# On Prosperity and Posterity:
# The Need for Fiscal Discipline in a Monetary Union

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Preliminary, please do not quote

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## 1. Introduction

Since the 1970s, most industrialised countries have recorded persistent budget deficits, leading to the accumulation of public debt to levels unusual for peacetime. In most countries, the situation is exacerbated by the impact of demographics on public finances in the coming years. In fact in most Member States of the European Union sustainability of pensions and health systems is among the most pressing challenges calling for structural reforms.

The benefits associated with sound public finances are generally recognised. Over the medium to long term budget deficits have a negative impact on growth or the level of potential output. From a theoretical viewpoint, the idea is that persistent budget deficits lead to the accumulation of public debt, to an increase in equilibrium real interest rates, crowding out of private investment and, therefore, to lower capital stock over time. There is also a redistribution of wealth and welfare from future to current generations.[1] Available empirical evidence seems to confirm these results. For example, Easterly et al. (1994), using a cross-section sample of more than 50 countries, covering the period from 1965-90, found a positive, and statistically significant relation, between growth in GDP per capita, and budget surplus (in per cent of GDP). Similar results have been reported by other researchers (add references).

Another problem associated with budget deficits over the medium to long term relates to solvency and sustainability. The Government is, like all other economic agents, subject to an intertemporal budget constraint. It is not easy to make the notion of sustainable fiscal developments operational. Nevertheless, it is clear that public sector expenditure and revenue paths, leading to persistent and significant increases in the public debt to the GDP ratio are unsustainable. Insolvency and unsustainability raise concerns with respect to financial stability.

In this paper we will be concerned with the link between fiscal discipline and increased bond market integration due to monetary unification. Specifically we will consider the case of intergenerational burden sharing. The basic idea is to argue that budgetary authorities face the temptation of benefiting generations currently alive (current prosperity) at the expense of future generations (posterity). After monetary unification the challenge is exacerbated by the closer integration of bond markets. Indeed the cost of current deficit financing for individual governments, in terms of higher interest rates, is lowered in monetary union. Given a unified

[1] See Blanchard (1985), Buiter (1988), Weil (1987).

bond market the higher costs of financing are spread out over the whole union. They constitute a negative spillover associated with current expansions.

Papers dealing with the game between several fiscal authorities in a monetary union are Beetsma and Uhlig (1999), Beetsma (1999) and Uhlig (2003). These papers also find an exacerbation of a debt bias in EMU. In these papers the externality for national fiscal policy arises only through the reaction function of the monetary authority, as pointed out by Gaspar (2003). The basic externality in these papers is that governments are excessively expansionary because they each think that their expansion will trigger no or only a muted response by the central bank, which in equilibrium turns out to be wrong. In this paper here we do not need a monetary policy authority to obtain an increase in the deficit bias in monetary union[2]. The closest paper in spirit to the present one is Beetsma and Vermeylen (2003). They rightly claim that the novelty of their paper (and ours) is to model the supply side of public debt in a monetary union. However, in Beetsma and Vermeylen (2003) the basic mechanism is different as the increased degree of debt substitutability leads to a lower demand for EMU countries' debt, which raises interest rates. The effect on overall debt issuance is ambiguous and works again via the central bank reaction function. The authors show that the relative share of EMU countries' debt issued by governments with previously more dependent central banks and more myopic governments increases in EMU.

Section 2 discusses some recent evidence on the integration of bond markets in the euro area. We argue by drawing on evidence from Baele et al. (2004) that eliminating exchange rate risk together with supply-driven and demand driven developments increasingly allow governments to consider euro area savings as a common pool from which to finance their debt. The developments in the euro area are distinct from the overall globalisation of financial markets.

In section 3 we introduce a standard work-horse in macroeconomics – the Blanchard-Yaari continuous overlapping generations model with bonds and productive capital – in order to demonstrate the trade-off a fiscal policy maker faces between current and future consumption. The trade-off occurs because the government has the power to grant transfers to current generations to the detriment of future generations. Higher consumption now and thus lower savings and investment will lead to a lower capital stock in the future. We will sketch how a government caring for its reputation might deal with this trade-off by balancing current

[2] See Gaspar (2003) describing the basic mechanism of this approach.

generations prosperity with posterity. We thus motivate the existence of a political-economy deficit bias in this intergenerational framework.

In section 4 we use a slightly simplified version of the Blanchard-Yaari model, which omits capital, in order to describe more explicitly the interaction of governments within a monetary union lacking fiscal rules. We argue that due to the integration of bond markets in a monetary union, governments are likely to face a common pool problem. The (static) Nash solution shows that the deficit bias is larger in a monetary union than in the closed economy. Specifically, in monetary union there is an important fiscal-fiscal externality - associated with the integration of bond markets. When a government engages in expansionary transfers, benefiting current generations, it affects the interest rate lees than it would have in closed economy. This weaker effect lowers the (domestic) costs of fiscal profligacy.

Section 5 concludes.

## 2. The integration of euro area bond markets

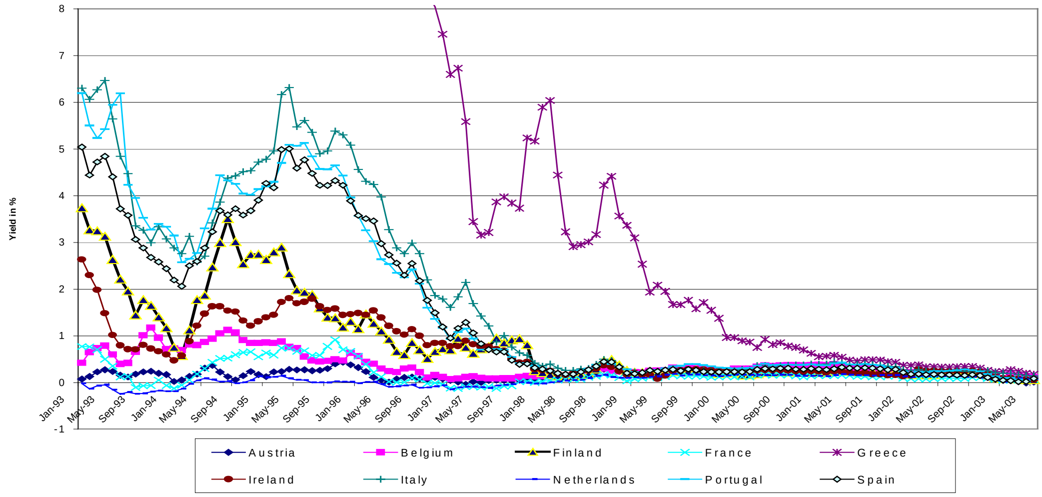
In this section we will present some evidence on the degree of integration of bond markets in the euro area. The evidence presented should add plausibility to our claim that it is the event of EMU, which is responsible for the fact that euro area savings can reasonably be considered a common pool by euro area governments, which was not the case before monetary unification. In our view the degree of integration of euro area bond markets, although not perfect, is of a scale not comparable to any other international integration of bond markets. Thus we argue that despite the fact that financial markets are and were to some degree already globalised before EMU, the introduction of the euro has had a significant impact on financing conditions for euro area governments. Euro area bond market integration in our view has reached a level, which could give rise to the common pool externality exposed in section 4.

