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ARE BUBBLES BAD? IS A HIGHER DEBT TARGET FOR THE EURO-ZONE DESIRABLE?

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Bubbles are usually viewed as a threat to financial stability. This paper takes a more nuanced view. The world economy is going through an episode of Secular Stagnation, where the equilibrium rate of return on capital r is below the growth rate of the economy g. As is well known, rational bubbles are sustainable when $r \leq g$ in a steady state equilibrium. Bubbles can then implement a dynamically efficient equilibrium. We show that from a structural point of view, bubbles, Pay-As-You-Go (PAYG) pensions and sovereign debt are perfect substitutes. However, when dealing with unexpected short run fluctuations in investment, sovereign debt is far more efficient than bubbles in shifting consumption over time and in risk sharing between generations. An increase in sovereign debt is therefore an efficient response to Secular Stagnation. Instead, the current Stability and Growth Pact for the Euro-zone embarks on an opposite course.

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Abstract

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"*There is increasing concern that we may be in an era of Secular Stagnation in which there is insufficient investment demand to absorb all the financial savings done by households and corporations, even with interest rates so low as to risk financial bubbles.*"

Lawrence Summers, Boston Globe, April 11, 2014

1 Introduction

The demise of Lehman Brothers in September 2008 has driven the world economy into a deep recession from which it is still struggling to recover. Economists like Larry Summers and Paul Krugman have suggested that we have entered an era of Secular Stagnation, where even a negative real interest rate is unable to clear the capital market at full employment level, see the Ebook edited by Coen Teulings and Richard Baldwin (2014) for an overview of the debate. In fact, the real interest rate is on a downward trend since 1980, long before the onset of the Great Recession in 2008. This downward trend has led to worries about financial stability, as clearly voiced by the citation by Larry Summers above: low interest rates might lead to bubbles on financial markets. This paper analyses these worries. Are they justified? Are bubbles bad? Or do bubbles have a useful role to play in a market economy? And if so, are bubbles the only institution that can play that role, or might other institutions yield better outcomes? We show that from a structural point of view, bubbles, Pay-As-You-Go (PAYG) pensions and sovereign debt are perfect substitutes. However, when dealing with unexpected short run fluctuations in investment, sovereign debt has different properties than bubbles. Sovereign debt is far more efficient than bubbles in shifting consumption over time and in risk sharing between generations. An increase in sovereign debt would therefore be an efficient response to Secular Stagnation. Instead, the current Stability and Growth Pact for fiscal policy in the Euro-zone embarks on an opposite course.

A bubble occurs when a particular class of assets is priced above its fundamental value, which is the net present value of all future returns on the asset, discounted by an appropriate discount rate. An asset commanding a positive price that does not yield any future return apart from its resale value is therefore by definition bubbly. Its fundamental value is zero, and nevertheless it carries a positive price. Money is a typical example. A bubble is called rational if the expectations of the buyer on the future resale value of the bubbly asset are rational. In this type of world, buying a bubbly asset is not an irrational decision that puts one's wealth at risk in the pursuit of a supernormal return. The purchase of a bubbly asset is a rational decision that maximizes the risk weighted return on the investors' portfolio.

Since Jean Tirole's (1985) seminal paper it is well known that rational bubbles can be sustained in an economy on a steady state growth path if the growth rate g exceeds the expected return on capital r, $r \leq g$. Tirole considers an economy with overlapping generations the each live for two periods. Each generation works in the first period and is retired in the second. They save part of their labour income for consumption when they are retired in the second period. When the demand for loanable funds needed for the maintenance of an efficient stock of productive capital is insufficient to absorb all these savings, the economy might end up on a dynamically inefficient path. Bubbles are a potential solution for that problem in that situation because they can serve as an alternative store of value. However, PAYG pensions or sovereign debt are perfect substitutes for bubbles. A higher sovereign debt will therefore reduce the size of the bubble.

In the debate on Secular Stagnation, it has been argued that the supply of savings has gone up mainly due to demographic factors, and that demand for savings might have gone down by a fall in the price of capital goods and by the rise of the IT industry with a high profit margin but a low demand for capital. These trends have pushed the economy into the direction of dynamic inefficiency, where the efficient stock of productive capital provides an insufficient store of value for all savings made to smooth lifetime consumption. Then, either the market generates bubbles or policy makers have to provide alternative stores of value by running a PAYG pension system or a higher sovereign debt. Since bubbles, PAYG and sovereign debt are perfect substitutes in this simple world without random shocks, it does not matter which alternative policy makers choose. However, they cannot reduce bubbles and sovereign debt at the same time. Either of the two has to increase.

