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Would a zero growth economy be achievable and be sustainable?

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Abstract

The argument for zero economic growth comes from environmental sustainability considerations. But can zero economic growth be achieved in demand-driven economy? What are the macro conditions under which it could be achieved, and would it be sustainable? There are a range of issues which would have to be resolved if a zero growth economy is to be achieved and sustained. The first concerns the routes through which net investment would be constrained to zero. The second relates to the issue of whether the rate of profit would go to zero in a zero growth economy, and hence the question of whether zero growth is compatible with capitalism. Or whether there are routes such as continual budget deficits, reduced savings which would maintain a non-zero rate of profit, then ask whether budget deficit, reduced savings are sustainable. The third relates to the nature of the banking system (and any related monetary growth imperative) and the implications of sustained zero/negative rates of interest. An outcome of zero growth would obviously involve constant level of GDP (though not necessarily of economic and social activity). Would there be forces which generated a supply of labour larger than 'full employment', and would productivity continue to rise?

Key words: zero growth, investment, profits, employment, budget deficit

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Introduction

The main arguments for zero economic growth come from concerns over environmental sustainability and requirements to meet net zero carbon and avoidance of temperature rises above 1.5^{o}C. Environmental harm lowers growth potential and could push growth lower from a supply side perspective. However, environmental harm needs to be limited before reaching catastrophic levels for nature, society and the economy. In this paper, we offer a demand-side perspective. We focus on a zero rate of growth (of GDP) as a possible requirement to avoid a climate catastrophe, at least in respect of industrialised nations, as argued by the de-growth school. Many others argue that continuing growth of GDP with sufficient de-coupling of the environmental damage from GDP would be possible and indeed desirable (e.g. Chomsky and Pollin, 2020, Pollin, 2021).

Hickel and Kallis (2020) contrast "green growth theory [which] asserts that continued economic expansion is compatible with our planet's ecology, as technological change and substitution will allow us to absolutely decouple GDP growth from resource use and carbon emissions". But they argue that "empirical evidence on resource use and carbon emissions does not support green growth theory" with there being "no empirical evidence that absolute decoupling from resource use can be achieved on a global scale against a background of continue economic growth" and "that absolute decoupling from carbon emission is highly unlikely to be achieved at a rate rapid enough to prevent global warming over 1.5^{o}C or 2^{o,} even under optimistic policy conditions" (469)

The 'de-growth school' argue for zero (or below) growth (usually of GDP) with particular application to the industrialised world. Growth could well continue – whether in terms of economic and social activity not recorded in GDP or in terms of growth of GDP in developing and emerging economies. The analysis in this paper should be read in terms of GDP and growth of GDP in industrialised economies. The de-growth debates include consideration of major economic, social and institutional changes which would need to accompany zero growth, but this paper is focused on the zero growth dimension, though our analysis points to some changes which would need to accompany de-growth. The focus of the analysis is on a zero rate of growth, though much of the analysis would carry over (suitably modified) to the case of slower (than previous) growth where the growth rate is constrained by environmentally and other considerations. Our focus here is on the demand-side

requirements which would be consistent with a zero growth rate of GDP. Those requirements may be reached through a combination of State and private sector decisions and actions. The supply potential of the economy also has to adjust to zero growth.

The general question, which this paper seeks to address, is as whether in a demand-driven economy a zero rate of GDP growth would be achievable and sustainable. In order to achieve a zero growth outcome, the growth of demand has to be limited to zero; and for a zero growth economy to be sustainable, the forces of demand have to remain at zero.

In this paper, economic activity is measured in terms of gross domestic product (GDP) which relates largely to market activities. The measurement of GDP is approached through the three variables of output, expenditure and income, which are, of course, equal in construction and the use of GDP enables analysis of each of them. There should be no suggestion that GDP is a relevant measure of economic and social well-being, and it could well be that with suitable social arrangements positive growth of economic and social well-being would be compatible with zero growth of GDP. Economic activity obviously takes place outside of the market (e.g. within the household) as well as within the market system, but we would argue that environmental damage comes predominantly from activities which are market-orientated. By this we mean from production undertaken by firms and sold in the market, and from the consumption of goods and services produced by firms. Economic activity within the household predominantly uses a combination of labour of the members of the household and material inputs purchased from the market.

There are two reasons to justify the use of GDP as a measure of economic activity. First, there is increasing evidence that environmental problems are associated to GDP. Secondly, it means that market-based macro-economic variables can be investigated – in this paper, notably paid employment, rate of profit, the distribution of market incomes, rate of interest, tax revenue and government expenditure.

Preliminary remarks

In Fontana and Sawyer (2021) we outline a simple post Keynesian macro-economic analysis from which the implications of zero growth of GDP were derived, and some of the relevant equations of that model are given in the appendix. The model is one where economic activity is demand-driven, and investment is a major driver of demand, and the investment function is viewed in terms of expected profitability, capacity utilisation and 'animal spirits'. Zero

growth would then require that the growth of demand is also zero, and that the net capital stock is constant with implications for the rate of investment.

