Zero growth and zero interest rate:
The revival of an old idea

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Abstract

Every euro or dollar of economic growth causes a stress mark of energy consumption, waste production, land use and water problems etc. The usual approach is to look for dematerialization of growth by technological innovations (eco-efficiency and consistency). However, these approaches have limited success. Another strategy is to demand cultural change and sufficiency. Yet under existing conditions, sufficiency strategies are not feasible; economies need growth. Politicians have the choice between either ecological or social and economic collapse. In order to see whether there is a way out of this trade-off, the sources of growth have to be analyzed. Growth is caused either by net investments (extension of the capital stock) or increases of productivity. As a result of a successful cultural change, the increases of productivity could be transferred into more leisure time. Nevertheless, net investments would continue to increase the endowment with machines and other capital. How can the net investments be reduced to zero in order to achieve zero growth? In a zero-growth steady state, the whole income of the economy has to be consumed (consumption rate = 100%, rate of net savings and net investments = 0%). In a closed economy this is only possible if the interest rate and profit rate is approximately zero. Under the present economic conditions, such a vision cannot be put in place because the liquidity premium of money (Keynes) means that the interest rate is always significantly higher than zero. However, some prominent academics recently discussed old proposals such as the "free money" approach of Silvio Gesell. By increasing the stock of capital assets, Gesell wanted to reduce the interest and profitability level down to zero. However, even in a situation of low real asset profitability and low interest rates, a high velocity of money circulation and reliable demand should be granted by putting "carrying costs" on money. Though Keynes was very excited by the proposals of Gesell, he criticized the fact that Gesell did not see many of the further obstacles. However, these obstacles could be overcome by means of further institutional reforms. Despite the fact that Gesell was not concerned about ecological problems directly, his basic approach merits discussion.

Keywords

1   Introduction

From 1990 to 2005, global GDP has more than doubled (UNCTAD, 2007). Global energy consumption is even doubling on average every four years (Legget, 2006). As Meadows et al. (1972) already recognized, every euro or dollar of economic growth causes a stress mark of energy consumption, waste production, land use and water problems etc. In former times growth was considered as being a solution for distribution problems. Considering the price development of non-renewable resources, economists are becoming more and more clear about the fact that today's growth is also the cause for new distribution bias. Particularly since India and China as threshold countries try to copy the unsustainable economic patterns of western countries, the growth problem is more urgent than ever before.

In the following article, we want first to argue that there are no promising strategies for "clean growth". Furthermore, we will demonstrate that the monetary system urges the economy to grow. A necessary requirement to escape the pressure for growth is monetary reform. However, many additional requirements have to be fulfilled to achieve a sustainable economic path. We will give some evidence to the subsequent statements by using some statistical data from Germany. Germany is a good example for a mature economy with zero population growth that nonetheless has the goal to achieve further economic growth.

2   "Clean growth"?

## 2.1   The common approach: growth of limits

The common approach used to deal with the problem of growth is the hope of dematerialization, achieved by a decoupling of growth from energy input and waste output. A closely connected strategy to decouple growth from waste and energy input is based on technological progress. Basically, two approaches are under discussion (Paech, 2006):

- Dematerialization by increasing eco-efficiency ("better" use of natural resources). The input of resources is minimized and the input-output ratio should be changed. This approach refers to a quantitative optimization of material flows. Approaches broadly discussed include the "factor four" (von Weizsäcker et al., 1995: Higher efficiency of energy) or "factor ten" (Schmidt-Bleek, 1997: Higher global efficiency of resource input).

- Ecological neutralization by consistency ("another" use of natural resources): Closed material flows should be established, the focus is more on the output. An important manifestation is "bionics": The style and design of natural blueprints should be copied. This track, using technologies such as renewable energies and "zero-emission" technologies, intends to achieve a qualitative optimization.

It appears that new technologies are a good way to harmonize the needs of economy and environment. Meanwhile, very often "sustainability" is defined in terms of engineering. Indeed, looking for example to Germany, at first glance this strategy seems to be successful:

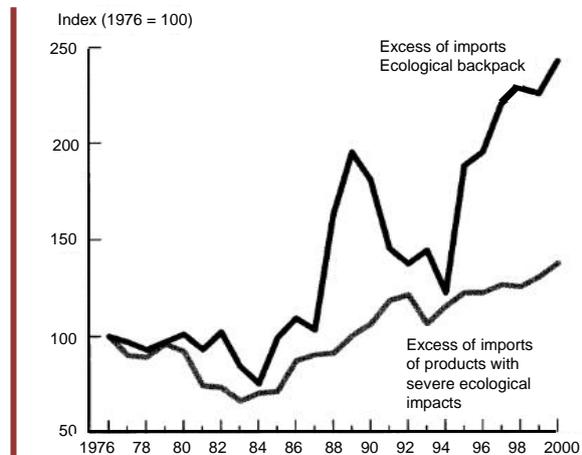**Fig. 1   CO2 emissions of the German economy from 1990 until 2004**