In the following we draw on evidence presented in the recent ECB Occasional Paper, No. 14 (2004) by Baele, Ferrando, Hördahl, Krylova and Monnet, titled “Measuring Financial Integration in the Euro Area”.

Chart 1 depicts the decline in yield spreads of euro area countries with respect to German government bonds. The striking decline of spreads towards the vicinity of zero by May 1998[3] for all countries except Greece (adopting the euro in January 2001) shows that the exchange rate risk

[3] Note that on 3 May 1998, the procedure for determining the irrevocable conversion rates for the euro were announced. It was decided that the conversion rates would be based on the ERM bilateral central rates.

**Chart 1: Yield spread for 10-year government bonds relative to Germany**

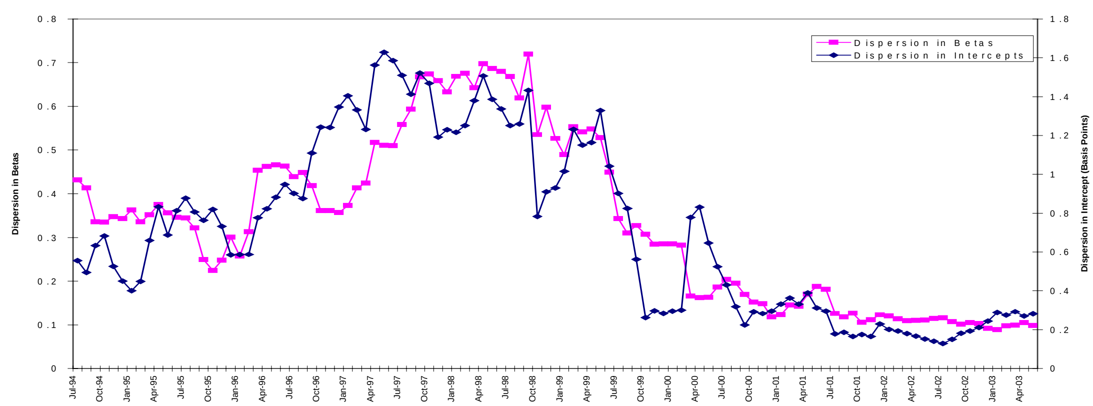



*Source: Baele et al. (2004, p. 50, Chart 5.1)*

seem to have dominated spreads between euro area countries. The exchange rate risk was not transformed into idiosyncratic default risk in EMU.

Baele et al. (2004) use another price based measure of integration. They explain the national yield changes by two regressors, a constant and the change in the German yield (beta coefficient). Chart 2 reports the average regression coefficients as deviations from the full integration case (intercept=0, beta=1) for time varying regression windows, consisting of 18 months each, moving one month at a step.  The average distance in cross-country betas decreased from about 0.7 in 1997 to close to 0.1 since 2000.

**Chart 2: Average distance of intercept/beta from values implied by complete integration**

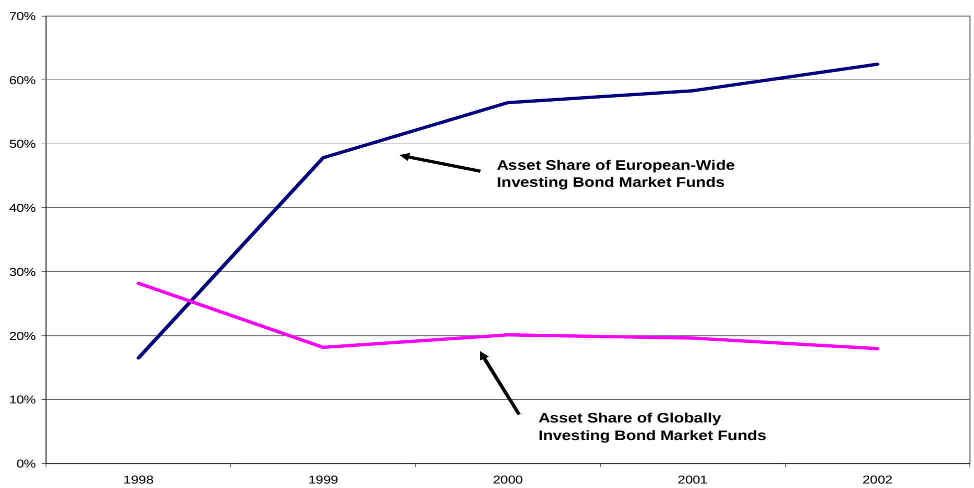



*Source: Baele et al. (2004, p. 56, Chart 5.5)*

Based on these regressions Baele et al. (2004, p. 56) also report that the proportion of variance in local yield changes explained by the change in German yields, reaches close to 100% for most countries already in 1999. Previously variance shares explained by the German yield changes had been below 50% for several countries (Finland, Greece, Italy, Portugal and Spain).

Another interesting piece of evidence, which supports our common pool assumption, is the fact that the asset share of European-wide investing bond market funds has increased dramatically since 1999.[4] As depicted in Chart 3, the asset share of European-wide investing funds increased from about 20% in 1998 to above 60% in 2002 and most importantly the share of globally investing bond market funds declined from about 30% to just below 20%. The latter supports our claim that the bond market integration in the euro area is likely to be a distinct development from the general globalisation of financial markets.

**Chart 3: Average share of bond funds with European or global investment strategies**




*Source: Baele et al. (2004, p. 72, Chart 6.9)*

We are confident that more evidence can be provided in order to substantiate the claim that bond market integration between euro area countries among themselves and euro area countries and third countries like the US, UK or Japan are on a very different scale.

[4] See again Baele et al. (2004, p. 71-72).

