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Dealing with the Eurozone Debt Crisis: A Proposal for Reform

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The Eurozone faces a fourfold challenge: (1) fiscal support: to provide a credible mechanism for supporting countries with high and rapidly rising national debt and high borrowing costs; (2) fiscal responsibility: to ensure that all member states of the Eurozone credibly commit to sustainable levels of national debt; (3) fiscal autonomy: to permit each member state to determine its own fiscal policy; and (4) counter-cyclical fiscal policy: to allow each member state to pursue fiscal stabilization policy, stimulating the economy in a recession and dampening it in a boom.

We outline a proposal for meeting these challenges. The paper is organized as follows. First, we summarize the underlying problems. Second, we present the proposal for overcoming these problems. Third, we consider two potentially important extentions of the proposal. Fourth, in the context of a simple model, we assess empirically how this proposal could work for the Greek economy. Fifth, we examine the merits of this proposal in relation to other prominent proposals for dealing with the Eurozone crisis. Finally, we conclude by highlighting the most important implications of the proposal for the Eurozone.

1.   Underlying Problems

The current Eurozone crisis has a number of straightforward causes. Several Eurozone countries – Greece, Ireland and Portugal – have come under severe financial market pressure, featuring high interest rates on government bonds and difficulty in servicing their national debt. They suffer from a lack of adequate fiscal support (Challenge (1)). The Eurozone rescue package, supported by Eurozone governments and the IMF, provides some support for heavily indebted countries, but financial markets perceive this support to be insufficient. However, some Eurozone governments – among which Germany figures prominently – are reluctant to extend the rescue package sufficiently to cover all conceivable national solvency risks, since they are uncertain whether their contributions will be repaid, indicating a lack of confidence in the Eurozone's fiscal responsibility (Challenge (2)).

This also explains their reluctance to create Eurobonds. Such Eurobonds will inevitably allow fiscally weak states to benefit the superior credit ratings of the fiscally strong states, particularly Germany. The strong states, in turn, would face higher interest rates. This clearly implies a fiscal transfer from the strong to the weak states – though perhaps one that is not sufficiently transparent to attract much voter attention. Of course, bond purchases by the European Financial Stability Facility (EFSF, the main emergency lending facility in the Eurozone) or the European Central Bank (ECB) may also lead to fiscal transfers, if the bond issuers should have difficulty repaying their debts.

Various politicians and other commentators have suggested that Eurobonds could become acceptable to fiscally strong countries, such as Germany, provided that there was binding fiscal oversight of all EU countries at the European level, perhaps conducted by the EU Commission. This would institutionalize fiscal responsibility at the pan-European level, thereby reducing the likelihood of national solvency crises in the future and increasing the likelihood that intercountry loans will be repaid. However, it is extremely unlikely that EU governments would consent to such a reduction of fiscal autonomy (Challenge (3)).

Meanwhile, the countries supported by the Eurozone rescue package are required to implement large-scale government expenditure reductions and tax rate increases in order to reduce their deficits. The problem with this strategy is that it exacerbates the recessions of these countries, and deeper recessions mean lower tax revenues and higher government transfers to the unemployed and other entitlement recipients. Thus the contractionary fiscal policy stance generates more national debt, making it even more difficult for these countries to overcome their solvency crisis. In short, countries in greatest need of counter-cyclical fiscal policy are prevented from using it (Challenge (4)).

The present crisis is likely to persist, or at least continue simmering under the surface, as long as the Eurozone has (i) heavily indebted states with potential solvency problems, which are (ii) not certain of receiving adequate outside support to pay their debts, (iii) forced to implement sharply contractionary fiscal policies, thereby generating further national debt, and (iv) unwilling to cede their fiscal sovereignty to the creditor countries. This is the reason why a solution to the Eurozone crisis requires credible enforcement of fiscal responsibility; adequate fiscal support; the opportunity to engage in counter-cyclical fiscal policy; and the maintenance of states' fiscal autonomy.

2.   The Proposal

Each Eurozone government that wishes to have access to the Eurozone rescue package should fulfill two requirements:

- **Formulate a fiscal rule:** This rule must specify (1) the country's *long-run debt ratio* (the ratio of national debt to national product), (2) the *fiscal convergence rate* (the average rate at which this debt ratio is to be approached) and (3) the *degree of fiscal counter-cyclicality* (how much fiscal stimulus the economy should receive in a recession and, correspondingly, how much fiscal contraction it should get in a boom).

- **Create a fiscal authority or constitutional amendment to implement the rule:** Since the fiscal rule allows for counter-cyclical fiscal policy, it requires estimation of the country's business cycle. The fiscal authority (which we shall call the Debt Commission) would comprise independent technical experts who (1) estimate the country's business cycle and (2) determine the government's deficit or surplus that is consistent with the fiscal rule. The Debt Commission would have veto power over the government's fiscal decisions, to ensure that the government's fiscal rule is followed. Alternatively, the fiscal rule could be implemented through a constitutional amendment committing governments to adhere to this rule. Once again, the fiscal rule would require estimation of the business cycle, to be performed by a Debt Commission that is independent of the government.