This indifference between bubbles and an increase in sovereign debt disappears when considering the resilience of the economy towards booms and busts in investment demand. Equilibrium on the market for output requires that fluctuations in investment must be offset by fluctuations in consumption of the same size but opposite sign. Efficient risk sharing and life-time consumption smoothing requires that these shocks are proportionally distributed to the young and the old. In this respect, bubbles do strictly worse than sovereign debt. While bubbles will be shown to attribute these shocks fully to the elderly cohort that is retired, sovereign debt allows a proportional distribution between both cohorts currently alive. When we account for the consequences to the resilience of the economy, a higher sovereign debt is therefore strictly preferred above bubbles.

This argument provides a challenge for the Euro-zone. The monetary union does not run a centralized fiscal policy. At the same time, distrust among its member states has led to a Stability and Growth Pact that constrains the freedom of individual member states to run their own fiscal policy. The trend towards dynamic inefficiency, where the economy lacks sufficient stores of value to

accommodate all savings made for the purpose of lifetime consumption smoothing, requires an increase in sovereign debt. However, the Stability and Growth Pact has embarked the union on a path that leads to the opposite, a lower instead of a higher sovereign debt.

The structure of this paper is as follows. Section 2 sets out the role of rational bubbles in dealing with dynamic inefficiency in a steady state, where the economy lacks sufficient stores of value to absorb all savings that are made to smooth lifetime consumption. We show that bubbles, PAYG pensions and sovereign debt are perfect substitutes. Next, Section 3 discusses some evidence on why dynamic inefficiency might have become are more pressing problem during the past two decades. Section 4 adds short run fluctuations in investment demand to the steady state world considered in Section 2. We show that bubbles and sovereign debt are no longer perfect substitutes. Sovereign debt has much better risk sharing properties than bubbles. Hence, an increase in sovereign debt is the best response to a structural shift towards a higher degree of dynamic inefficiency. Section 5 discusses the policy implications for the Euro-zone.

2 Bubbles and dynamic efficiency

Paul Samuelson (1958) is the godfather of OverLapping Generation (OLG) models. In its simplest form, people live for two periods. In the first period, when young, they work and earn a labour income. In the second period, they are retired. Hence, smoothing their income over their entire lifetime requires them to save part of their earnings in the first period to finance their consumption in the second period. At the end of each period, the retired cohort dies, the working cohort retires, and a fresh cohort of young workers enters the market. We shall use this simple two period OLG model as our workhorse throughout this paper. At some occasions, we shall discuss how using a more advanced model changes our conclusions.

How can people save in this world? In its simplest version, a world output cannot be stored for future consumption and where labour is the only factor of production, there is a problem. Workers would like to set apart part of their production for consumption in the second stage of life. But how can they do? There is no counterparty to trade with. The elderly would be happy to consume the current output, but they have nothing to offer in return because by the time the current youngsters need something in return, the elderly are already deceased. The only generation that would be able to grant today's youngsters output for their consumption during their retirement is the next generation, which is yet unborn and hence cannot commit to any voluntary trade. Moreover, the current cohort of youngsters would have nothing to offer the next generation in return for that, for

the same reason as the current elderly cannot offer anything in return to the current youngsters. There is a missing market for transfers of consumption over the life cycle which deprives people from the opportunity to save for their retirement.

This story changes when we consider a somewhat more complicated world, where there are two factors of production: labour and capital. We assume that this production takes place by a production technology featuring constant returns to scale. Firms hire workers and capital as to maximize profits. Furthermore, we assume that there is perfect competition on all markets and free entry of firms. The young lend their savings to firms, which these funds invest in productive capital. In return, firms pay them their loan plus a return r next period. Investment in the capital stock provides the young a means for saving for their consumption during retirement, thereby resolving the problem of the missing market for transfers of consumption over the life cycle. The big question is whether the efficient capital stock is sufficiently large to absorb all savings the young want to make to smooth their lifetime consumption.

First, suppose it is. Then, the assumptions of constant returns to scale and perfect competition imply that the equilibrium on the capital market is determined by two relations:

1. the factor price frontier for the rewards for labour and capital;
2. the Euler equation for the intertemporal trade-off between consumption in both stages of life.