## 3. The Blanchard-Yaari model with bonds and capital: the trade-off

We use the standard Blanchard-Yaari continuous overlapping generations model with infinitely lived agents (Weil, 1987), capital (*K*), government debt (*B*) and without money. Each moment in time the growth rate of the population is *n*. The newborns are disconnected from current members of the population by the fact that they are born with no financial wealth and initially start consuming due to their positive human wealth. Both assets *K* and *B* earn the real rate of interest, *r*. To keep things simple, we use a Cobb-Douglas production function and assume exogenous labour supply. Furthermore we introduce a tax reaction function as specified in equation (4), which shows that the government can decide on a permanent, lump sum transfer payment of the size *z* ($z \geq 0$). In order to prevent debt from violating the transversality condition, taxes will be increased at rate $\beta$ with the growing stock of government debt (see Blanchard 1985, p. 240 who uses this tax function with a constant interest rate version of this model). Government (non-interest) expenditures are zero. After optimising individual utility (log-preferences in consumption), we obtain the standard dynamic system of equations, where capital letters as well as *z* refer to aggregate, per capita variables:

(1) $$\dot{C}_t = \left[(1-\gamma)K_t^{-\gamma} - \theta\right]C_t - \theta\, n\left[B_t + K_t\right]$$

(2) $$\dot{B}_t = \left[(1-\gamma)K_t^{-\gamma} - n - \beta\right]B_t + z$$

(3) $$\dot{K}_t = K_t^{1-\gamma} - nK_t - C_t$$

with $F(K) = K_t^{1-\gamma}$ ; $F'(K) = (1-\gamma)K_t^{-\gamma} = r_t$

(4) $$T_t = \beta B_t - z$$

$\theta$ = individual rate of time preference; *n* = rate of population growth = rate of disconnectedness of generations.

Assuming $\beta > (1-\gamma)K_t^{-\gamma} - n$ at all times is a necessary and sufficient condition to have a positive steady state debt level with $z>0$. Disregarding a reasonable economic interpretation, there could exist up to four equilibria. We restrict our attention to the saddle path equilibrium (the second equilibrium ordered with respect to the size of *K*), in which the economy is dynamically efficient and *C, K* and *B* are all positive. A useful and common assumption is $\theta > n$, which automatically excludes dynamically inefficient (second) equilibria.

It is useful to characterise the model in *C/K* space[5]. The demarcation lines in *C/K* space are:

(5) $$\dot{K}_t = 0: \quad C_t = K_t^{1-\gamma} - nK_t$$

(6) $$\dot{C}_t = 0: \quad C_t = \frac{\theta n\left[K_t + \dfrac{z}{\beta + n - (1-\gamma)K_t^{-\gamma}}\right]}{(1-\gamma)K_t^{-\gamma} - \theta}$$

where the steady state value of *B* as depicted in equation (7) has been used in (6). Thus equation (6) is only valid in simultaneous equilibrium of *C* and *B*.

(7) $$B_t = \frac{z}{\beta + n - (1-\gamma)K_t^{-\gamma}}$$

Figure 1 depicts the phase diagram with equations (5) and (6).

*Figure 1 near here*

The steady state satisfies (5)=(6) and we can define function $G(K_t,z)$ characterising the steady state.

(8) $$G(K_t, z) \quad = \quad K_t^{1-\gamma} - nK_t - \frac{\theta n\left[K_t + \dfrac{z}{\beta + n - (1-\gamma)K_t^{-\gamma}}\right]}{(1-\gamma)K_t^{-\gamma} - \theta} = 0$$

Equation (8) can be used to obtain the steady state decline of *K* when the transfer, *z*, is increased by means of the implicit function theorem, i.e. *dK/dz=-dG/dz / dG/dK.*

[5] See Blanchard (1985, p.232).

(9) $$\frac{dK}{dz} = \frac{\dfrac{\theta n}{(\beta + n - r_t)(r_t - \theta)}}{(r_t - n) - \left( \dfrac{\theta n \left[ 1 - \dfrac{\gamma r_t K_t^{-1} z}{(\beta - r_t + n)^2} \right]}{r_t - \theta} + \dfrac{\theta n \gamma r_t \left[ 1 + \dfrac{K_t^{-1} z}{\beta - r_t + n} \right]}{(r_t - \theta)^2} \right)} < 0$$

The sign of $dK/dz$ is clearly negative for the equilibrium we are considering. We know that due to the overlapping generations structure, the interest rate, $r_t$ , will be exceeding the rate of time preference, $\theta$, and by assumption $\theta > n$.Thus we know that in equilibrium $r > \theta$ and $r > n$ and also by assumption $\beta > r_t - n$.

Furthermore, one can see that the term $r_t - n$ is the slope of the *K* demarcation line in Figure 1, while the whole term in the largest brackets in (9) is the slope of the *C* demarcation line. As long as the *C* demarcation line is steeper than the *K* demarcation line, $dK/dz$ is negative. As this very property of the two relative slopes exactly characterises the equilibrium, this proves the negative sign of $dK/dz$.

Thus the larger the permanent transfer, the lower will be the long-run, aggregate per capita, capital stock and long-run, aggregate per capita, consumption level.

Figure 1 shows that *C* demarcation lines shift upwards, the higher the transfer *z*. The trajectories in Figure 1 are drafted for equilibrium point C and indicate that we can expect to find a saddle path equilibrium with consumption as the jump variable and government debt and capital as predetermined state variables. The annex confirms this claim by formally analysing the local stability properties by properly accounting for the dynamics of government debt.

What remains to be analysed is the short run impact of an increase in the transfer payment. Integrating the private budget constraints, using the first order conditions and then aggregating, one can derive the following, standard consumption equation.

(10) $$C_t = \theta \left[ B_t + K_t + H_t \right]$$

where $H_t$ is human wealth, which is defined as

(11) $$H_t = \int_{v=t}^{\infty} \left(W_v - T_v\right) e^{-\int_{u=t}^{v} r_u du} dv$$

where $W_v$ stands for aggregate, per capita wages, which given our production function, competitive firms and fixed labour supply, equal $\gamma K_v^{1-\gamma}$.

The stock of government debt as well as the stock of real capital is predetermined and changes only slowly over time. Thus the impact effect of consumption of any change in *z* has to come from changes in human capital. Inserting wages and the tax function we can write (11) as follows.

(12) $$H_t = \int_{v=t}^{\infty} (\gamma K_v^{1-\gamma} - \beta B_v + z) e^{-\int_{u=t}^{v} r_u du} dv$$

A rise in *z* will trigger three immediate effects on human capital. Capital will decumulate along its path to the lower steady state, which alone will already diminish the present value of future wages. The debt level will increase and thus taxes will start to rise according to the tax policy function. This effect alone increases the present value of future taxes. The permanent transfer *z*, of course, increases human wealth. In a partial equilibrum, i.e. excluding the wage effect, one can easily show that due to the disconnectedness of new generations, a current transfer increases human wealth of those currently alive despite future higher taxes, which is the reason why Ricardian equivalence does not hold in this model[6]. The easiest way to show that the initial effect is nevertheless positive in general equilibrium is in terms of the phase diagram of Figure 1.

We know that a rise in *z* will let the economy immediately jump on the new saddle path (point B) associated to a new equilibrium with lower capital and consumption. The saddle paths are upward sloping thus consumption will rise initially, and we thus know that human capital must have risen despite the decline in the present value of future wages.