Note that the government is the author of the fiscal rule. It thereby retains fiscal sovereignty. The Debt Commission simply implements the rule. Since the Commission has the power to do so, it ensures that the government keeps its fiscal promises.

Furthermore, observe that the fiscal rule is not equivalent to a balanced-budget amendment, such as Germany's prospective "debt brake" (Schuldenbremse). Balanced-budget amendments do not require interpretation, since they generally require that government

expenditures must equal government revenues, aside from cyclical swings resulting from the government's automatic stabilizers (operating through the tax and transfer system). However, balanced-budget amendments have two unfavorable effects: (i) they do not permit the government to fight extraordinary recessions with extraordinary fiscal stimuli (as happened worldwide in the aftermath of the financial crisis of 2008–09) and (ii) they imply that the long-run debt ratio (the ratio of national debt to national product) gradually trends downwards toward zero, since the national debt remains constant whereas national product tends to grow. Shrinking debt ratios can be harmful to long-term growth (since they don't permit governments to provide more public goods as the economy expands). Countries require their long-run debt ratios to be constant, not declining.[1] The above-mentioned fiscal rule avoids both of the above disadvantages, since it permits counter-cyclical fiscal policy in excess of the government's automatic stabilizers and specifies a constant long-run debt ratio.

The government is able to revise its fiscal rule whenever it deems appropriate. The only constraint on its fiscal power is its agreed commitment to the debt provision of the EU's Stability and Growth Pact, which specifies that national debt should not exceed 60 percent of GDP in the long run.

The Debt Commission must be completely independent of the government. Its estimates of the business cycle and calculations of permissible deficits or surpluses must be free of any government interference.

If this proposal were implemented, it would have the following implications. First, the fiscal rule would guarantee that a country's debts don't grow faster than its GDP. If the debt ratio (ratio of national debt to GDP) is set sufficiently low (such as the 60 percent specified by the Stability and Growth Pact), this would generally reassure financial markets that the country does not have solvency problems.

In theory, it is impossible to specify unambiguously what a country's socially desirable debt ratio should be. Clearly, it depends on various factors, such as whether the government's debts finance investment (in infrastructure, physical capital or human capital) or consumption (everything else) and who holds the debt. (The greater the share of debt used for investment purposes and the smaller the share of foreigners holding the debt, the larger is the social desirable debt ratio.) In practice, however, fiscal discipline requires adherence to simple, transparent criteria, and a country's debt ratio is such a criterion.

Second, since the Commission is independent of the government, it would reliably determine the deficits and surpluses that lead to this long-run debt ratio. The Commission would have no incentive to cheat, as the Greek government did.

Of course the Debt Commission may make mistakes in estimating the country's business cycle. No doubt: business cycle estimation is always subject to error. But at least the Commission's errors won't be politically motivated. This is crucial, since it is only the politically motivated errors that drive the debt ratio systematically upwards. The Commission's mistakes, by contrast, will be random – over the long-run, over-estimates will match under-estimates, leading to something approaching the specified debt ratio.

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[1]   A balanced-budget amendment has further undesirable consequences that much of the public and many policy-makers seem unaware of, namely, (i) the faster the economy grows, the faster the debt ratio must decline and (ii) if the economy shrinks, then the debt ratio can rise.

Third, since the Debt Commission has the power to set the government's deficits and surpluses, the commitment to sustain the country's solvency is credible. Thus financial markets would be assured that the government will adhere to its fiscal plan. Consequently, highly indebted countries that adopt the fiscal rule and fiscal authority will experience reductions in the interest rate on the national debt.

Fourth, the fiscal rule permits a country to stimulate the economy through fiscal policy during a recession. Thus we are not in danger of forgetting the lesson learnt in the Great Depression, namely, that it is folly for the government to reduce its expenditures and increase taxes in a recession-plagued economy. The reason is that these measures make the recession worse, leading to rises in unemployment benefits and reductions in tax receipts, thereby intensifying the recession.

Fifth, since each Eurozone government retains sovereignty over its fiscal policy, there would be no need to negotiate conditions under which member states cede authority over their fiscal policy to supra-national European entities. As noted, such negotiations are likely to elicit strong resistance from national governments, create tensions within the European Union and raise voter's concerns about a "democratic deficit" within the EU.

Sixth, since each country would ensure that its own financial affairs were in order over the long run, it would become easy to agree on a massive expansion of the Eurozone rescue package. The reason, of course, is that fiscally strong governments would be prepared to support their fiscally weak counterparts, since they would be assured that their loans will be repaid. Worries about the possibility of large, new interstate transfers would disappear.