Jointly, both relations imply that the rate of return on capital is equal to the growth rate of the economy: $r=g$. A higher interest rate induces the young to postpone their consumption, thereby increasing the supply of loanable funds. It also induces firms to apply a less capital intensive production technology, thereby reducing the demand for loanable funds. Jointly, these processes implement an equilibrium on the capital market, which happens to be $r=g$.

Now, suppose it is not. Then, $r\leq g$. The capital stock provides insufficient capacity as a store of value to allow workers to invest all their savings in productive capital. This is a dynamically inefficient outcome: the capital stock is extended beyond its efficient size. The condition $r\leq g$ is also Tirole's condition for the existence of rational bubbles. If a bubbly asset exists, workers will invest part of their savings in this asset. This drives the price of this asset up to the point where the value of the bubbly asset is sufficiently high to absorb the excess of savings above the storing capacity of the capital stock. In fact, trade in the bubbly assets is a substitute for government enforced inter-generational transfers. The young buy the bubbly asset from the old, thereby transferring resources to buy consumption goods from the young to the old. The old will never be able to reimburse the

young because they have passed away when it is time to pay back. However, the young expect to be reimbursed by the next generation, who will buy the bubbly asset from them. In this way, the bubble allows an infinite chain of intergenerational transfers which is to the mutual benefit of all. By buying the bubbly asset, the current generation workers pays for the pension of the retirees, without government enforcement being required.

Note that in this world there are multiple equilibria. We discuss the two obvious equilibria. The first is the naïve, dynamically inefficient equilibrium, where all savings are invested in productive capital and nobody invests in bubbly assets. This equilibrium is fully rational, as everybody expects the future price of bubbly assets to be zero. Hence, nobody has an incentive to buy bubbly assets. The second is the bubbly, dynamically efficient equilibrium, where everybody expects bubbly assets to command a positive future price that rises at rate g, since spending on bubbly assets grows at rate g while its supply is constant. As long as the return on capital r is less than g, it would be rational to invest in bubbly assets. People will continue to invest in bubbly assets till $r=g$.

The condition $r \leq g$ is also Henry Aaron's (1966) condition for a PAYG pension system to be more efficient than a funded pension system. The idea is exactly the same as in the bubbly equilibrium. A generation can better spend its saving on the pension of the previous generation, knowing that their pension will be paid for by the next generation, since savings grow at a rate g, while investing the funds will yield a return $r \leq g$. The only difference between a PAYG and a bubbly equilibrium is therefore the enforcement mechanism: the government in the case of PAYG, individual rationality in the bubbly equilibrium.

Next to PAYG and bubbles, there is a third, intermediate option: sovereign debt. The government issues bonds which are bought by the young as a store of value for their savings. The government repays these bonds next period by issuing new bonds. The government pays an interest g on these bonds and repays them without ever having to raise taxes since savings grow at a rate g. Again, as long as $r \leq g$, investing in sovereign debt is a rational strategy. Hence, where saving is forced in a PAYG equilibrium, saving is voluntary in both the bubbly and sovereign debt equilibrium. However, the repayment of the assets is enforced by the government in the debt equilibrium, while it is just an outcome of the market process in the bubbly equilibrium. It is a matter of taste which enforcement mechanism is viewed as most credible and hence most reliable. Apart from these difference in enforcement, bubbles, PAYG, and sovereign debt are perfect substitutes in a dynamically inefficient world. More PAYG or more sovereign debt reduces the demand for bubbly assets and the other way around.

It is easy to see that the economy without productive capital is just the limiting special case of $r \leq g$, since in an economy without capital, any output 'invested' in capital is just wasted and hence yields a return r=-1. The three methods to achieve dynamic efficiency discussed previously for the economy without capital apply likewise in the economy with capital: either bubbles, or PAYG, or sovereign debt, or any combination of these three can implement dynamic efficiency.

3 Dynamic inefficiency and demography

The practical relevance of this detour along the three ways in which an economy can resolve potential dynamic inefficiencies is obviously dependent on the question whether or not the actual world is dynamically inefficient in the absence of either bubbles, or PAYG pensions, or sovereign debt. Andrew Abel, Gregory Mankiw, Larry Summers and Richard Zeckhauser (1989) have addressed this question in a celebrated paper. They show that there is a simple criterion. Take the annual outflow of the capital sector in the form of interest payments and dividends, and deduct the annual inflow of funds (that is: investment). If there is a positive surplus, the economy is dynamically efficient; if there is a deficit, the economy is dynamically inefficient. Abel et.al. show that the actual surplus is indeed positive by a wide margin for a large set of countries over a prolonged period of time, suggesting that the real world is indeed dynamically efficient.