Using Mulligan and Sala-I-Martin's time elimination method, we prove in the annex that the slope of the saddle paths in equilibrium steepen as *K* declines. The relative slope of saddle paths associated with two different equilibria is indicated in Figure 2. If it is true (and we have so far no reason to doubt this) that the slope of saddle paths associated with different steady state *K*'s will not cross at any level of *K*, it will follow that the higher the transfer payment, i.e. the larger the initial jump in consumption, the lower will be the long run, steady state consumption and capital.[7]

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[6] See Blanchard (1985), Weil (1987, 1989), Blanchard and Fischer (1989, Ch. 3) or Heijdra and Van der Ploeg (2002, Ch. 16).

[7] The latter argument remains to be completed.

*Figure 2 near here*

The largest transfer possible is the one associated with the tangency equilibrium in point D of Figure 2. Higher values of the transfer would violate the government's budget constraint given the tax policy function (4). A government being able to freely chose the size of the transfer in the permissible range between *0* and $z^{max}$ thus would face a trade-off between current, aggregate per capita and long-run, aggregate per capita consumption. In order to determine the transfer policy, we have to deal with government preferences.

We assume that the government cares about its reputation. For the sake of simplicity we assume that the parameter of the tax reaction function, $\beta$, is given, so that $z$ is really the only control variable for the government. The reputation of the government will depend on the weighted sum of two components. The first component is the present discounted value of consumption of agents currently alive. It seems natural to assume that the government cares mainly for people currently alive, as only these are potential voters. This is the prosperity argument. Second, the government gains reputation by conducting policies with sufficient foresight for the benefit of the country. This reputation for foresight positively depends on the steady state, aggregate per capita capital stock, which is also a function of the fiscal policy of the government. An alternative way to motivate the foresight term, would be to argue that the welfare of future generations has nevertheless some weight in the political process. The mechanism providing political cloud to future generations could be due to altruism[8]. This is the posterity component of the government's reputation function.

The present discounted value of current generations' consumption streams is derived in equation (13).

$$(13) \qquad \int_{v=0}^{\infty} C_t e^{(r-\theta)v} e^{-rv} dv = \frac{C_t}{\theta}$$

We know that the present discounted value of current generations aggregate per capita consumption will grow at the rate $r$-$\theta$, like individual consumption. Discounted at rate $r$ and integrating gives simply $C_t/\theta$. Note that $C_t e^{(r-\theta)v} > C_{t+v}$ as current generations consumption grows faster than aggregate per capita consumption due to the fact that the lower consumption of generations born between period $t$ and $t+v$ is not included in $C_t e^{(r-\theta)v}$.[9] In order to maximise the

[8] An extreme form of altruism is a bequest motive, which could even restore Ricardian equivalence (Barro, 1974).

[9] See Weil (1991).

material impact effect on current generations, the government would thus simply try to maximise human capital of people currently alive, because according to (10) $C_t/\theta$ equals exactly the sum of non-human and human wealth with the former being predetermined. Non-human wealth can thus be neglected with respect to the impact effect. Maximising $H_t$ would result in a transfer choice of $z^{max}$ . Due to the second term in the government preference function, the foresight effect, the final choice of $z$ would be smaller than $z^{max}$ . The government would maximise the following reputation function, where $\alpha$ is the weight given to prosperity, i.e. the present value of current generations' consumption.

$$(14) \qquad \max_z \quad \left\{ \alpha \int_{v=t}^{\infty} (\gamma K_v^{1-\gamma} - \beta B_v + z) e^{-\int_{u=t}^{v} r_u du} dv + (1-\alpha) K^2 \right\}$$

As (14) is difficult to handle[10] we will derive the size of the deficit bias and the nature of the common pool problem in a monetary union in a slightly simpler version of the Blanchard-Yaari model.

## 4. The Blanchard-Yaari model with bonds: the common pool[11] problem

The model (1)-(3) without capital but with the same tax policy function (4) reduces to the following set of equations.

$$(15) \qquad r_t = \theta + \frac{\theta n}{C} B_t$$

$$(16) \qquad \dot{B}_t = \left(r_t - n - \beta\right) B_t + z$$

$$(17) \qquad Y = C$$

where Y is constant, aggregate per capita, non-interest income. Thus aggregate per capita consumption has to be constant. Equation (15) stems from the Euler equation and holds in and out

[10] Note that the discount factor $r$ depends on $z$ and that the non-linear, three equation, differential equation system is difficult to solve in general terms.
[11] On common pool problems with respect to fiscal policy see e.g. Persson and Tabellini (2000, Ch. 7+13) and Von Hagen and Harden (1996).

of steady state. It shows that the interest rate exceeds the rate of time preference proportionally to the level of government debt. As government bonds constitute to some extent net wealth, the interest rate has to rise to offset any positive wealth effects coming from a larger *B*.

Figure 3 shows the phase diagram for the model (15)-(17) in *r/B* space. The upward sloping straight line is equation (15) while the *B* demarcation line is given in (18).

$$(18) \quad \dot{B}_t = 0: \qquad r_t = \beta + n - \frac{z}{B_t}$$

*Figure 3 near here*

There could exist two equilibria. The first one (point A) is stable, while the second one (point B) is unstable. We do restrict our attention to the first equilibrium, where equation (15) also represents the adjustment path. There exists again a maximum value for the transfer *z*, which is associated with equilibrium point C, in which the interest rate would reach its maximum level of $(\beta + n + \theta)/2$. Here, setting *z* to zero, would lead to equilibrium in point D, with no debt and the interest rate equal to the rate of time preference. Point A depicts some equilibrium for $0<z<z^{max}$.

What are the equivalent components in the government reputation function for the simplified model, which are expressed in equation (14) for the model with capital? We first find a corresponding substitute for the prosperity component.

One could argue that due to the fact that capital is excluded and output is constant, the relevant horizon of the simplified model is much shorter than for the full model. Thus we will consider the steady state of the simplified version to proxy for the impact effect in the model with capital. In the model without capital, a higher transfer would tend to increase total wealth of current generations, but due to the fact that output is fixed, aggregate per capita consumption has to remain constant as well. Thus interest rates rise to keep total steady state wealth - and thus consumption - constant. In fact, one can show that whatever the value of *z*, steady state total wealth, which is $B+(Y-T)/r$ always equals $C/\theta$ - a constant. Nevertheless it would be wrong to argue that bonds are no net wealth to current generations because the rise in interest rates exactly shows that bonds do matter. The correct way to capture the positive wealth effects of higher transfers is to simply analyse steady state total wealth excluding the present value of constant non-interest income *Y/r*, which is labelled net wealth, $\Omega$, in equation (19).[12] The initial positive

[12] See Weil (1991), Detken (1999).

wealth effect can be measured by inserting the tax policy (4) and the steady state value for *B*, which then gives the very right hand side term in equation (19).

$$(19) \qquad \Omega = \quad B - \frac{T}{r} \quad = \quad B - \frac{\beta}{r}B + \frac{z}{r} \quad = \quad \frac{z\,n}{r(\beta + n - r)}$$

This definition of net wealth is very intuitive and shows that the size of the positive wealth effect depends on the size of *z*, but that transfers are only net wealth because new generations are disconnected ($n>0$). A larger *r* reduces the present value of the transfer. The term $\beta+n-r$ reduces $\Omega$, as it stands for the size of *B* and thus the size of future tax payments.