Finally, voters would become empowered to determine their fiscal future. Under the prevailing arrangements, governments make their decisions on expenditures and taxes on a year-by-year basis. This makes them vulnerable to a "deficit bias". During recessions, governments generally require expansionary fiscal policy to reduce unemployment and promote production activity, but during booms they often face insuperable political pressures to spend too much. When tax receipts are surging, there is an irresistible temptation to spend them on all sorts of good causes and to buy the allegiance of all sorts of interest groups. On this account, the debt ratio has trended upward since the 1970s in most OECD countries. By contrast, when governments are required to formulate fiscal rules, their budget deficits during recessions are automatically compensated by surpluses in booms.

Though fiscal authorities have not been created thus far, there is a substantial body of evidence that fiscal councils (with the power to advise the government, but not dictate its budgetary decisions) often improve the fiscal performance of their governments.[2] They have tended to be less effective when they were not deemed to be independent of political influence and when they had little influence on the budgetary process. These findings suggest that a fiscal authority, which is both independent of the government and can constrain the government's budgetary decisions, could be an effective instrument for ensuring fiscal responsibility.

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[2]   See, for example, Debrun and Kumar (2008), Debrun, Moulin, Turrini, Ayuso-i-Casals and Kumar (2008), European Commission (2006), and van Hagen and Harden (1995).

3.　　Extensions

The proposed fiscal rule can be refined to (i) distinguish between government consumption and investment expenditures and (ii) distinguish between domestically-held and foreign-held public debt.

3.1　　Government Investment versus Government Consumption

There is a case for treating debts that finance government investment (expenditures on physical capital, such as infrastructure, and on human capital, such as education and training) differently from debts that finance government consumption (all other government expenditures). The reason is that government investment generally enhances the productive potential of the economy and thus generates more national income in the future. This extra national income, in turn, will generate more tax revenues, which will reduce the future national debt. Naturally, government consumption does not have this effect.

To take this consideration into account, the long-run objective of the proposed fiscal rule could be amended as follows. Instead of targeting the government budget deficit/surplus at a long-run debt ratio, the fiscal rule could specify that the budget deficit/surplus should be targeted at a specific present value of the national debt. Then the fiscal rule would allow more current debt to be accumulated for financing government investment than for financing government consumption. The greater the rate of return on the government investment, the more current debt could be accumulated. If current government investment generated a debt that was exactly equal to the present value of the additional future tax revenues, then this government investment would not be considered under the fiscal rule.[3]

3.2　　Domestically-held versus Foreign-held Debt

The proposed fiscal rule implicitly makes no distinction between domestically-held and foreign-held public debt. It could be argued that this distinction should be made, since domestically-held public debt often tends to be less substitutable for other financial assets than foreign-held public debt is, and thus domestically-held debt is less vulnerable to financial market swings that could jeopardize a country's solvency.

If this distinction can be specified empirically, then the fiscal rule could treat domestically-held public debt more leniently than foreign-held debt.

3.3　　Caveat

It is important to emphasize that these extensions are difficult, if not impossible, to implement in practice. The reasons are clear: the rates of return on government investment and the substitutability of domestically-held versus foreign-held public debt relative to other financial assets are notoriously difficult to predict. They are thus particularly prone to become subject to political manipulation.

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[3]　The well-known "golden rule" – whereby, over the cycle, the government can borrow only to invest and not to fund current consumption – is a simplistic version of this principle. It is simplistic, because it makes the implicit assumption that all government investment expenditure leads to additional tax revenues that are sufficient to finance the investment. Obviously, this assumption is not necessarily justified.

4.   Applying the Proposal to Greece

To get an initial picture of how this proposal may work in practice, we use a stripped-down model of the Greek economy to examine the consequences of a fiscal rule, implemented through an independent fiscal authority. The underlying question is this: how Greece would have fared, if it had adopted a fiscal rule consistent with the debt provision of the Stability and Growth Pact?

We choose a model, outlined in the Appendix, that is sufficiently simple to bring the main effects of the fiscal rule into sharp relief. We assume that all adjustments of the government deficit are implemented through a 10 percent rise in the average tax rate and the remaining required adjustment in government expenditures. The current government expenditure multiplier (in the absence of a hike in the tax rate) is taken to be 0.7 (a conservative estimate in the literature[4]). The multiplier after the 10 percent rise in the average tax rate is calculated to be 0.664. The illustrative fiscal rule is characterized by three parameters: (i) the long-run debt ratio, which is assumed to be 60 percent (the maximal debt provision of the Stability and Growth Pact), (ii) the fiscal counter-cyclicality parameter, which is taken to be 0.9 (i.e. the government seeks to stabilize 90 percent of the business cycle, other things being equal) and (iii) the fiscal-convergence parameter, which is taken to be 0.05 (i.e. in any particular year, the government seeks to close 5 percent of the gap between the current debt ratio and the long-run debt ratio).

In the context of our model, we ask a simple question: Had Greece committed itself credibly to the above fiscal rule when it joined the Eurozone in 2001, what would have been the economic implications? The answer is given in the following figures.