There are two caveats here. First, whether the real world features bubbles is open to debate, but it does feature PAYG and sovereign debt. Whether the result of Abel et.al. that the capital sector generates a net surplus would also apply in the absence of these institutions is an open question. Second, Francois Geerolf (2013) has shown recently that the conclusion of Abel et.al. hinges crucially on the way they deal with the rents on natural resources. Theory requires these rents to be excluded from the outflow of the capital sector because they are not a return to prior investment. Geerolf tries to calculate their magnitude and concludes that after this correction Abel's et.al. conclusion does not survive.

The case $r=g=0$ allows a simple intuitive calculation of the supply and demand for loanable funds. Let us assume that we live for 75 years, 20 years at school, 40 years at work, and 15 years in retirement. Consumption is much lower during the first 20 years, let us say: ¼ of the average level, yielding a debt of 5 years of average consumption when entering the labour market. Otherwise, we assume that consumption is perfectly smoothed over the life cycle. Correcting the consumption during the first 20 years yields a total consumption of 60 years (5 at school, 40 while working, 15 during retirement), for which we earn a labour income during 40 years. Hence, annual consumption is 2/3

of annual labour income. Let us assume that people are born without assets and also die without assets. The debt when entering the labour market is 5 years x 2/3 = 10/3 of the annual income. Asset holding at the date of retirement are 15 years of retirement x 2/3 = 30/3. Simple linear interpolation shows that the average asset position over the life cycle is the half the difference between the maximum debt and the maximum assets, that is [30/3 -10/3]/2 = 3.3 times annual labour income. Since the population is about twice the size of the workforce, this is equivalent to 6.6 times annual labour income, but since labour income is about 2/3 of GDP, the required capital stock is about 4 times GDP. The capital coefficient (the ratio between the capital stock and GDP) is between 3 and 4. This rough ballpark calculation suggests therefore that the two numbers are of the same order of magnitude. Small changes in either supply or demand might therefore lead to quite dramatic shifts between dynamic efficiency and inefficiency.

Oliver Blanchard, Davide Furceri, and Andrea Pescatori (2014) and Coen Teulings and Richard Baldwin (2014) summarize a number of factors that might have shifted the balance of supply and demand of loanable funds during the past three decades, the period in which the interest rate has come down steadily. Both the supply and demand side of the market have contributed. On the demand side the fall in the price of capital goods and the rise of the IT sector might have contributed. Google, Facebook, Amazon, and Twitter make enormous profits (the IT sector accounts for 25% of the market capitalization of the American stock market when excluding financials to avoid double counting), but probably do not require an equally large share in investment.

On the supply side several factors have contributed to a global increase in savings. The first is China. Its phenomenal growth and its one-child-policy have had a large effect on its savings. This effect has been amplified by the lack of a welfare state with proper social and health insurance. The second factor is the increase in longevity over the past four decades by about ten years. Meanwhile the retirement age has hardly changed, see Axel Gottfries and Coen Teulings (2015). This table suggests that the increase in longevity alone has raised the supply of loanable funds by one to two times GDP. This factor is common to almost all rich countries. The rise in the average number of years of education has offset this trend only partially. The third factor is the decline in the steady state growth rate of the population g. This has increased the stock of savings for two reasons. First, a cohort owns least assets when it enters the labour market and it owns most assets at the moment it retires. A smaller population growth rate implies that the cohorts owning least assets are relatively small and the cohorts owning most are relatively large. Second, as is explained in Section 2, there are strong forces causing $r=g$. Hence, a fall in the growth rate can be expected to lead to a fall in the return to capital. A lower return to capital increases the stock of assets that is required to pay for the

same pension entitlement. The final factor is the fall in fertility rates around 1970 due to the introduction of the pill. Cohorts born in the 1960s are therefore about twice the size of cohorts born in 1990s, causing the age-composition of the population to be far off from its steady state equilibrium. The large cohorts are now in the last decade of their working life, at the peak of the lifecycle pattern in asset holdings. This leads to temporary excess savings, which last for about two decades. Together, these factors led to a massive increase in the supply of loanable funds. Lukasz Rachel and Thomas Smith (2015) in a recent working paper of the Bank of England provide evidence that demography does indeed play a major role in the decline in the interest rate over the past two decades.