With regard to the posterity component, the variable suitable to replace the steady state capital stock in the government reputation function is the deviation of the interest rate from the lowest possible rate, $\theta$. A higher interest rate could be interpreted as indicative for the adverse long run effects found in the extended model.

The government reputation function in the simplified model can thus be depicted by equation (20).

$$(20) \qquad Ugov = \alpha \frac{zn}{r(\beta + n - r)} - (1-\alpha)(r-\theta)^2$$

We will present the government reputation functions *Ugov* and the common pool problem graphically in *r/z* space, which is why we first derive the slope *dr/dz* of *Ugov* by means of the implicit function theorem.

$$(21) \qquad \left.\frac{dr}{dz}\right|_{Ugov} \quad = \quad \frac{\alpha\, n}{\dfrac{\alpha\, z\, n(\beta+n-2r)}{r(\beta+n-r)} + 2(1-\alpha)(\beta+n-r)r(r-\theta)}$$

The slope depicted in (21) is definitely positive if $r<(\beta+n)/2$ and $r\geq\theta$. Even if *r* is larger than $(\beta+n)/2$, a sufficiently small $\alpha$ would make sure that the slope is always positive. The second derivative with respect to *z* is derived in (22).

$$(22) \qquad \left.\frac{dr}{dz^2}\right|_{Ugov} \quad = \quad -\frac{\dfrac{n^2(\beta+n-2r)}{r(\beta+n-r)}}{\left[\dfrac{zn(\beta+n-2r)}{r(\beta+n-r)} + 2\dfrac{1-\alpha}{\alpha}(\beta+n-r)r(r-\theta)\right]^2}$$

The sign of the second derivative is negative for $r<(\beta+n)/2$. We will assume that $\alpha$ is sufficiently small to obtain a positive first derivative and that the associated steady state interest rate for this reason will be smaller than $(\beta+n)/2$ so that the second derivative will be negative. The iso-reputation functions can then be depicted in *r/z* space as in Figure 4. A higher reputation is obtained, the closer is the iso-reputation curve to the lower right corner, thus *Ugov(1)<Ugov(2)<Ugov(3)<Ugov(4*). The concave shape of the iso-reputation curves is due to the fact that at higher levels of *z* and thus of *r*, further deviations of the interest rate from the optimal level $\theta$ are seen as increasingly costly in terms of foresight reputation (posterity effect).

*Figure 4 near here*

The solution of the model (15)-(17) for the interest rate as a function of *z* can easily be derived. As from now on we are interested in comparing this outcome with the outcome in a monetary union, we will introduce country superscripts. Equation (23) reveals the equilibrium interest rate for country *i* as a function of $z^i$.

(23) $$r_t^i = \frac{\beta+n+\theta}{2} - \sqrt{\frac{(\beta+n+\theta)^2}{4} - \theta(\beta+n) - \frac{\theta n}{C^i} z^i} \quad \text{with}$$

(24) $$\frac{dr_t^i}{dz^i} = \frac{\theta n}{2C^i\sqrt{\frac{(\beta+n+\theta)^2}{4} - \theta(\beta+n) - \frac{\theta n}{C^i} z^i}}$$

Obviously $dr/dz>0$ and it is straightforward to show that $dr/dz^2>0$ as well. Thus equation (23) has the convex shape depicted in Figure 4. The optimal size of *z*, maximising reputation in a single closed economy, static optimisation exercise will be depicted by a point like A. In equilibrium A the government of country *i* has chosen $z^{i,Pre\text{-}EMU}$ , which maximises its reputation. The resulting deficit bias can be measured either by the size of the transfer itself or the positive difference $r^{Pre\text{-}EMU}-\theta$.

The model reveals that government debt is the source of the overlapping generations distortion, as debt is always a redistribution from future to current generations. With zero transfers and thus no debt, the interest rate would be equal to the rate of time preference. The fact that new generations are born without non-human capital, would obviously not matter at all and the economy would enjoy the lower interest rate of the Ramsey model. The size of the intergenerational distortion is then determined by the size of the transfers.

We assume now country *i* enters a monetary union of all-together *m* perfectly symmetric countries ($z^1 \ldots z^i \ldots z^m$). Bond markets will become integrated as bonds of each country can now be sold to other countries citizens, which was not possible or desirable before EMU. The rationale is that eliminating the exchange rate risk and disregarding default risk has made government bonds of the *m* participating countries perfect substitutes. There is only one common interest rate level in the union.

In EMU equations (15)-(17) now have to be rewritten as follows.

(25) $$r_t = \theta + \frac{\theta n}{\sum_{j=1}^{m} C^j} \sum_{j=1}^{m} B_t^j$$

(26) $$\sum_{j=1}^{m} \dot{B}_t^j = (r_t - n - \beta) \sum_{j=1}^{m} B_t^j + \sum_{j=1}^{m} z^j$$

(27) $$\sum_{j=1}^{m} Y^j = \sum_{j=1}^{m} C^j$$

Furthermore the steady state value for EMU countries debt is given in (28).

(28) $$\sum_{j=1}^{m} B_t^j = \frac{\sum_{j=1}^{m} z^j}{\beta + n - r_t}$$

As all *m* countries are perfectly symmetric and all governments will eventually chose the same *z* in equilibrium, we know that (29) holds.

(29) $$\sum_{j=1}^{m} C^j = mC^i; \quad \sum_{j=1}^{m} B^j = mB^i; \quad \sum_{j=1}^{m} z^j = mz^i$$

Inserting (29) in the model (25)-(27) and solving for the common interest rate, *r*, results in the very same equilibrium locus as give in equation (23) and depicted in Figure 4.

Also the iso-reputation curves in Figure 4 apply for each country with or without monetary union in the very same way.

The function $r_t(z)$ depicted in Figure 4 changes though in EMU, once one assumes that governments take the fiscal policies of the other countries as given. Solving the model (25)-(27) gives the following result for *r*:

(30) $$r_t = \frac{\beta+n+\theta}{2} - \sqrt{\frac{(\beta+n+\theta)^2}{4} - \theta(\beta+n) - \frac{\theta n}{\sum_{j=1}^{m} C^j}\left[z^i + \sum_{\substack{j=1\\ j\neq i}}^{m} z^j\right]}$$

where the slope in *r/z* space is given by (31).