Figure 1 shows the evolution of the actual Greek debt ratio (national debt relative to GDP, shown by the upper curve) and the estimated debt ratio under the fiscal rule (shown by the lower curve). Note that the actual debt ratio grows, first gradually and then rapidly after the onset of the financial crisis. By contrast, the rule-based debt ratio gradually falls to below 60 percent in the boom years and then expands modestly in the subsequent recession.
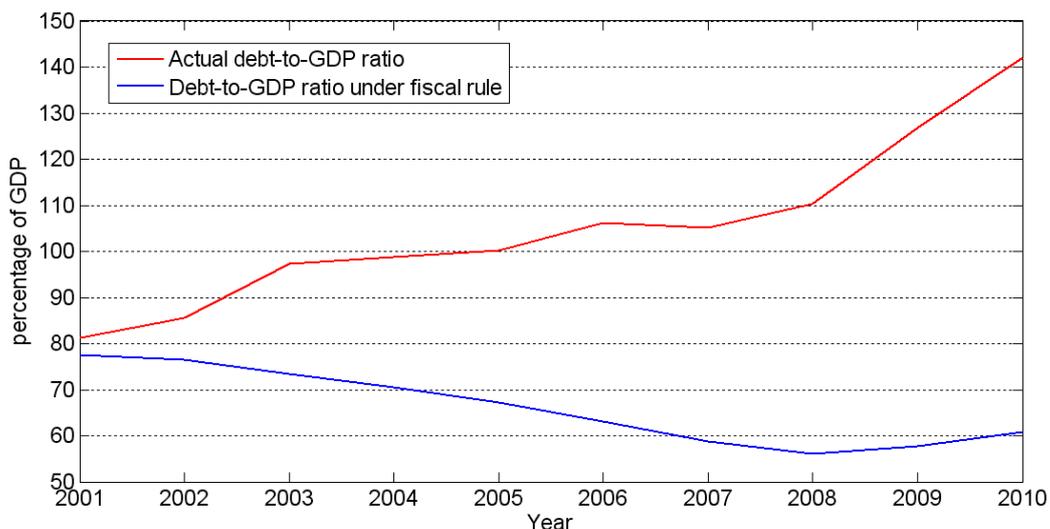

Figure 1: Debt-to-GDP ratio, actual and under fiscal rule

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[4]   See Blanchard and Perotti (2002) and Cogan, Cwik, Taylor and Wieland (2010).

Figure 2 presents the corresponding movement of the actual Greek deficit ratio (government deficit relative to GDP, the upper curve) and the corresponding ratio under the fiscal rule (the lower curve). The actual deficit ratio explodes from 2007 till 2009, and then implodes just as the Greek economy sinks into a depression. By contrast, the rule-based deficit ratio declines gradually until 2008, and then rises rapidly in order to reduce the severity of the economic downswing.
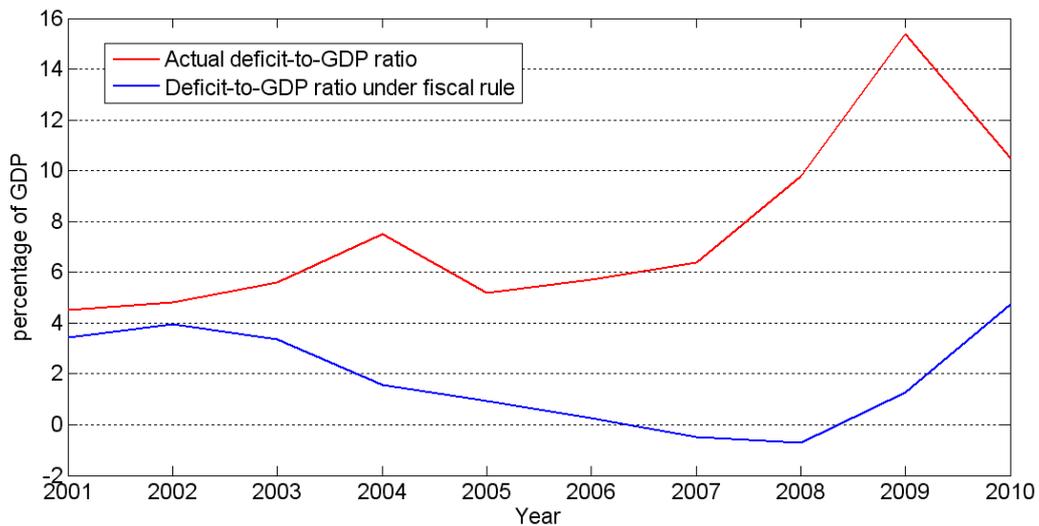