All this makes it likely that the economy is currently going through an 'episode of increased dynamic inefficiency'. Obviously, the concept of an 'episode of increased dynamic inefficiency' is problematic, since as far as I am aware of, all theoretical results on dynamic efficiency are derived for economies in steady state. An 'episode of dynamic inefficiency' is difficult to handle because it is by definition a non-steady state phenomenon. At some point during the episode some cohorts will suffer from lower consumption than the cohorts before and after. However, the general message of an economy facing dynamic inefficiency remains true: they require a greater reliance on either bubbles, or PAYG pensions, or sovereign debt as a store of value. As long as policy makers want to rely on bubbles as a resolution to the problem of excess saving, no further action is required. Those cohorts owning the bubbly assets at the beginning of the bubbly episode will benefit from the high price at which they can sell their assets. Those cohorts owning the bubbly assets at the end of the bubbly episode will lose as the price at which they can sell their assets is low. Nevertheless, this can be a rational expectations equilibrium. However, if policy makers view this solution as too risky an alternative, pension systems and fiscal policy have to be redesigned to allowing for a greater role for PAYG systems and higher sovereign debt levels which serve as alternative stores of value.

4 Why higher sovereign debt is preferred above bubbles

The previous argument led to the conclusion that an episode of dynamic inefficiency requires either bubbles or more sovereign debt. Since both are perfect substitutes, it was irrelevant what alternative policy makers picked. However, as I argued in Teulings (2016) there are good reasons for preferring fiscal policy above bubbles. To understand this argument, we have to dive somewhat deeper in the economies that are on balance dynamically inefficient. Consider an economy that relies on bubbly assets to deal with the average degree of dynamic inefficiency. We add a feature to

this economy, by assuming that the expected return on investment is stochastic. We refer to this risk factor as *ex ante* uncertainty, which affects the expected return on investment *before* the investor has committed to the investment, in contrast to *ex post* uncertainty, which affects the return *after* commitment. Consider what happens at the moment that the realisation of the *ex ante* risk factor makes investment in productive capital less profitable. Then, there is an investment slump. This hurts the young who have to invest their savings. Because they have the choice between either investing in productive capital or buying the bubbly asset, they will substitute away from productive investment towards bubbly assets. This causes the price of bubbly assets to go up. The elderly, who held these assets at the start of the period, benefit from this by receiving a higher price than previously expected. They use this windfall profit to increase their consumption as a retiree. The low return on investment leads therefore to a substitution in final demand away from investment, towards consumption, to the benefit of the retirees. Again, trade in bubbly assets implements an inter-generational transfer from the young to the elderly.

There is one condition for this mechanism to work: there must be a market where bubbly assets command a positive price at any time. Stated differently, even in an investment boom, the young must find it attractive to invest part of their savings in bubbly assets, even though investment in productive capital yields a return r higher than g. Why do the young find it attractive to buy the bubbly asset in that situation? That is because there might be an investment slump in the next period, which will increase the price of the bubbly asset. It turns out that the condition of the price of bubbly assets being positive at any time is equivalent to the condition that the economy is dynamically inefficient 'on average'.

Strictly speaking, this condition requires the young to be risk neutral. If they are risk averse, the condition has to be slightly modified. The modification depends what risk factor has the largest impact: *ex ante* or *ex post* risk. *Ex ante* risk makes bubbly assets less attractive to hold, since their return depends on the realisation of next period's *ex ante* risk. It is this risk factor that determines the price at which the bubbly asset can be sold next period. *Ex post* risk makes productive capital less attractive to hold, since its return depends on the future realisation of the *ex post* risk on today's investment in productive capital. Hence, when the impact *ex post* risk is larger than that of *ex ante* risk, the young are more likely to hold bubbly assets and hence the requirement of 'on average' inefficiency is relaxed somewhat, and the reverse if the impact of both risk factors is the other way around.

Whatever the exact formulation of this condition, whenever bubbly assets alleviate a dynamic inefficiency problem, they are therefore also helpful in dealing with investment slumps, leading to a

temporary fall in investment. This conclusion has an important policy implication. As we argued in Section 3, the world economy has moved towards dynamic inefficiency. Hence, bubbly assets play a greater role in absorbing a structural excess supply of loanable funds today than two decades ago. However, this implies that they play a larger role in absorbing temporary booms and busts in investment.