(31) $$\frac{dr_t}{dz^i} = \frac{\theta n}{2\sum_{j=1}^{m} C^j \sqrt{\frac{(\beta+n+\theta)^2}{4} - \theta(\beta+n) - \frac{\theta n}{\sum_{j=1}^{m} C^j}\sum_{j=1}^{m} z^j}}$$

Again we see that the slope is positive, but comparing (30) with (24) one realises that the slope of $r_t(z)$ in EMU is smaller as obviously $\sum_{j=1}^{m} C^j > C^i$.

The flatter schedule is represented by the dotted curve in Figure 4. The lowest one, passing through point A, is drawn for the case the government of country *i* expects all other countries to leave their transfers unchanged at their pre-EMU levels. Under this assumption country *i*'s government could hope reaching point B by increasing their transfers significantly, which would deliver them a higher reputation as $Ugov^i(4) > Ugov^i(3)$.The reason why the government could benefit from being more expansionary is that the country could possibly draw on savings of the whole union to finance its debt. This would dampen the increase in interest rates. In our simple model, the government would expect foreign consumers to give up part of their consumption to buy part of country *i*'s debt.

Eventually Point B will not be an equilibrium as each government will face the same incentives and countries are perfectly symmetric. The interest rate is determined as a function of *z* under symmetric behaviour on the $r_t(z)$ schedule as given in equation (23). In terms of Figure 4, point C would be the equilibrium if all governments would expand as much as country *i* did. under the unrealistic assumption that the others would not change their transfer policy in the monetary union. But point C cannot be an equilibrium either, as each single government could improve its popularity by unilaterally reducing transfers, taking the other's expansionary policies as given and because each government's assumption about the other governments' actions would turn out to be wrong. The Nash equilibrium is depicted in point D, at which no government can improve its position, given the other countries' fiscal policies in equilibrium and expectations are validated.

To show that point D is associated with a larger $z^i$ and thus higher $r$ than in point A it is sufficient to have concave iso-reputation functions (see (21) and (22)) and a flatter $r_t(z)$ schedule in EMU at the equilibrium (or symmetry-) locus (compare (24) and (31)). To see that the slope in (31) is always flatter than in (24) in equilibrium, it suffices to realise that in equilibrium (32) is true.

(32) $$\frac{\theta n}{\sum_{j=1}^{m} C^j} \sum_{j=1}^{m} z^j = \frac{\theta n}{C^i} z^i$$

Thus we have for $r_t(z)$:

(33) $$\left.\frac{dr_t}{dz^i}\right| z^j = z^i \ \forall j \quad > \quad \left.\frac{dr_t}{dz^i}\right| z^j = \bar{z}^j \ \forall j \neq i$$

We have shown that the common pool problem can lead to an increase in the deficit bias in a monetary union without fiscal rules. The increase in our simple model without capital would be the difference $r^{EMU} - r^{Pre\text{-}EMU} > 0$ triggered by the increased transfer to current generations $z^{EMU}$-$z^{Pre\text{-}EMU} > 0$. The common pool problem worsens the existing intergenerational, polit-economic deficit bias. We have thus exposed a rationale for fiscal rules in a monetary union. With regard to EMU, the mechanism we have presented rationalises the "G" for growth in the Stability and Growth Pact. Without the pact, in the long-run potential output or real growth could be lower in EMU.

## 5. Conclusions (to be written)

The current version of the paper is very preliminary and is still incomplete. It tries to outline a novel approach to externalities across national fiscal policies inside a monetary union. The externalities stem from the conjunction of insufficiently forward looking governments with more closely integrated bond markets. The model is extremely simple and is aimed only at illuminating what we believe is an important mechanism providing grounds for fiscal discipline. The idea is that in monetary union there will be a single interest rate in the bond market leading to externalities among national fiscal authorities. Specifically, the impact of current fiscal profligacy on long term interest rates is less under monetary union than what it would have been in its absence. Therefore, through this channel, monetary union leads to weaker incentives for fiscal discipline. Moreover, in our view, the main ingredients of the model are well grounded empirically. The current version is circulated only in the expectation of comments and criticism. Please do not quote without permission.

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## Annex

### A) Local stability properties of the model with bonds and capital

In order to investigate the local stability properties of the equilibrium, we linearise the system of equations (1)-(3). We linearise around steady states, so that *r, c, b* and *k* are the respective values of the steady state real interest rate, aggregate per capita consumption, debt and capital. Percent deviations from steady state levels are denoted by variables with a hat.

$$\text{(A1)} \qquad \begin{bmatrix} d\hat{C}_t \\ d\hat{B}_t \\ d\hat{K}_t \end{bmatrix} = \begin{bmatrix} r-\theta & -\theta n \frac{b}{c} & -\left(\gamma r + \theta n \frac{k}{c}\right) \\ 0 & r-n-\beta & -\gamma r \\ -\frac{c}{k} & 0 & r-n \end{bmatrix} \begin{bmatrix} \hat{C}_t \\ \hat{B}_t \\ \hat{K}_t \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & \frac{z}{b} \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ \hat{z}_t \end{bmatrix}$$

The determinant of the first matrix (*A*) on the right hand side of (A1) equals the product of the three Eigenvalues. In order to have a saddle path equilibrium with one jump variable, *C*, and two predetermined state variables, *B* and *K*, we need one positive and two negative Eigenvalues of *A*. The determinant is depicted in (A2).

(A2) $$|A| = -(r-\theta)(r-n)(\beta - r + n) - \theta n \frac{b}{k} \gamma r + (\beta - r + n)(\theta n + \gamma r \frac{c}{k})$$

The demarcation lines of the linearised system in *C/K* space are the following:

(A3) $$d\hat{K}_t = 0: \qquad \hat{C}_t = (r-n)\frac{k}{c}\hat{K}_t$$

(A4) $$d\hat{C}_t = 0: \qquad \hat{C}_t = \frac{\theta n \frac{z}{c}}{(r-\theta)(\beta - r + n)} \hat{z}_t + \frac{\gamma r + \theta n \frac{k}{c} - \frac{\gamma r \theta n \frac{b}{c}}{\beta - r + n}}{r - \theta} \hat{K}_t$$

We know that the second equilibrium of the non-linear system, which we are interested in, is characterised by a steeper *C* than *K* demarcation line. Imposing this slope condition on the linearised system results exactly in the condition for the determinant of *A* to be positive. Thus we conclude that the local dynamics of second equilibrium of the non-linear system are such that the determinant of *A* is positive.