Source: Federal Environmental Office (Germany), own calculations
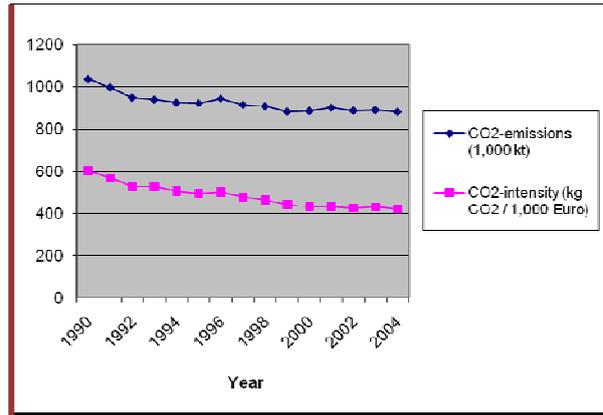
However, a closer look shows that a great deal of the "dirty" parts of the value chain is externalized to development and threshold countries:

Fig. 2   Externalization of the "dirty parts" of the value chain

Source: Wuppertal Institute (2005)

The resource extraction, heavy industry and other parts of the value chain with negative ecological and social impacts are shifted more and more to threshold and developing countries. On the other hand, most of the profits are made in so-called "industrialized" countries, where in fact it is mainly the refinement that is carried out (Wuppertal Institute, 2005).

Fig. 3 gives evidence for the world economy as a whole that, despite the progress of eco-efficiency and consistency, total CO2 emissions grew continuously; the technical progress has been more than offset by the stress mark of growth:

Fig. 3   Unsuccessful decoupling strategy

Source: Raupach et al. (2007) - Interpretations by N. Paech, University of Oldenburg, Germany
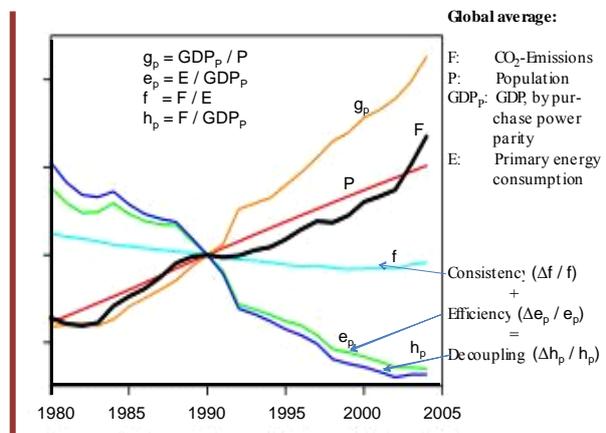
The success of such technological strategies (particularly the strategy of eco-efficiency) is also hampered by rebound and backfire effects, which are estimated to account for some 10 – 50% of the efficiency increase (Sorell, 2007). For instance, the higher efficiency in engines is not used to produce fuel-saving cars, but faster, stronger and bigger cars.

However, the reader should not misunderstand the arguments: The limited success of an isolated technology-based approach is not an argument against the development of environmental technologies. Eco-efficiency and consistency strategies should be pursued. However, it would not be reasonable to pursue these strategies in an isolated manner. They are useful in order to win more time for the development of complementary strategies.

2.2   Limits of growth: Cultural change

The idea of cultural charge is a change of the contemporary paradigm (Huber, 2000; Kuhn, 1962), though it ties in with ideas of classical economists. Many classical economists have been convinced that economic development is ending up in a zero-growth steady state (Costanza et al., 2001). However, only the far-seeing John Stuart Mill (1848) considered this zero-growth steady state as being positive, already thinking about the consequences for the natural environment. The zero-growth steady state in the understanding of Mill is not the same as the steady state as promoted by contemporary economists – in their understanding, the steady state is characterized by steady growth rates. The classical interpretation of the steady state was picked up again by Daly (1991), who interpreted the steady state as the zero growth of energy and material flows.

One necessary condition in order to achieve a zero-growth steady state economy or even a voluntarily shrinking economy is cultural change. The supporters of cultural change argue that "clean" growth is not possible. Instead, they appeal to us to consider what we really need for life, which is sufficiency instead of materialism. Doing business as usual and mitigating the effects by technical means is not enough. The whole lifestyle should be changed.

If a strategy of sufficiency ("less" use of natural resources) is successful, increases of labour productivity could be transformed into more leisure time in order to develop the potentials of human beings. However, only appealing for people to change their behaviour promises to be unsuccessful. Instead, the appeal for cultural change has to be based on institutional changes.

3   The urge to grow

3.1   The distribution argument

Although the idea of cultural change appears to be appealing, the following section demonstrates that today's economy is dependent on growth in order to avoid economic or social collapse.

The first argument is related to distribution. In today's economy, interests, profits, speculative forces, land rents etc. are currently shifting parts of the national income from the labour income to the owners of capital. If the dynamics of these redistribution forces are higher than the growth rate of national income, the share of capital income will rise at the expense of labour income.