Figure 2: Deficit-to-GDP ratio, actual and under fiscal rule

Figure 3 shows the development of the rule-based deficit ratio vis-a-vis the output gap (the gap between actual and potential national output). This clearly illustrates the strong counter-cyclicality of fiscal policy under the fiscal rule.
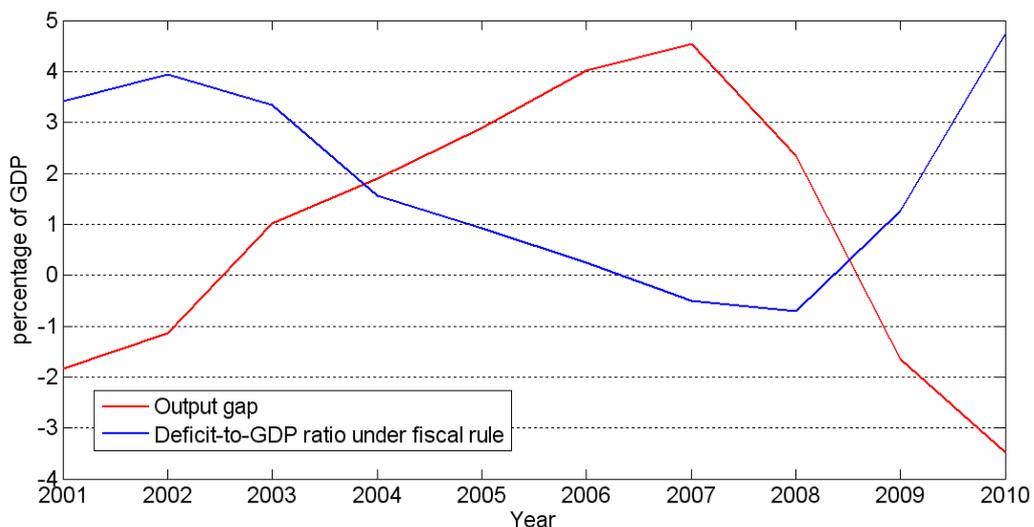

Figure 3: Counter-cyclicality of rule-based fiscal policy

Figure 4 describes the time paths of actual government expenditures and actual government revenues (the dashed curves) and the corresponding estimated time paths under the fiscal rule (the solid curves). Actual government expenditures grow rapidly until 2009 and then

collapse just as the recession occurs; actual government revenues rise gradually until the beginning of the recession in 2008, then fall till 2009, and remain roughly unchanged thereafter. Under the fiscal rule, government expenditures rise more gradually till 2008, and then increase rapidly with the onset of the recession. Government revenues under the fiscal rule are higher than their actual counterparts, but rise more gradually till 2008 and then level off.
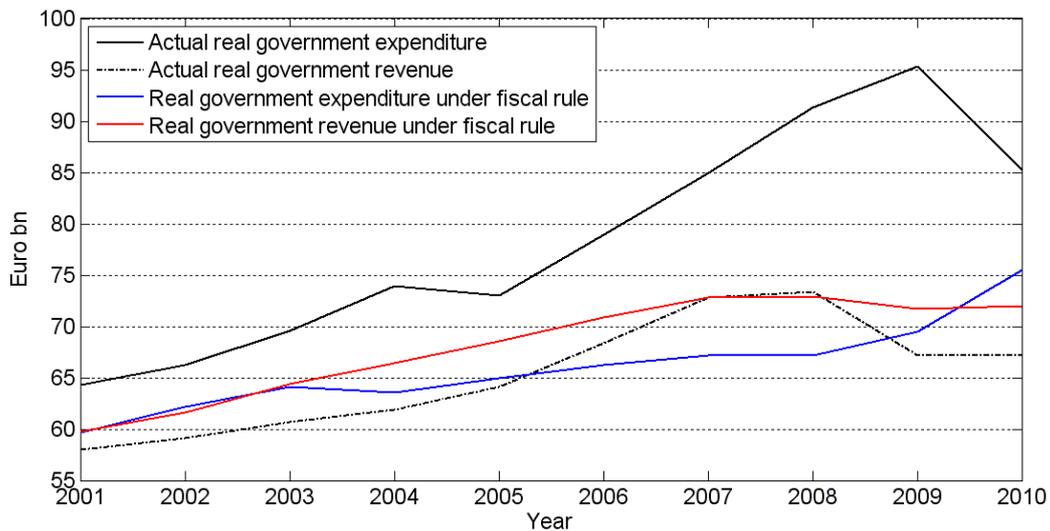