The determinant of *A* could be positive with either two negative and one positive Eigenvalues or with three positive Eigenvalues. If we can show that there is a possibility of negative Eigenvalues, we have also shown that the equilibrium is saddle path stable.
We know that the trace of *A* equals the sum of the three Eigenvalues.

(A5) $$tr|A| = 3r - 2n - \theta - \beta$$

thus if we chose $\beta$ sufficiently large, we can ensure that the trace of *A* is negative. A negative trace requires at least one negative Eigenvalue. As the determinant is positive, we know that there must then be two negative Eigenvalues. By imposing $\beta > 3r-2n-\theta$ we have a sufficient (not necessary) condition for our equilibrium to be a saddle path in the model with bonds and capital.

## B) Slopes of saddle paths

Proof that saddle paths in steady states characterised by different *z* have a decreasing slope with *K* or $(dC/dK)^{SP}/dK < 0$.

We use the time-elimination method for non-linear systems by Mulligan and Sala-I-Martin as described in Barro and Sala-I-Martin (1995, pp. 488-491) and Mulligan (1993).

Note that the slope of the saddle path $(dC/dK)^{SP}$ at equilibrium is given by the ratio of equations (1) and (3), where the steady state of *B* from equation (2) has been used to replace *B* in (1).

(B1) $$\left(\frac{dC}{dK}\right)^{SP} = C^{'}(K) = \frac{\dot{C}}{\dot{K}}$$

where $C$ is considered a function of $K$ and time does not appear anymore. As in equilibrium $dC$ and $dK$ are both equal to zero, Barro and Sala-I-Martin suggest as one possibility to use l'Hôpital's rule to evaluate indeterminate forms. This then yields a quadratic function in $C'(K)$. The two solutions can be depicted as follows.

(B2) $$C'(K)_{1,2} = \frac{\theta - n}{2} \mp \sqrt{\frac{(\theta - n)^2}{4} + \theta n + \gamma(1-\gamma)K^{-(1-\gamma)}C(K) + \frac{\gamma(1-\gamma)K^{-(1+\gamma)}z}{\left(\beta - (1-\gamma)K^{-\gamma} + n\right)^2}}$$

We are interested in the stable branch of the two paths crossing at the steady state, which is the positively sloped one, thus $C'(K)_2$. In order to evaluate whether the slope $C'(K)_2$ increases or decreases with the different equilibria associated with different $z$, we have to evaluate the last two terms under the square root.
As we know that $dK/dz<0$, it is immediately evident that the last term decreases as $z$ is reduced and thus $K$ increased. To evaluate the second to last term under the square root of (B2) we insert equation (5) for $C(K)$.
The resulting term $\gamma(1-\gamma)K^{-\gamma}(K^{-\gamma} - n)$ is also decreasing with $K$. Thus we can clearly show that reducing z and thus increasing $K$ leads to smaller slopes of the saddle path in steady state. Due to the fact that we have a second state variable, $B$, which we cannot replace without solving the non-linear differential equation system in steady state, we cannot use the time elimination method to derive the slopes of saddle paths outside the steady state in general terms.

**Figure 1: Phase diagram with bonds and capital: the trade off**

[the indicated trajectories are drawn with respect to equilibrium C; B shows the impact effect when transfers are increased from $z^A$ to $z^C$ ]

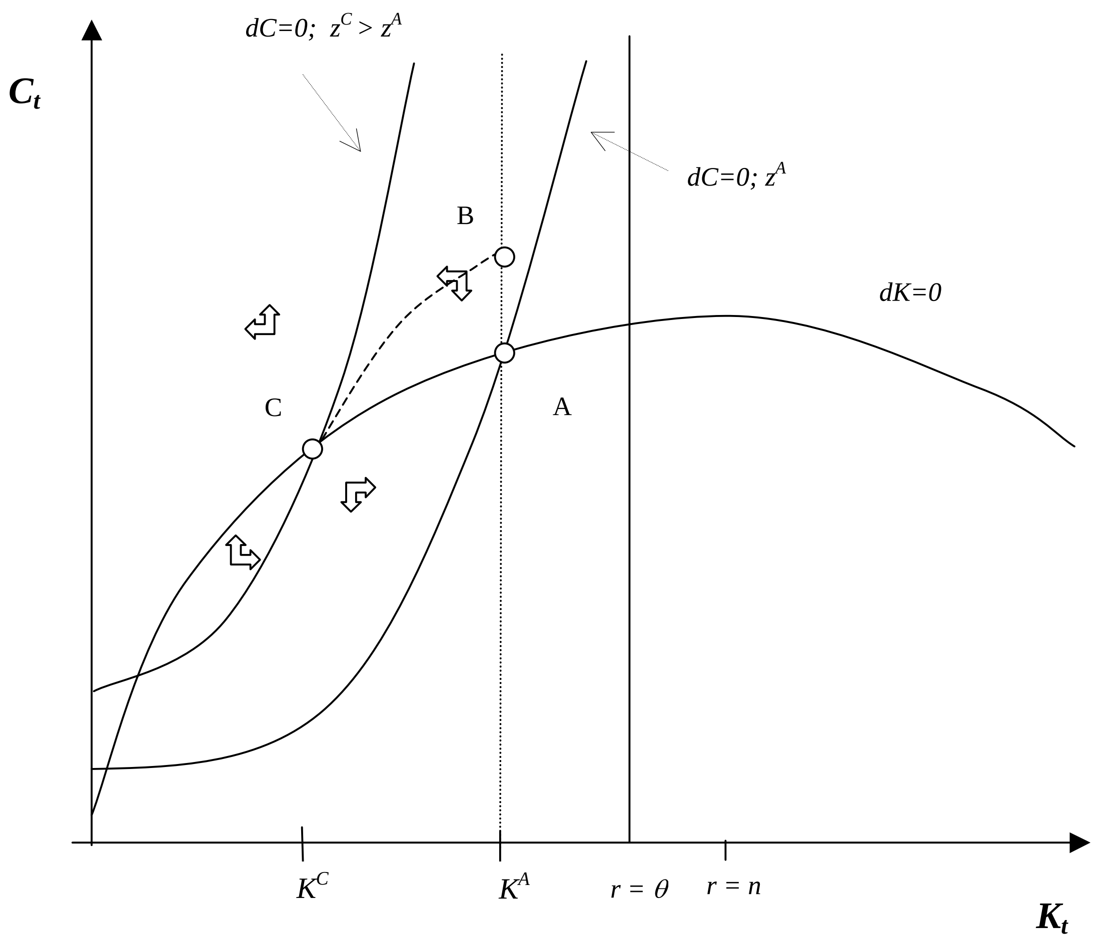

**Figure 2: Phase diagram with bonds and capital: $z^{max}$ and relative slope of saddle paths in equilibrium**

[the indicated trajectories are drawn  with respect to A]