Are the intergenerational transfers generated by trade in bubbly assets in response to these temporary booms and busts efficient in any proper definition of this concept? This question has two aspects:

1. Is the induced substitution between consumption and investment efficient?
2. Shifts between consumption and investment lead to shocks in consumption. Are these shocks allocated efficiently between youngsters and elderly?

Both issues are addressed below, following the analysis in Teulings (2016).

First, consider the substitution between consumption and investment. For the sake of the argument, we define efficiency as maximizing the present value of total output over all generations, using the long rung return to capital *r* as a discount factor. This swipes under the carpet some hairy issues regarding the distribution of welfare across generations and regarding the boundedness of this present value, but it is helpful in understanding the issue. A first best equilibrium would invest in productive capital up to the point where the marginal return is equal to *r*. Any loanable funds above that amount of investment could be better consumed than invested at a low return. The higher price of bubbly assets in an investment slump achieves exactly this because the retired cohort uses the windfall profits on their holding of bubbly assets to boost their consumption (let us say: an additional cruise to the Bahamas). However, bubbly assets implement less than the optimal amount of transfers from investment to consumption. This transfer is implemented by the price of bubbly assets rising temporarily above its long equilibrium value. Hence, the expected return on bubbly assets will be below its long run equilibrium. Since the young allocate their savings by setting equal the expected return on productive investment and on bubbly assets, it must be the case that the expected return on productive capital is also below its long run equilibrium *r*. Hence, there will be overinvestment in productive capital in the slump relative to the benchmark of the first best equilibrium. Bubbly assets implement an investment plan that is half way between the naive plan where all savings are invested anyway and the first best plan where society invests up to the point where the return to capital is equal to its long run equilibrium.

Second, consider the allocation of shocks in consumption between youngsters and elderly. Since output cannot be stored, shocks in investment due to *ex ante* risk must be offset by shocks of opposite sign in consumption. However, shocks in consumption run counter to risk aversion and to the preference for smoothing consumption over the life cycle. Hence, a shock in consumption can best be spread among both the young and the elderly cohort that are around when the shock hits the economy. Here, bubbly assets fail desperately. The entire burden of adjustment is put on the elderly. The transfer between consumption and investment is implemented by fluctuations in the price of bubbly assets. The windfall profits and losses generated by these fluctuations account for the variation in the consumption of the elderly. Whether youngsters share at all in the fluctuations in consumption depends on their elasticity of intertemporal substitution. If that elasticity is equal to unity (a Cobb Douglas utility function), then they spend a fixed share of their life time income on current consumption, while saving the remainder for their retirement. Hence, the young would not share in the absorption of the consumption shock at all. They do share in the effect of the *ex ante* risk on next period's output, but they do not share in the effect of this risk factor on today's consumption. If the elasticity of intertemporal substitution is less than one – as suggested by most empirical research - , a fall in return to capital will lead to a fall in the share of lifetime wealth spent on current consumption. If that were the case, the savings response of the young would run counter to the absorption of savings. Their response exacerbates the problem.

Trade in bubbly assets helps therefore in adjusting investment and consumption to investment booms and busts by adjusting the consumption of the retired cohort. However, this trade fails miserably in the attribution of the shocks in consumption to the young and the old. The full burden of adjustment is imposed upon the elderly. If the elasticity of intertemporal substitution is less than one, the response the young exacerbates the problem. This problem is even more serious since an optimal division of the shock in consumption between both generations would assign a larger share to the working generation, simply because their share in consumption is larger in the first place.

Could a fiscal policy run by the government alleviate these problems? We consider a very simple fiscal policy rule, where the government does not have to take a stance on the state of the economy (i.e. the realisations of the *ex ante* and *ex post* risk factors), but just follows a fixed policy rule that applies alike in all states of the economy. Every period, the government sells a fixed amount of bonds that grows at a rate g and that yields a return of unity in the next period. It uses the revenues from selling these new bonds to repay last period's bonds. The market price of these bonds determines the interest rate r. If $r< g$, the government runs a profit on its market operations: the revenues from selling today's bonds exceeds outlays of repaying yesterday's bonds. This profit is

distributed among the young by a subsidy on labour income. In the reverse case, if $r>g$, the government runs a deficit. It covers the deficit by a levying a tax on labour income.