Figure 4: Government expenditures and revenues, actual and under fiscal rule

Finally, Figure 5 compares actual Greek GDP growth to estimated GDP growth under the fiscal rule. Note that, not surprisingly, rule-based growth is lower in the boom from 2001 to 2008, since the tax rate is higher and government expenditures are lower; but the GDP contraction in 2009 is less pronounced, since the fiscal rule permits counter-cyclical fiscal stimuli during recessions. Furthermore, in contrast to the actual implosion that occurred in 2010, GDP growth turns positive again under the fiscal rule. In other words, the fiscal rule implies that the Greek recession, beginning in 2008, is short-lived.
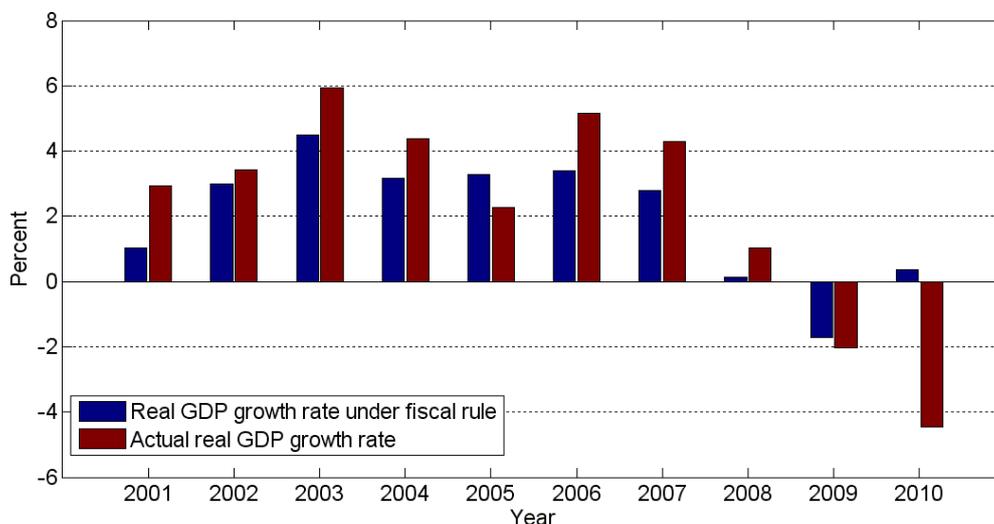

Figure 5: GDP growth, actual and under fiscal rule

5.   Other Proposals for Dealing with the Eurozone Crisis

The proposal above meets the four challenges summarized in the introduction of this paper. It ensures fiscal responsibility, since the fiscal rule is credibly enforced. It preserves the fiscal autonomy of member states, since each government formulates its own fiscal rule. It establishes the conditions necessary for the provision of adequate support for debtor countries, since loans (through the ECB and EFSF) would be unproblematic for creditor countries, given the credible assurance that the loans will be repaid. The existing reluctance to issue Eurobonds may also evaporate under these conditions.

  The merits of other prominent proposals should also be assessed with regard to these four challenges.

- *The haircut strategy:* Restructure the debts of the crisis countries, such as Greece and Ireland, forcing the bondholders to accept a haircut on their interest and possibly principal. However if this strategy is implemented during a solvency crisis, it immediately raises interest rates on government bonds (making it even more difficult to finance the national debt) and, even more importantly, increases the risk of financial contagion (as creditors of other countries begin to fear the possibility of a future haircut as well). On this account, the haircut strategy runs afoul of Challenges (1) and (2), since it makes it more difficult for creditor countries to provide adequate support and for debtor countries to demonstrate fiscal responsibility.

- *Issue Eurobonds*, so that the heavily indebted countries can benefit from the resulting low interest rates. This strategy fails to meet Challenge (2) since it reduces governments' incentives to pursue fiscal responsibility.

- *The fining strategy:* Fine the fiscally irresponsible countries, to discourage them from accumulating excessive national debt. This policy suffers from a credibility problem: a country that has difficulty paying its debts cannot be credibly required to increase its debts through the addition of fines. The policy is analogous to the following novel type of fire insurance: when a fire breaks out in your house, the fire department comes and plants another fire. This may well encourage you to take extra fire precautions, but it is not helpful once the fire has started. The policy thus interferes with all four challenges: fiscal support, fiscal responsibility, fiscal autonomy and counter-cyclical fiscal policy.

- *The Euro exclusion and default strategy:* Exclude the excessively indebted countries from the Eurozone and allow them to default. In addition to creating substantial economic hardship in the affected countries, this strategy would also raise the risk of financial contagion, since bondholders in other Eurozone countries then perceive increased default risk. Financial contagion is likely to be accompanied by the collapse of banking systems, as people and enterprises liquidate their accounts in expectation of devaluation. Thus this strategy fails to meet Challenges (1) and (4) – fiscal support and counter-cyclical fiscal policy.

- *Moving towards Eurozone fiscal union:* Set minimum requirements for national fiscal frameworks, conduct in-depth country analyses scoreboards for economic and financial indicators, and make fiscal recommendations when there are macroeconomic imbalances or competitiveness problems. This strategy does not meet the challenge of fiscal autonomy. On this account, it is unlikely that the Eurozone member states would heed such recommendations.

- *Germany's Schuldenbremse* (constitutional provision of a "debt brake"), which is an approximation of a balanced-budget law, for the other Eurozone countries.[5] As noted, this strategy has two disadvantages. In the short run, it may prevent the use of counter-cyclical fiscal policy beyond the operation of the automatic stabilizers of the tax and transfer system. (If the debt brake is suspended in severe recessions, the credibility of the policy may become undermined, as happened to the debt provisions of the Stability and Growth Pact). In the long run, the strategy leads to continually declining debt ratios (even once the target debt ratio of 60 percent has been reached), thereby preventing governments from providing more public goods as the economy grows

6.   Concluding Remarks

A country's solvency depends on two things: ability to pay and willingness to pay. Every developed country is able to repay its debts. That includes Greece. If the Greek government were to sell its assets, significantly increase the tax base and raise taxes more, the Greek national debt could easily be brought down to 60 percent of GDP, as required by the Stability and Growth Pact. The problem is that the current or future Greek governments may be unwilling to repay its debts.