In **Fig. 4**, the difference between the growth in real national income and the real interest rate (blue line) indicates how much of the GDP "cake" goes to capital and labour income. If the interest rate is higher than the growth rate of GDP (blue line in the negative range), redistribution at the expense of labour income has to be expected (falling red line) and vice versa. There is an indication that the more the interest rate exceeds the growth rate, the lower the share of wages in national income (correlation coefficient here:

-0.68). Indeed, in the decade from 1999 to 2008, the overall winner is the capital income.
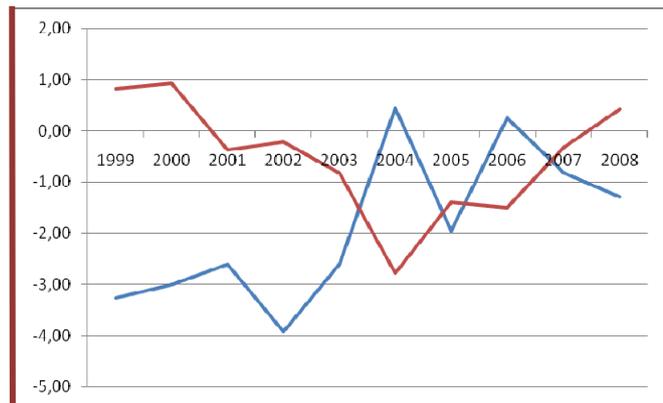
Whereas in former times growth was clearly a strategy in order to solve distribution problems, economic growth is now considered more and more to cause new distribution problems. For example, in 2007 and 2008 it was evident that the rise of oil prices affects the poor countries and vulnerable classes in developing countries most severely (food security problems). But energy price hikes also cause higher inequality of distribution in industrialized countries, because low-income households are comparatively worse affected than high-income households.

If sustainable zero growth were put in place without eliminating the redistribution mechanism mentioned above, the consequences for distribution would be severe.

3.2   The business cycle argument

The second argument refers to the necessity of a closed economic cycle. If, according to Keynes, in a closed economy the (ex ante) savings "**S**" exceed the (ex ante) investments "**I**", the economic cycle is not closed. However, net investments are only made if they are able to earn the capital costs required by the creditors (interests) and shareholders (profits). Keynes already described that during the business cycle the profitability of real investments ("marginal efficiency of capital", "**MEC**", which in Keynes' model calculates a rate of return over cost, Keynes, 1936) may decrease due to the rising competition of new investments. On the other hand, the interest rate of money "**r**" may be more reluctant to fall due to the special characteristics of money (Keynes, 1936, see more below). If new investments are not profitable enough in order to earn the capital costs, investments will be cancelled. In this case, (ex ante) "**S**" exceeds "**I**" and the economic circulation is interrupted (in our analysis, "**I**" comprises the net investments and the replacements; as a flip-side, "**S**" comprises the savings as well as the depreciation).

Table 1   Components of GDP

Legend
(explanations are given in the subsequent text)

$\dot{K}$: Increase of capital stock during a time period

δK : Depreciation rate and restitution rate δ of the whole capital stock K

MEC: Marginal efficiency of capital

λ: Liquidity premium

r: Real interest rate

Economic cycle	Division	Expenditures	Composition (simplified)	
Sphere of consumption	Consumption C	Consumption C	National income	Gross domestic product Y
Sphere of accumulation	(Net-) savings	(Net-) investment $\dot{K}$		
	r > λ	MEC $\geq$ r		
Replacement	Capital consumption	Restitution investment δK		

The consequences of such an interruption may be severe. Like the interruption of blood circulation, the interruption of the economic circulation may lead to a collapse of the (economic) organism. Due to multiplier effects, the interruption of the economic cycle may spread into other sectors of the economy. In order to avoid this situation, savings have to be currently transferred into net investments. **Table 1** shows the components of GDP in a closed economy without government activities. The most critical area for the economic cycle is the accumulation sphere of net savings and net investments.

The consequences of an interruption of the economic circulation might be also illustrated by the Fisher equation. In terms of rates of change, the equation might be expressed as

$$m + v = p + y,$$

where "**m**" is the change in money supply (may be different aggregates), "**v**" is the change of velocity of money circulation (due to different "**m**" and "**y**", various "**v**" may also be calculated), "**p**" is the change of average (consumer) price level and "**y**" is the change of economic activity (e.g. GDP or national income).

<table>
<tr><td rowspan="3" style="text-align:right">Table 2   Changes of velocity of money and real GDP in Germany (in percent)

Source: German Federal Bank, Monthly Reports, Federal Statistical Office, 2009b, own calculations</td><td>Year</td><td>00</td><td>01</td><td>02</td><td>03</td><td>04</td><td>05</td><td>06</td><td>07</td><td>08</td></tr>
<tr><td>v(M1)</td><td>-2.5</td><td>-3.3</td><td>8.3</td><td>-9.7</td><td>-6.8</td><td>-9.9</td><td>-4.0</td><td>0.5</td><td>-0.5</td></tr>
<tr><td>y (GDP$_{real}$)</td><td>3.2</td><td>1.2</td><td>0.0</td><td>-0.2</td><td>1.2</td><td>0.8</td><td>3.0</td><td>2.5</td><td>1.3</td></tr>
</table>

Table 2 shows the change of the money aggregate M1 and the changes of price-adjusted German GDP in percent. The velocity of money is currently decreasing, but at varying rates. It can easily be seen that the velocity of money, calculated as a residual, is not stable in the short run and that higher decreases in "**v**" (2001, 2003, 2005, 2008) are usually connected with falling "**y**" values[1].

