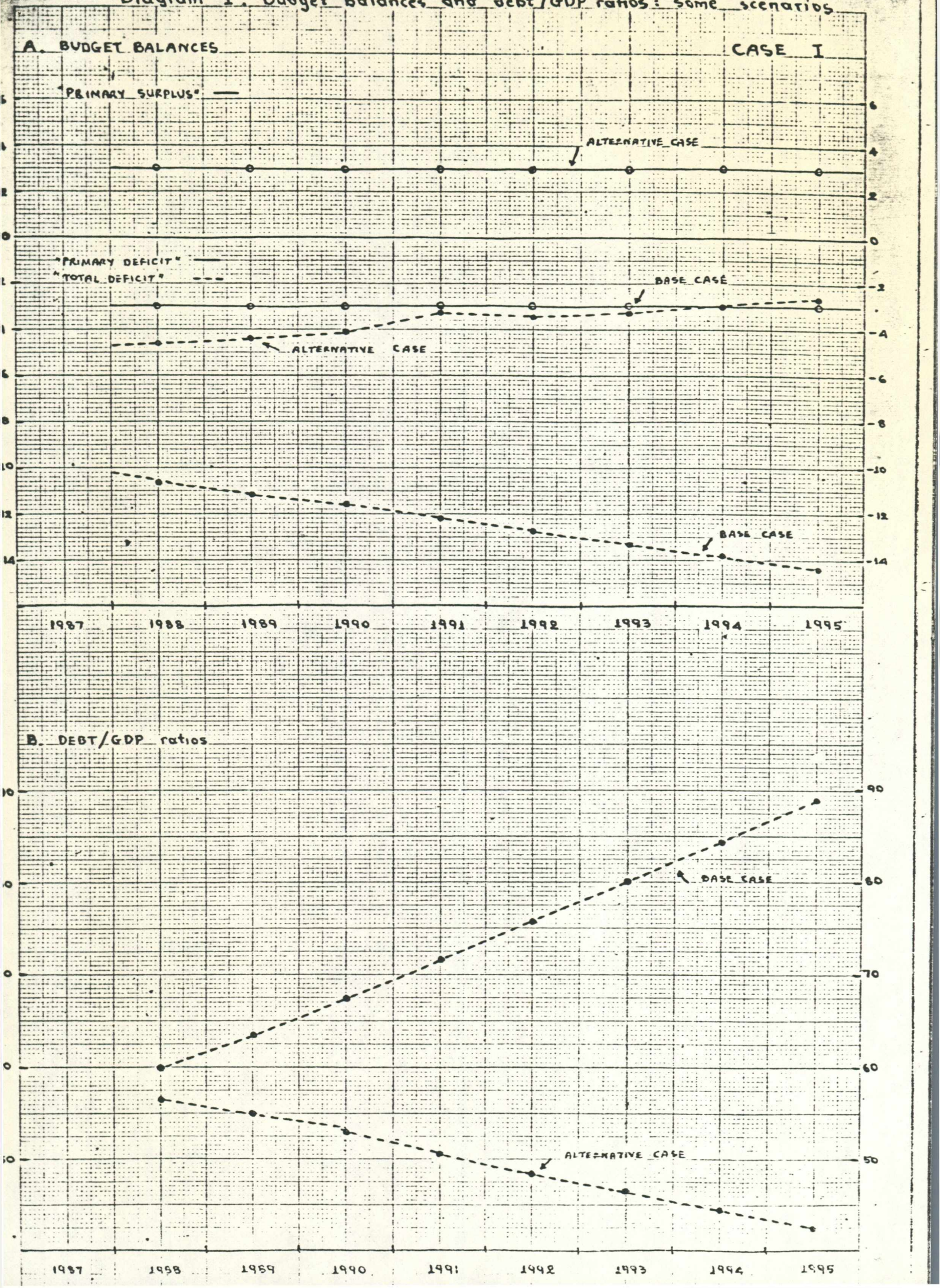
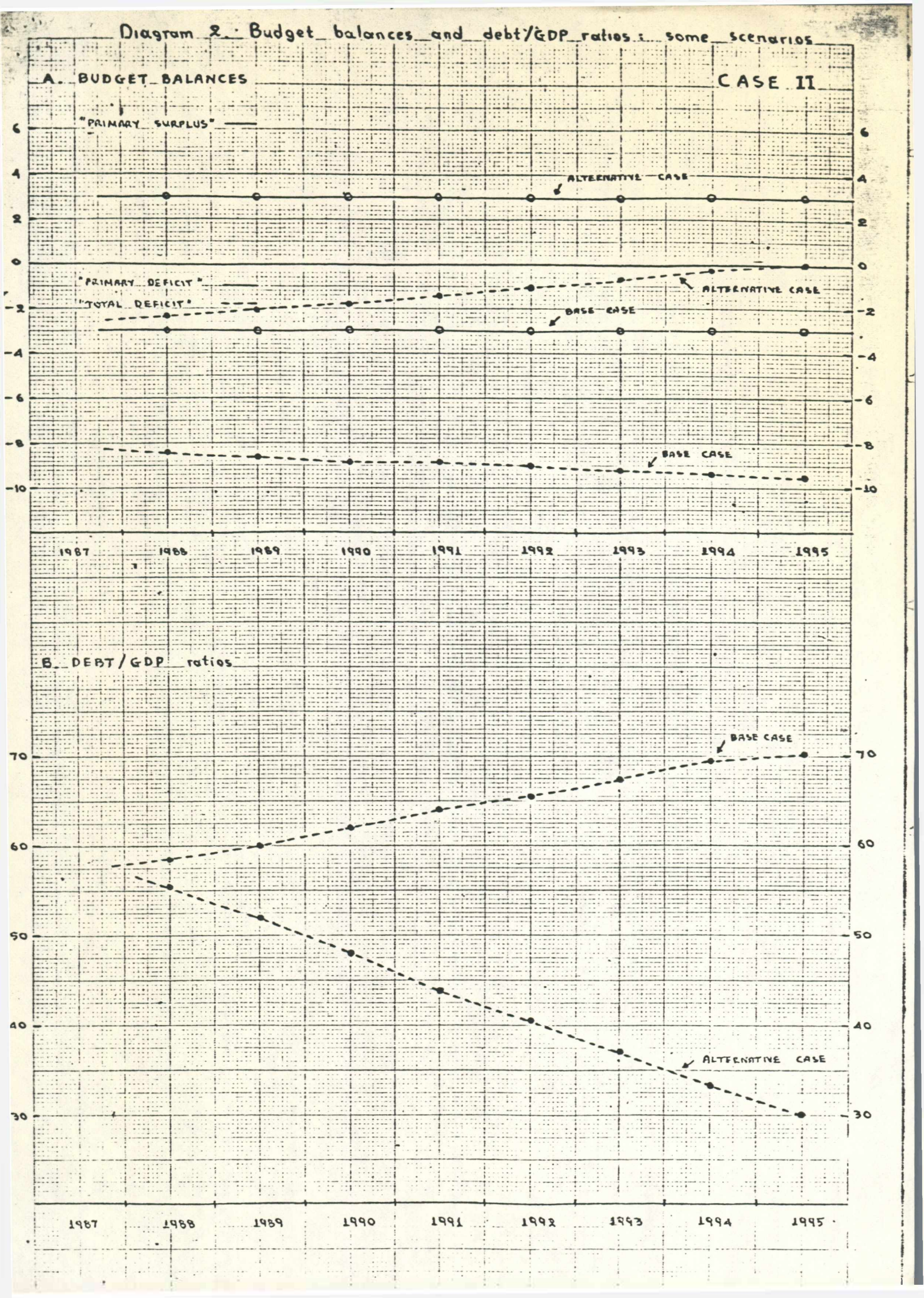