What would this policy achieve in an investment slump? The young would not like to invest much in productive capital due to its low expected productivity. Hence, they substitute to other asset classes like government bonds. The price of these bonds goes up, driving the interest rate down. The government runs a profit on its market operations and distributes the proceeds among the workers by a subsidy on labour income. Their lifetime wealth goes up. Part of this wealth is saved for future consumption, but another part is used for current consumption. It is the latter part that makes fiscal policy helpful in absorbing the negative effect on demand of an investment slump by increasing the consumption of the young. The reverse mechanism applies during an investment boom.

At first sight, this mechanism seems to imply a transfer of wealth from the elderly to the young. The young receive the full revenues from the government's market operation in the form of a tax relief on labour income. However, the young also pay for this via the higher price for the government bonds above their equilibrium value. It is this higher price that extracts loanable funds from investment in productive capital. The young experience a rise in their lifetime wealth from the tax relief, but find it more costly to consume during retirement due to the fall in the real interest rate. Hence, this equilibrium uses the income effect to increase current consumption and uses the substitution effect to reduce future consumption. In this way, fiscal policy implements an intra-generational transfer from consumption tomorrow to consumption today that trade in bubbly assets fails to deliver.

It can be shown that this fiscal policy is less efficient in transferring resources from investment to consumption than trade in bubbly assets. Hence, investment responds less strongly to fluctuations in its return. However, fiscal policy is far more efficient in spreading the corresponding shocks in consumption across generations. Hence, this type of fiscal policy should always be part of the optimal mix of instruments to absorb shocks in the demand for productive investment. An increase in the average dynamic inefficiency in the economy should therefore lead to an increase in sovereign debt. We know from the discussion in Section 2 that government debt and bubbles are substitutes. Hence, a higher sovereign debt will lower the average value of bubbly assets.

The rationale for fiscal policy provided here contrasts sharply to the standard argument. This standard argument relies on intergenerational transfers. Fiscal policy is used as an insurance policy to redistribute wealth from cohorts facing good shocks to cohorts facing bad shocks. The analysis in this paper stresses the intra-generational aspect of fiscal policy, inducing a cohort to spend its

lifetime wealth mostly when the output availability constraint is least binding, that is, during an investment slump. However, both views do not exclude each other. They can be combined by applying more advanced fiscal policy rules. For example: suppose that a cohort enters the labour market during a slump. Hence, consumption will be high. One could partly offset this favourable outcome during the first period of the lifetime of this cohort by reducing their consumption in the second period, when the cohort is retired. This more advanced fiscal policy would improve on the intergenerational insurance characteristics.

Finally, we have to consider whether dynamic inefficiency is a local or a global phenomenon. When there are no constraints on the mobility of capital, one would expect capital to flow to the region where it commands the highest rate of return. In this type of world, a local savings surplus would be easily absorbed on the global capital market. Dynamic inefficiency could prevail only when the highest return to capital across all regions is less than the growth rate in the own region. This condition is far more difficult to satisfy than the condition that $r \leq g$ in the own region. However, as shown by Martin Feldstein and Charles Horioka (1980), the world economy does not look like an integrated capital market. Empirically, local savings are highly correlated to local investment, contrary to what one would expect in a globally integrated capital market. This phenomenon might be explained by the Balassa-Samuelson effect, which says that consumption price levels and productivity are highly positively correlated across regions. Most regional productivity differentials are related to tradable commodities. High productivity drives up wages and therefore makes non-tradables more expensive. Youngsters might therefore wish to overweigh the local capital stock in their investment portfolio as to insure against the risk of local price increases in non-tradables as a result of productivity gains in the tradable sector. This mechanism explains why dynamic inefficiency might be regional instead of global phenomenon.

5 Dynamic inefficiency and economic policy in the Euro zone

This paper argues that the global shift towards dynamic inefficiency is a major factor driving the Great Recession and the increased financial volatility. The main cause of this global shift are demographic factors: the increase in longevity (not offset by an increase in the retirement age) and the fall in fertility. An economy that is dynamically inefficient lacks stores of value. Its population wants to save more to smooth its consumption over the life cycle than is needed for the maintenance of an efficient capital stock. In that situation, either policy makers or the market create

additional stores of value: a PAYG pension system or sovereign debt, if we leave it to policy makers; trade in bubbly assets, if we leave it to the market.