In most cases economic crises will also cause a destruction of capital. This means a physical destruction as well as a decline of value. On the other hand, the destruction of capital causes scarcity again. Scarcity is the basis for profitability of capital assets. Hence, such a "purification crisis" is the precondition for the following economic upswing. However, considering these destructions and reconstructions, it should not be forgotten that every reconstruction needs a large amount of resources.

3.3   Accumulation and interest rate

Subsequently we wish to demonstrate that the accumulation sphere of table 1 is connected closely to the interest rate. In order to save space, we have to simplify and can only pick out some arguments of the "Golden Rule of Accumulation" as it has been developed by Phelps (1961). In particular we will not discuss the differences between the Golden Rule and the Keynes-Ramsey rule on equilibrium (cf. Frenkel and Hemmer, 1999), nor do we refer to the meaning of the "time preference" as a model variable or to an endogenous explanation of the savings rate. The same holds for changes of labour force and technological progress. It is not our intention to set up an alternative growth theory, but only to illustrate the importance of one important modification in a simple model. As above, we suppose the economy to be closed and without a governmental sector.

If we assume equilibrium (**I = S**), we get

$$Y = C + S \wedge I = S \Rightarrow C = Y - I$$

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[1] Monetarists claim that the velocity is stable in the long run. However, in the long run we are all dead, as Keynes said. Also, it is possible to drown in a river which is on average 30 cm deep. Such long-term average considerations are of limited value.

The economic task is to maximize the consumption "**C**" (see more below):

$$C = Y \quad I \overset{!}{=} \max \quad \text{and}$$

$$C = Y \quad S \overset{!}{=} \max$$

On the other hand, according to **Table 1**,

$$I = \dot{K} + \delta K$$

The gross investments "**I**" are equal to the net investments "$\dot{K}$" during a time period plus the replacement of the existing capital stock "**δ K**".

Hence, the maximization task is

$$C = Y - \dot{K} - \delta K \overset{!}{=} \max$$

Note that we are searching for the optimal accumulation rate of the stock of capital assets. We get it by calculating the partial derivative for changes of "**K**":

$$\partial C/\partial K = \partial Y/\partial K - g - \delta = 0 \quad \text{or}$$

$$\partial Y/\partial K - \delta = g \quad \text{or} \quad MPK = g$$

"**MPK**" is the net marginal productivity of capital. According to Phelps, "**MPK**" is equal to the real interest rate "**r**" (MPK = r). Hence, also the accumulation rate "**g**" is equal to the real interest rate "**r**" (**r = g**). For simplification purposes, we want to set "**MPK**" in the following argumentation equal with "**MEC**" (see **section 3.2**). Hence, the production, which is optimizing the consumption level (which is the goal of production), is following the path

MEC = r = g

as a necessary condition.

So far we have been following the common growth theory. Now let us consider the modification. It is important to state that – as mentioned already in the previous section – due to an increase of capital assets the marginal efficiency of capital will fall. However, it was one of the findings of Keynes (1936) that particularly the interest rate "**r**" cannot fall below a certain minimum. This minimum is set by the liquidity premium "**λ**". According to Keynes (1936), this liquidity premium is some 2.0 – 2.5%. Hence, "MEC" and "**r**" always have to be at least as high as "**λ**" ( ). Thus the capital stock can only grow until the "point of stagnation", which is determined by

MEC = r = g = λ.

Keynes (1936) affirmed that the rate of interest on money "**r**" "sets a standard to which the marginal efficiency of a capital-asset must attain if it is newly produced." And the lower limit for the rate of interest on money "**r**" is the liquidity premium "**λ**".

Table 3 shows the change of the value of the capital stock in Germany, as an example for a mature economy, near to the point of stagnation if there are no significant changes in the labour force. It is easy to see that the growth rate of the capital stock of the German economy is indeed in the range in which

Keynes assumed the liquidity premium.

| Table 3 Change of value of capital stock, in prices of 2000 | | | | | | | | | |

Year	92	93	94	95	96	97	98	99	00
Per cent	3.1	2.9	2.7	2.6	2.4	2.3	2.3	2.3	2.3
Year	01	02	03	04	05	06	07	08	09
Per cent	2.1	1.8	1.6	1.5	1.4	1.6	1.8	2.0	1.7

Table 3 Change of value of capital stock, in prices of 2000

Source: Federal Statistical Office of Germany, 2009a, 2010

Beyond the point of stagnation, the further production of capital assets will come to a standstill due to **S > I** (cf. Keynes, 1936). Every standstill causes a crisis – capital assets are destroyed in terms of value and also physically. Considering such purification crises (see **section 3.2**), Keynes (1936) noted: "That the world after several millennia of steady individual saving, is so poor as it is in accumulated capital-assets, is to be explained, in my opinion, neither by the improvident propensities of mankind, nor even by the destruction of war, but by the high liquidity premiums formerly attaching to the ownership of land and now attaching to money." Keynes, and before him Silvio Gesell (1958), saw the problem of a positive "λ" as a major obstacle to bringing the real interest rate "**r**" down to zero. Gesell (1958) called "λ" the "basic interest" (German: "Urzins"). Also according to Gesell, the positive "λ" is responsible for the continual scarcity of capital assets and jobs. In contrast to Marx, Gesell (1958) defined "capitalism" as "an economic condition in which the demand for loan money and real capital exceeds the supply and therefore gives rise to interest."