Diagram 2. Budget balances and debt/GDP ratios: some scenarios



CONCLUSIONS

Under case I, that is when the interest rate on the public debt will be 2 points higher than the rate of nominal GDP growth, stabilizing or even decreasing the debt/GDP ratio will involve achieving and building up a primary surplus. Maintaining a primary deficit of -3.0 percent of GDP (Diagram 1, Base case) would imply a 4 percentage point increase in the deficit relative to GDP between 1987 and 1995, bringing the debt up to almost 90 per cent of GDP. On the other hand, when maintaining a primary surplus of 3.0 percent of GDP (Diagram 1, alternative case) would imply a 2 percentage point decrease in the deficit relative to GDP between 1987 and 1995, bringing the debt down to almost 40 per cent of GDP.

Under case II, that is when the interest rate on the public debt will be 2 points lower than the rate of nominal GDP growth, stabilizing or even decreasing the debt/GDP ratio will also involve achieving and building up a primary surplus (although in this case we have a quicker adjustment). Maintaining a primary deficit of -3.0 percent of GDP (Diagram 2, Base case) would imply a 1 percentage point increase in the deficit relative to GDP between 1987 and 1995, bringing the debt up to 70 per cent of GDP. On the other hand, when maintaining a primary surplus of 3.0 percent of GDP (Diagram 2, alternative case) would imply the elimination of deficit relative to GDP between 1987 and 1995, bringing the debt down to 30 per cent of GDP.