When we consider a world without business cycle fluctuations, it does not really matter whether society relies on the market or on policy makers to resolve the dynamic inefficiency. However, the real world is characterized by booms and busts in investments, driven by fluctuations in the expected return on investment in productive capital. In this type of world, market equilibrium requires fluctuations in investment to be offset by opposite fluctuations in consumption. While bubbles are rather efficient in accommodating fluctuations in the profitability of investment, they are extremely inefficient in the attribution of the shocks in consumption to the young and the elderly. Presuming that the elasticity of intertemporal substitution in consumption is less than unity (as the empirical evidence suggests), trade in bubbly assets attributes more than the full burden of adjustment to the elderly, since the consumption response of the young only acerbates the problem.

This conclusion has important policy implications. The empirical evidence discussed in Section 3 documents that the world economy has moved towards dynamic inefficiency over the past two decades. Then, policy makers could improve the resilience either by moving pension systems away from fully funded towards PAYG or by increasing sovereign debt. This would reduce the reliance on bubbles as a store of value and, more importantly, it would lead to a better risk sharing between the young and the elderly. From that perspective, the high sovereign debt of Japan is a logical implication of its demographic structure. Japan has aged earlier than Europe and China. Its course provides an indication for what is going to happen elsewhere in the world economy.

From this perspective, the Euro-zone is in a difficult position. Where monetary policy is centralized at the ECB, fiscal policy has got stuck in the middle between centralization to the community level and decentralization to its member states. There is no centralized fiscal policy, but since member states distrust each, there are centralized norms laid down in the Stability and Growth Pact and monitored by the European Commission. These norms put binding limits on member states' actual budget deficits (3%) and sovereign debt levels (60%). More importantly, the Pact imposes a norm for their structural deficits of 1% of GDP which implies that the level of sovereign debt will decrease gradually to approximately 33% of GDP (in steady state, the debt level is the structural deficit, 1%, divided by the nominal growth rate of GDP, say: 3%). The sovereign debt level is currently well above 60% on average across all member states. Where the analysis in this paper shows that an episode of increased dynamic inefficiency would require a higher debt level, the Euro-zone is embarking on an opposite course which will lead to much lower debt levels.

The analysis in this paper was cast in a Walrasian framework where all markets clear and where all expectations are rational. Compared to a Keynesian framework, the benefit of this approach is that the hairy issue as to how to model non-clearing markets is avoided. A framework that would allow for a non-clearing output market is likely to yield much larger distortions from booms and busts in investment than the current framework. A further disadvantage of our Walrasian framework is that we have nothing to say about the nominal price level and hence about deflation. The Zero Lower Bound (ZLB) simply does not exist in this model. The real interest rate can move freely to clear the capital market. For a different reason, the theoretical framework has nothing to say about Quantitative Easing (QE). In a two period OLG model only claims with a duration of one period are traded on capital markets. Hence, there is no term structure for the interest rate, which makes QE irrelevant. In this framework, the only role of monetary policy is to avoid the ZLB, thereby enabling the real interest rate to clear the capital market. Our analysis presumes that monetary authorities are successful in this.

However, this framework does have something to say about the consequences of the deadlock on fiscal policy for the economy of the Euro-zone and hence the necessity for policy makers to rely on monetary policy only. This implies that the real rate of return on capital r has to be allowed to fall to a market clearing level, below the growth rate g, and that fiscal policy is not allowed to absorb the excess loanable funds that flood the capital market. Hence, the Euro-zone enters an episode of dynamic inefficiency. In the absence of a proper response of policymakers in the form of either fiscal policy or the introduction of more PAYG elements in the pension system, the market will find its own solution, by generating asset bubbles. The analysis in the paper shows that this solution allows the generation of elderly to benefit from current investment slump. In a richer framework that accounts for heterogeneity within cohorts, it would be the wealthy elderly in particular who benefit, since they hold the assets that generate the windfall profits. These two observations, the emergence of bubbles and the disproportional benefit for the wealthy elderly, are indeed exactly the two main objections to the ECB policy raised in the current public debate. However, the ECB has to set its monetary policy to accommodate to the low real interest rate that clears the capital market. Those who do not like this low interest rate should not reproach the monetary authorities. They should reproach a fiscal policy that fails to contribute to the absorption of excess savings by raising the current consumption of the young.

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