In reality, the point of stagnation might be postponed by the means of technological progress. Technological innovations may increase the productivity of the economy and thus also increase "**MEC**". However, this happens at the expense of the environment, because the accumulation of capital may continue. The explanatory power of the model shown above is certainly limited. Nonetheless, the model modification provides a strong explanation of why we cannot achieve a zero-growth steady state. In the long run, the economy has to grow with a certain rate, even if there is no need for further growth, no population growth and even if there were no technological progress. We also get an important necessary condition for a zero-growth steady state: The interest rate "**r**" has to achieve zero.

3.4 The competing explanations for the lower limit of the rate of interest of money

In the aforementioned section the lower limit of the real interest rate "**r**" was explained with Keynes by the liquidity premium "λ".

- According to Keynes (1936) we are living in an insecure world, in which holding cash gives many benefits to the cash-holder despite the absence of yields. A holder of cash is always able to pay sudden expenditures (precautionary holdings), and furthermore may take sudden chances and speculative opportunities (speculative balances). Making long-term investments means giving up these benefits. A cash-holder only gives up this advantage if he is compensated for the lost opportunities with the liquidity premium of money.

- Gesell (1958), a theoretical predecessor of Keynes, stressed the argument that money is superior to goods, services and labour. If a cash-holder does not buy, the idle money normally does not lose value (with stable fiat money or gold currency). In contrast, if an owner of goods does not offer them, he will suffer carrying costs due to changes in fashion, storage costs, rotting, thieves etc. Because money is superior to goods, liquidity is only parted with if a mark-up (basic interest) is paid. Gesell (1958) stressed that in the long range in different economies, countries and cultures, the interest rate did not fall below a certain minimum, set by the "basic interest".

- Suhr (1989) compared money with a joker in the "economic card game", which is a more valuable card than others. This special advantage is only given up in case of compensation.

- A similar approach is to interpret money as a universal option, which provides a higher degree of freedom than any other good in order to take economic chances. This counts particularly in an insecure world. Parting with liquidity means losing the value of the option. Hence, liquidity is only parted with in case of sufficient compensation (Löhr, 2002).

These explanations are in contrast to those of neoclassical economists, who see the reason for a positive interest rate in the preference structure of humans. Basically, humans have to choose between consumption in the present (consumption) and consumption in the future (savings). Because humans have a positive time preference rate (for consumption in the present), they only save (as "waiting" for future consumption) if they are rewarded by receiving interest. Many objections have been made against this theory (e.g. Hummel, 1999). Keynes (1936) argues against this explanation: "It should be obvious that the rate of interest cannot be a return to saving or waiting as such. For if a man hoards his savings in cash, he earns no interest, though he saves just as much as before. On the contrary, the mere definition of the rate of interest tells us in so many words that the rate of interest is the reward for parting with liquidity for a specified period".

4   Goodbye, Dagobert Duck

In the section above, the liquidity premium of money was analyzed as the key for the urge to grow. Because the stock of capital assets has to grow in the long run at a certain rate ($g = MEC = r = \lambda$), a necessary condition for a zero-growth steady state ($g = 0$) is to neutralize the liquidity premium "λ". Although Keynes carried out a more comprehensive theoretical analysis on the characteristics of money, Gesell thought more radically about how to achieve this state. Gesell was not an ecologist, although the title of his most important book "The Natural Economic Order" (1958) is somewhat misleading in this regard. Gesell, and before him N.A.L.J. Johannsen (1913) and Proudhon (1970), recognized the imbalance in society due to the power of money to interrupt the economic cycle. As a consequence, Proudhon tried to "upgrade" goods and services using barter banks. Ultimately he was unsuccessful. Gesell (as well as Johannsen) preferred the opposite approach: He wanted to downgrade money to goods and services by putting "carrying costs" "δ" on money, with $\lambda = \delta$ ("free money"). By doing this, Gesell wanted to eliminate the superiority of money and make the velocity of money almost constant, also in the short run.

Today, the owner of cash is able to block the economic cycle. He disclaims for blocking if he gets interesting investment opportunities. If there are no such investment opportunities, the government has to offer attractive "fiscal interests" by taking debts. The state spends the borrowed money, hoping that the economic machine will start again. However, there is no guarantee for this – as for example Japan experienced during its major crises. According to Gesell, money is the most important vehicle in the economic cycle. Instead of giving a reward (interest) to those who do not block the economy, he wanted to make those who block the economic cycle pay (according to the costs-by-cause principle).