In this respect, governments differ from individuals. People have to repay their debts, as long as they are able. If they refuse, the courts can force them to do so. However, you usually can't force a country to repay its debts without risking war. The assets of every developed country are sufficient to dwarf the size of its national debt. The government may be unwilling to use the assets for this purpose, for fear of losing office.

This implies that state solvency depends not merely on the solvency indicators that usually receive attention – competitiveness, growth rates, breadth of tax base, and so on – but also on the effectiveness and transparency of the political process whereby government budgetary problems are resolved. The proposal above is helpful in this regard, since it provides an institutional mechanism for ensuring willingness to pay.

Finally, the proposal represents a way of improving the functioning of democratic systems with regard to national debt. As noted, the prevailing fiscal systems are prone to deficit bias, since governments have insufficient incentives to run large budget surpluses during booms. Furthermore, fiscal policy is often pro-cyclical (stimulating the economy in booms and contracting it in recessions), partly because of governments' short-term responses to budgetary pressures. There is widespread agreement that neither the deficit bias nor the fiscal pro-cyclicality is in the public interest. But since governments are currently unable to commit themselves credibly to longer-term fiscal plans, voters are unable to induce their elected representatives to take the public interest into better account.

The proposal creates a credible commitment device to establish discipline. It thereby prevents deficit bias and enables governments to stabilize their economies through counter-cyclical fiscal policy. Governments' capacity to exercise fiscal responsibility depends on the task they are given. When their task is the short-run determination of government expendi-

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[5] In the absence of extreme circumstances, Germany's constitutionally binding balanced-budget law limits the size of new debt to 0.35 percent of GNP from 2016 onwards.

tures and revenues, reflecting an inability to make long-term commitments, the result is often a tendency for the national debt ratio to trend upwards. By contrast, no government – when given the task of formulating a fiscal rule – would formulate one that allows the debt ratio to explode with the passage of time. Instead, the government would set a constant debt ratio and thereby become committed to fiscal responsibility.

7.   References

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8. Appendix

We begin with the government budget constraint:

$$\Delta b = d - (\pi + n)b_{-1} \qquad (1)$$

where b denotes the current government debt ratio, i.e. its net financial debt, as a ratio of GDP (Δb is the change in the debt ratio and b_{-1} is the debt ratio of the previous year); d is the deficit ratio, i.e. government financial deficit, as a ratio of GDP; π is the inflation rate; and n is the GDP growth rate.[6] In words, equation (1) says that the change in the debt ratio is equal to the deficit ratio minus the reduction in the debt ratio due to growth in nominal GDP.

The deficit ratio is

$$d = -s + ib_{-1} \qquad (2)$$

where s denotes the primary (i.e. non-interest) government surplus, as a ratio of GDP, and i is the nominal interest rate (so that $r = i - \pi$ is the real interest rate). The primary surplus ratio is

$$s = g - \tau \qquad (3)$$

where g is government spending, as a ratio of GDP, and τ is government revenue, including taxes and capital income, as a ratio of GDP.

Substituting equations (2) and (3) into (1), we obtain

$$\Delta b = (r - n)b_{-1} - (g - \tau) \qquad (4)$$

Next, we turn to the fiscal rule. As noted, this rule has three parameters, (i) the *long-run debt ratio*: $b^{LR} = 0.6$ (in accordance with the maximal debt provision of the Stability and Growth Pact), (ii) the *fiscal counter-cyclicality parameter*: $a = 0.9$, and (iii) the *fiscal-convergence parameter*: $c = 0.05$. The components corresponding to these three goals of fiscal policy – long-run indebtedness, fiscal counter-cyclicality and fiscal convergence – are denoted by d^{FC}, d^{CC}, and d^{LR}, respectively. Then the aggregate government deficit ratio may be specified as

$$d = d^{FC} + d^{CC} + d^{LR} \qquad (5)$$

The *fiscal convergence rate* is given by the portion of the deficit devoted to adjustment:

$$d^{FC} = c(b^{LR} - b_{-1}) \qquad (6)$$

where c is the fiscal convergence parameter. This equation specifies that, in each year, the deficit ratio adjusts to cover c percent of the difference between the long-run debt ratio and the actual debt ratio in the previous period.

The *degree of fiscal counter-cyclicality* is given by the portion of the deficit devoted to counter-cyclical fiscal policy. Letting q^p represent the ratio of potential GDP (measured by trend GDP) to actual GDP, the counter-cyclicality component is

$$d^{CC} = a(q^p - 1) \qquad (7)$$

where a is the fiscal counter-cyclicality parameter.