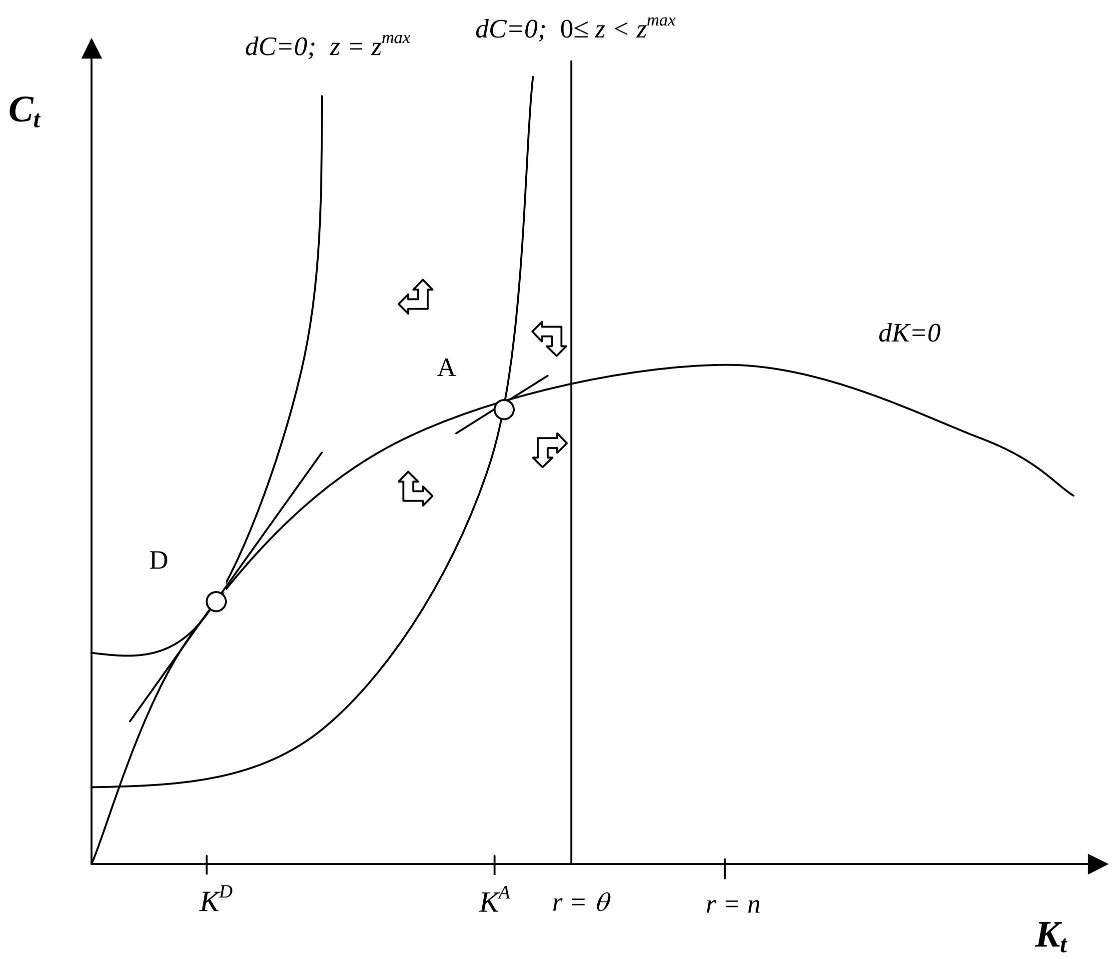

**Figure 3: Phase diagram with bonds as the single state variable**

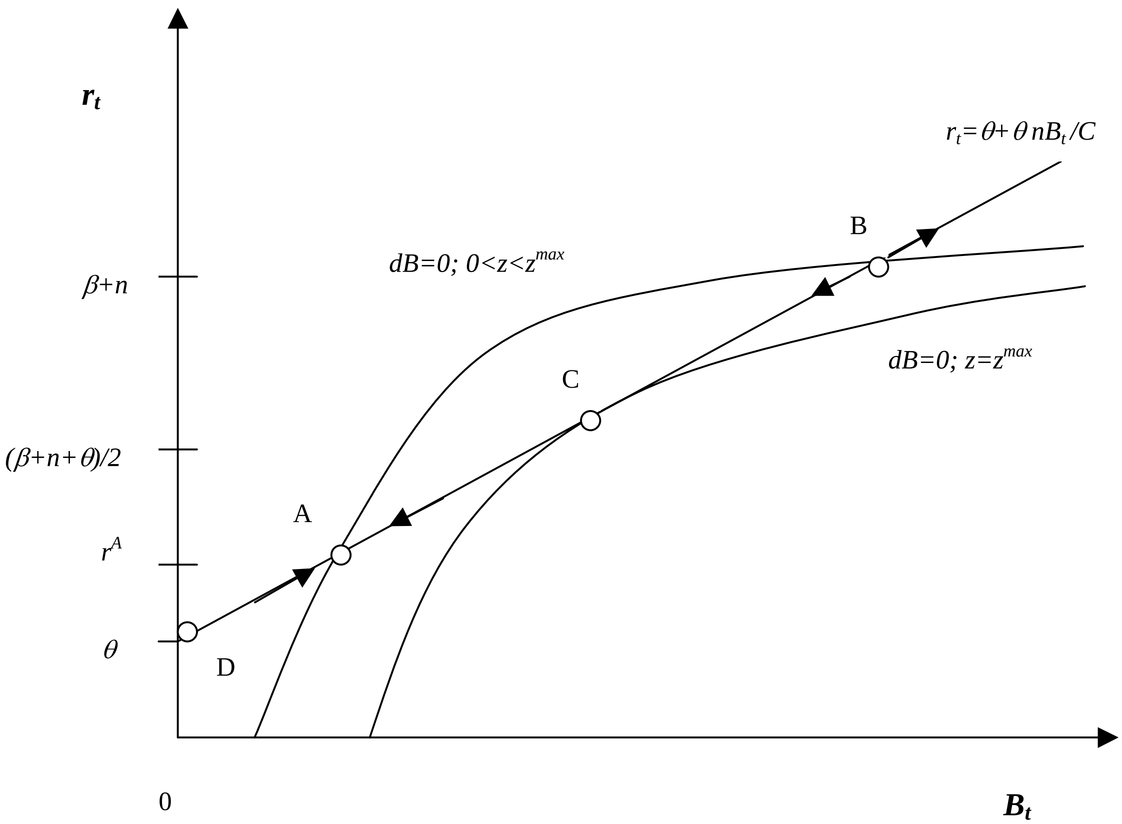

**Figure 4: The common pool problem without fiscal rules**