Particularly among German "free money" supporters there is an ongoing discussion about the technique of adding carrying costs, because not only cash but also deposits have to be considered. A reiteration of this discussion would exceed the scope of this analysis. However, the problem can basically be considered to have been resolved.

Although the current situation is different, successful experiments of "free money" in the past should also be taken into consideration. The most important experiment took place in Wörgl (Austria) near Innsbruck in 1932. Whereas in the other parts of Austria the rate of unemployment was rising, in Wörgl it was decreased from 21% to 15% by using local "free money" for 14 months. In the end the experiment was

prohibited by the Austrian central bank. However, many politicians (e.g. Daladier) and economists (e.g. Irving Fisher) were very impressed by the success of this experiment. Fisher promoted the introduction of "free money" also in the USA (Senft, 1990).

The crucial point of the success of "free money" is the pressure of the carrying costs "δ". Owners of idle money suffer a loss. Hence, even if attractive investments are no longer available, the money has to be pushed back into the economic cycle.

Usually the counter-argument is that saving is no longer possible. Basically this is not true. The carrying costs only impact on cash or liquid deposits. Long-term savings are not affected. However, the savings rate will decrease for several reasons:

- Due to the increase of the capital stock, additional income and additional savings will be created. Not only the profit rate (of real capital) but also the interest rate of money converges to zero. From this point on, the marginal savings will be discouraged by a negative interest rate.

- If the economic cycle is closed in any circumstances (natural catastrophes, war etc.), insecurity about income and jobs decreases. By taking away the economic insecurities, the need for individual provision will also decrease.

Hence, the zero-growth steady state may be achieved simply by increasing the capital stock. Like Proudhon and unlike Marx, Gesell (1958) expected the rising competition among the increased capital assets to decrease "**MEC**" and "**r**". Also Keynes (1936) supposed that the stock of capital assets could be increased to a degree "that a properly run community equipped with modern technical resources, of which the population is not increasing rapidly, ought to be able to bring down the marginal efficiency of capital in equilibrium approximately to zero within a single generation; so that we should attain the conditions of a quasi-stationary community where change and progress would result only from changes in technique, taste, population and institutions, with the products of capital selling at a price proportioned to the labour, etc., embodied in them on just the same principles as govern the prices of consumption-goods into which capital-charges enter in an insignificant degree." In the concluding notes, Keynes (1936) senses that, "though this state of affairs would be quite compatible with some measure of individualism, yet it would mean the euthanasia of the rentier, and, consequently, the euthanasia of the cumulative oppressive power of the capitalist to exploit the scarcity value of capital."

If our assumption of a savings rate of approximately zero is correct, this steady state can be demonstrated as in **Table 4**:

Table4 Zero-growth steady state – necessary conditions	Economic cycle	Division	Expenditures	Simplified	
Legend (explanations are given in the subsequent text):	Sphere of consumption	Consumption C	Consumption C	National income	Gross domestic product Y
$\dot{K}$: Increase of capital stock during a time period	Sphere of accumulation	(Net-) savings $\rightarrow 0$	(Net-) investments $\dot{K} \rightarrow 0$		
δK : Depreciation rate and restitution rate δ of the whole capital stock K					
MEC: Marginal efficiency of capital		r $\rightarrow 0$	MEC $\rightarrow 0$		
r: Real interest rate	Replacement	Capital consumption	Restitution investment δK		
λ: Liquidity premium					

In this zero-growth steady state, the whole income is consumed. There is no longer any net investment and net savings, only replacement of the capital stock consumed. The rate of consumption of the national

income is 100%. This does not mean that individuals are no longer saving. Although some (especially younger people) have positive savings rates, the savings rate as a whole can be zero if others (particularly older people) compensate for this with negative savings rates.

Basically the result shown in table 4 is not astonishing at all. The sphere of consumption and the sphere of accumulation are competing. The more accumulation, the fewer goods are left for consumption. The sphere of accumulation should be a means and consumption should be an end of economizing. Hence, optimized consumption and economic development must result in the diminishing of the accumulation sphere! The end is achieved if **r = g = 0**!

In contrast, nowadays we see a perversion: In this "Dagobert Duck economy", consumption serves as a means in order to feed the accumulation sphere, this is to satisfy the demands of capital providers for profitability as an end in itself. New needs are created by marketing efforts, new products are created, for which there is no need – in order to meet the profit interests of the shareholders and to create "shareholder value". For example, the concept of consumer sovereignty cannot explain the use of gene technology despite the fact that the majority of consumers do not support it. Aristotle called this kind of perversion "chrematistics", in contrast to "economy".

The closed economic cycle, which is achieved by the carrying costs that punish idle money, allows even a shrinking economy: If, due to changed preferences, the level of economic activity is considered too high, it can be reduced without provoking an economic crisis. Economic activity should change according to the needs of the people instead of adapting the people's behaviour according to the development of an economic system which is in fact out of control.