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[6] For notational simplicity, we suppress time subscripts. Variables without time subscripts refer to the current year. One-year lagged variables have the subscript "–1".

To derive the *long-run indebtedness* implicit in the fiscal rule, recall that $\Delta b = d - (\pi + n)b_{-1}$ (equation (1)) and note that in the long run $\pi = \pi^{LR}$ and $n = n^{LR}$, where π^{LR} and n^{LR} are long-run inflation and GDP growth; furthermore, $b = b_{-1} = b^{LR}$ and thus $\Delta b = 0$, i.e. the ratio of government debt to GDP is constant. Finally, in the long run, $d^{FC} = 0$ and $q^p = 1$, so that $d^{CC} = 0$. Thus the long-run deficit ratio is

$$d^{LR} = \left(\pi^{LR} + n^{LR}\right)b^{LR} \tag{8}$$

Substituting the components (6), (7) and (8) into the deficit ratio (5), we obtain the *fiscal rule*:

$$d = \left(\pi^{LR} + n^{LR}\right)b^{LR} + a\left(q^p - 1\right) + c\left(b^{LR} - b_{-1}\right) \tag{9}$$

To close the model, we make the following assumptions, in order to make the workings of the model as simple and transparent as possible. We assume that the fiscal rule has no influence on the long-run inflation rate. Thus, the long-run inflation rate is estimated as the average growth of the GDP deflator over the period 2001–2010: $\pi^{LR} = 0.0295$. The actual inflation rate is calculated as the actual growth of the GDP deflator. The estimated long-run GDP growth rate, used to calculate the long-run deficit ratio, is assumed to be the growth trend that obtained prior to 2003. Specifically, it is the average growth rate of real GDP, calculated peak-to-peak from 1985–2003: $n^{LR} = 0.0227$. Under the fiscal rule, the time path of the nominal interest rate may of course be expected to be more stable than the one actually observed. So we assume, for simplicity, that the rule-dependent nominal interest rate is constant over the sample period and that, conservatively, the average nominal interest rate under the fiscal rule is the same as the actual one over that period.[7] Specifically, we take the nominal interest rate to be the average of government bond-yields (10-year maturity) 2001–2009.[8]

The influence of the government deficit or surplus on GDP depends on the assumptions made about government expenditures and government revenues. For simplicity, we assume that, upon adopting the fiscal rule, Greece raises its ratio of government revenue to GDP by 10 percent over its actual level for 2001–2009. Specifically, government revenue is calculated as

$$T = \tau Q \tag{10}$$

where Q is real GDP and τ lies 10 percent above the actual average ratio of government revenue to GDP. The government expenditure multiplier is assumed to be $m = 0.664$.

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[7] This assumption is conservative since the fiscal rule reduces the debt-to-GDP ratio and thus may be expected to reduce the average nominal interest rate, thereby stimulating GDP.

[8] The underlying assumption is that the fiscal rule does not influence this average nominal interest rate.

The assumptions above are summarized in the following table.

Parameter	Description	Value
a	fiscal counter-cyclicality	0.9
c	fiscal convergence	0.05
b^{LR}	long-run debt ratio	0.6
m	government expenditure multiplier	0.664
π^{LR}	long-run inflation rate	0.0295
n^{LR}	long-run GDP growth rate	0.0227
i	long-run nominal interest rate	0.0456
τ	government revenue as a ratio of GDP	0.429

Table 1: Parameters

GDP is the sum of potential output (Q^p) and cyclical output (Q^c):

$$Q = Q^p + Q^c \tag{11}$$

Potential output is measured as trend GDP. For simplicity, let cyclical output be given by

$$Q^c = \beta + mG \tag{12}$$

where m is a constant and β is an exogenous time series.

In sum, the model of the economy comprises the following system of equations: the government budget constraint (4), the fiscal rule (9), tax revenues (10), national output (11) and cyclical output (12).

The model is solved as follows. The data is taken from Eurostat. The relevant time period extends from 2001 (when Greece joined the Eurozone) to 2010 (the last year for which data is available). Given the time series on GDP (Q), we compute potential output Q^p as the log-linear trend GDP. We derive cyclical output (Q^c) as the difference $Q^c = Q - Q^p$. Given the estimated multiplier m and the time series on actual government expenditures, we can derive the time series on β. The constant τ is the average ratio of tax revenues to GDP. The long-run debt ratio is taken to be the maximal debt provision of the Stability and Growth Pact: $b^{LR} = 0.6$. The long-run GDP growth rate n^{LR} is the log-linear trend of real GDP, calculated peak to peak, 1985–2003. The long-run inflation rate π^{LR} is calculated as the average over the period 2001–2010 (in consideration of the conventional claim that there was a permanent shift in inflation since the beginning of the millenium). The government deficit is derived from the fiscal rule (9). Given the deficit and the tax revenue equation (10), government expenditures are derived. Then the debt ratio is derived from the government budget constraint (4).

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