5 Further implications

A positive interest rate has many implications for ecology. A positive interest rate means that one dollar received or spent today has a higher value than a dollar received or spent in the future. In investment calculations this fact is considered by discounting future cash flows. Only some consequences are mentioned subsequently:

- Discounting of benefits and costs creates an incentive to bring forward benefits of economic strategies e.g. of exploiting resources, but to postpone the costs to future generations (intertemporal externalization!). Instead, a zero interest rate gives equal weight to the needs of the present and future generations. The path of resource depletion and environment pollution is more equal ("intertemporal justice", cf. Rawls, 1972).

- Also, the strategies of eco-efficiency and consistency are blocked. For example, eco-efficient investments often have higher initial investments, but also higher future returns (due to future savings, achieved by a lower energy input), than conventional investment alternatives. However, by means of discounting, the future savings of energy inputs are given a lesser weighting than the higher initial investments. Due to the positive hurdle rate, such investments are often only profitable with the backing of governmental subsidies.

- If the interest rate is higher than zero, "time is money". Slowing down, as called for by sufficiency strategy, is a waste of money. In a positive-interest economy, material flows are accelerated. With "just in time" production, for example, warehouses are transferred onto the highways (more and more heavy trucks, traffic jams) because the storage of merchandise is tying up capital and causing capital costs.

- Etc., etc.

6   Results

We have discussed the fact that it is not enough only to look for technological answers for the old and new problems of growth. Instead, cultural change (sufficiency strategy) is necessary. However, sufficiency strategies are not feasible under existing conditions. Nowadays economies need growth. By modifying the "Golden Rule of Accumulation", we have demonstrated that the rate of economic growth is determined by the liquidity premium of money in the long run. As a consequence, a necessary precondition for a zero-growth steady state is an interest rate of zero, or rather a liquidity advantage of money of zero. Gesell wanted to achieve this by putting "artificial" carrying costs on money (not on savings). These carrying costs should also keep the velocity of money circulation constant at a high level. According to Keynes, the scarcity of capital could be overcome within one generation by doing this. Without being scarce any more, the profit yields of capital assets approximate to zero (except for the risk premium, however, which would also decrease due to a constantly running business cycle). The accumulation sphere would disappear and the whole national income would be consumed. A consumption rate of 100% would be a necessary precondition for a zero-growth economy.

7   Discussion

At first glance the theory appears sound and easy to realize. However, there are many obstacles and uncertainties involved.

7.1   Structure of preferences

The hope for a zero-growth economy is also based on an optimistic view of humankind: Humankind is not greedy per se, accumulation is not an end in itself, and consumption patterns will follow the law of decreasing marginal utility. Moreover, progress of productivity would have to be transferred into leisure time and not into higher consumption. All of these conditions could be doubted. To date, no proper evidence can be provided pro or contra, since the design of the "free money society" would imply completely different cultural patterns compared with the ones we have today. However, according to the Keynes-Ramsey rule (cf. Frenkel and Hemmer, 1999), a time preference rate of zero (cf. **section 3.4**.) and an interest rate of zero would make the utility-maximizing consumption depend only on the demographic development.

7.2   Population growth

Achieving a zero-growth steady state is only possible if no autonomous increases of population take place. In an optimistic view, the population growth will decrease with the increase of wealth. Supporters of Malthus (1798) may argue against this optimistic view; they may assume that population growth is an autonomous variable. However, population growth could be politically controlled, as is the case in China.

7.3   The ubiquity of liquidity premiums

Keynes (1936) was already aware that Gesell's approach faces serious obstacles. Not only money has a liquidity premium and low carrying costs, but also other goods, due to a low elasticity of replacement and reproduction. According to Keynes, the total return of an asset ("own-rate of interest") "r" of any good is equal to its yield "**q**" minus its carrying costs "**δ**" plus its liquidity premium "**λ**" (in the subsequent argumentation we do not consider the difference of risk premiums of different assets). Keynes (1936) characterized the features of different goods as follows: "It is characteristic of instrumental capital (e.g. a machine) or of consumption capital (e.g. a house) which is in use, that its yield should normally exceed its carrying costs, whilst its liquidity-premium is probably negligible … and of money that its yield is nil, and

its carrying costs negligible, but its liquidity premium substantial … it is an essential difference between money and all (or most) other assets that in the case of money its liquidity-premium much exceeds its carrying costs, whereas in the case of other assets their carrying costs much exceed their liquidity-premium." **Table 5** shows that, in contrast to "traditional" money, "free money" neutralizes the liquidity premium by "artificial" carrying costs.

Table 5 Structure of "own-rates of interest" of traditional money and free money	Total return r (own-rate of interest) of …	=	Yield q	+	Liquidity premium λ	-	Carrying costs δ
	"Traditional" money: **2.5%**	=	0.0%	+	2.5%	-	0.0%
	"Free money" (Gesell): **0.0%**	=	0.0%	+	2.5%	-	2.5%

According to Keynes, the good with the highest difference between liquidity premium "**λ**" and carrying costs "**δ**" sets the minimum standard of "**r**" (and "**g**") for the economy. Today this is "traditional" money. In **Table 5**, this difference (**λ – δ**) is 2.5%. In contrast, "free money" has an own-rate of interest of zero. However, Keynes (1936) argued that if certain other capital assets have a liquidity premium and low carrying costs, the own-rate of interest of these and other capital assets cannot be pushed down to zero. The own-rates of interest of different capital assets are connected. If the own-rate of interest of some assets falls below the own-rate of interest of other assets, the portfolio is shifted until the own-rates of interest equalize. An important capital asset with a large difference between liquidity premium and carrying costs is land, due to a low elasticity of production and substitution.

Table 6 Structure of "own-rates of interest" of private land and free money	Total return (own-rate of interest) of …		Yield q		Liquidity premium λ		Carrying costs δ
	"Free money" (Gesell): **0.0%**	=	0.0%	+	2.5%	-	2.5%
	Bonds: **2.0%**	=	2.0%	+	0.0%	-	0.0%
	Unused land: **2.0%**	=	0.0%	+	2.0%	-	0.0%

Table 6 shows that even if the land is unused, the own-rate of interest is significantly positive. Hence, also the own rate of other capital assets such as bonds cannot be pushed below this rate – despite a "free money reform" (Keynes, 1936). Keynes (1936) stressed that not only land but a lot of other capital assets have a liquidity premium attached and low carrying costs. The special importance of "traditional" money results from the greater difference between liquidity premium and carrying costs compared with other assets. Hence, a lot of assets could transpire to be an obstacle in bringing the interest rate down. Regarding land, however, Keynes (1936) admitted that "under Gesell's system this possibility would have been eliminated by land nationalization." Indeed, Gesell wanted to abolish private property on land and replace it with possession rights (leasehold system). Modern supporters of Gesell accept a great deal of Keynes' criticisms. They call for a comprehensive reform of the economic order, which should comprise all capital assets with similar characteristics as land (e.g. non-renewable resources such as sources of water, metals, oil, but also assets that have been given a similar character by law, e.g. intellectual property rights, CO_2 certificates etc.) (Löhr, 2009). Also, (natural) monopolies should be transferred into the hands of the state.

7.4   International interdependence of interest rates

The interpretation above refers to a closed economy. Gesell himself recognized that due to the international interdependence of interest rates it would not be possible for a country to bring down the interest rate to zero in a solo attempt. On the other hand, the supporters of Gesell argue that within a free money regime the relevant variables of the money side of the quantity equation could be controlled completely by the central bank (particularly the creation of money and the velocity of money can be controlled perfectly). Hence, it was much easier to keep a currency stable than today, where important variables of money supply and money demand are out of the control of the central bank. A stable currency may produce confidence – hence the difference in interest rates between a stand-alone, free money country and the capitalist rest of the world could be considerable. All of these arguments are based on assumptions, however, and there is no possibility to provide evidence to support them.

7.5   Other manifestations of speculative balances

Actually, other forms of speculative balances may have similar effects as the traditional "hoarding" of money, which was stressed by Gesell. If, for example, the financial sector departs from the real economic sector, savings are diverted away from the productive sectors of the economy. Indeed, in a free money system, speculation in art, gold etc. would also be possible. However, one could think about some regulations, particularly preventing speculative bubbles by prohibiting loans in order to buy such kinds of goods. The Tobin tax is also a good start, but certainly not sufficient by itself to control all possible aberrations. The discussion of these problems is in its very beginnings among the supporters of Gesell's theory.

8   Conclusions

Despite the obvious problems of a rent-seeking economy, contemporary economists have widely ignored the theory discussed in this article. This is rather astonishing, because Gesell is one of the most-cited economists in Keynes' General Theory. Keynes adopted a great deal of Gesell's analysis and transferred it into a scientific language. Keynes also knew about another creator of the "free money" idea (that already described multiplier processes), N.A.L.J. Johannsen (Johannsen was cited in "A Treatise on Money"). Keynes (1936) called Gesell an "unduly neglected prophet" and supposed that "the incompleteness of his theory is doubtless the explanation of his work having suffered neglect at the hands of the academic world." However, one may argue about whether the ignorance of the mainstream is due to the patterns of scientific revolutions (Kuhn, 1962). Gesell was moving beyond the prevalent paradigm. Even the interpretation of Keynes described above can hardly be detected from academic textbooks – instead, so far the neoclassical synthesis is dominant. This has changed in recent times: First spurred by the Japanese crisis (cf. Fukao, 2005) and now triggered by the financial crises, some prominent academics such as Buiter (2003), Mankiw (2009) or van Suntum (2009, "Keynesianism 2.0") have discussed his proposals. These ideas have even been found in the American Federal Reserve Bank (cf. Goodfriend, 2000).

Recently the issue also came up in the environmental movement, closely connected with regional money as a counter-movement to globalization. However, the regional money approach is also a very controversial topic among supporters of "free money".

A zero-growth economy depends on an interest rate that is decreased significantly. Although Gesell was not concerned about ecological problems directly, his basic approach merits discussion in order to achieve the target of a zero-growth steady state. Keynes (1936) argued that "… those reformers, who look for a remedy by creating artificial carrying-costs for money (…) have been on the right track; and the practical value of their proposals deserves consideration."

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