Some of the implications of a post Keynesian macroeconomic analysis are now discussed, illustrated by drawing on the model of Fontana and Sawyer (2021). We consider a range of issues which would have to be resolved if a zero growth economy is to be achieved and sustained. In the following sections, we discuss that in terms of net investment being close to zero with gross investment at depreciation level, rate of profit, the prospects for full employment, productivity, interest rate and the nature of the monetary system.

A zero growth economy (ZGE) would have a starting point, i.e. a level of output which thereafter remains constant, and similarly a level of paid employment which may decline in so far as labour productivity increases. Although such a level of output and the consequent zero growth may well be needed to address the climate emergency, there is the question of whether the members of the public (or significant portions of it) are content to accept that level of output and income, or whether some would seek to increase their own incomes and thereby income in total. We discuss below some of the implications of a significant minority of not accepting that level of output (and their share of it).

Another point to note is that a comparison between a growth economy and ZGE for a given stock of productive capacity and employment levels would indicate that per capita consumption would be higher under zero growth as net investment falls to zero (gross investment equal depreciation) and other costs associated with growth such as advertising, marketing and finance would be lower or non-existent. Resources which would have been deployed in advertising and the promotion of consumerism could be deployed elsewhere. Thus, a move to a ZGE which maintained the initial level of GDP would involve higher rates of consumption per capita, though there would be the social choice of a lower level of GDP along with lower paid working time.

In discussing a zero growth economy, there should be an appreciation as to whether the zero is to be taken as definitive or whether the focus is on much slower growth. Further, should a zero growth economy be viewed as a stationary state in which there was not only zero growth, but zero change and the structure of economic activity is repeated from period to period.

The specific rate of growth (of GDP) is treated as set by requirements to stay within planetary boundaries and to address the climate emergency. This rate of growth is treated as a given

for the purposes of our analysis, and we do not investigate interactions between the rate of growth of demand (which come from the post Keynesian analysis) and the rate of growth of GDP (positive or negative) which is consistent with staying within planetary boundaries.

Net investment

The rate of net (of depreciation) investment would need to be close to zero in order that zero growth of GDP is achieved and is sustainable. In so far as the capital-output is rising, then net investment would be positive but that would come with a lower rate of profit (for a given profit share). In a private economy, a lower rate of investment would be associated with lower capacity utilisation, and hence a lower rate of growth would be associated with lower capacity utilisation (and in general lower employment).

In our model, the rate of profit is an endogenous variable, though the profit share of income is generally treated as a given, and in the Kaleckian spirit the profit share would be closely linked with the mark-up of prices over direct costs (in effect here wages). The relationship between the rate of growth and rate of profit is discussed in the next section. The rate of capacity utilisation (and thereby levels of output and employment) is also endogenous, though we allow for fiscal policy to seek to secure the equivalent of full capacity utilisation.

In our specification, the investment function contains a term which we label 'animal spirits', which is intended to capture the state of expectations about the future, including prospects for growth, technological change and environmental damage. A high level of animal spirits based on high expectations of future growth stimulates investment as a component of demand and as addition to the capital stock. The achievement of specified growth rate in terms of capital stock then requires appropriate adjustments of 'animal spirits' and the state of expectations on future growth. From eqn. (A1) in the appendix for net investment, and allowing 'animal spirits' to be linear function of expected growth g^e, the following can be derived for net investment:

(1) $\frac{NI}{K} = \epsilon + \theta g^e + \alpha_1(u - u^*) + \alpha_2(\frac{mu}{v} - \delta)$

Where *NI* is net investment, *K* the capital stock, g^e expected rate of future growth, *u* capacity utilisation and *u** desired capacity utilisation, *m* profit share and *v* capital-output ratio.

Equation (A5) indicates (as would be expected) that 'animal spirits' and the rate of growth (and also capacity utilisation) would be positively related. The achievement of a specific growth rate clearly requires that 'animal spirits' and expectations on future growth prospects

are consistent with that growth rate. The expectations on future growth operating via the investment function and thereby capital formation are an important determinant of future growth, though the resulting growth may well not coincide with those expectations. Having 'animal spirits' and expectations on future growth consistent with zero growth are particularly important components for the achievement of and sustainability of zero growth. In general, there would be a lack of mechanisms which would bring about a consistency between the state of 'animal spirits' and zero growth of GDP. From a post Keynesian perspective, there will be issues of instability involved in the adjustment of growth expectations and actual growth. The 'animal spirits' could be viewed in terms of the capitalist drive for growth, and what would be the requirement to tame those 'animal spirits'.

In our analysis, the rate of profit, profitability and capacity utilisation are endogenous variables, and limitations on the rate of investment have in effect to come from 'animal spirits'. This allows us to explore the relationship between the rate of growth (at zero) and the rate of profit, and also the role of fiscal policy (budget deficit) in the achievement of full capacity utilisation (and full employment when there is the relevant scale of productive capacity).

There is the well-known two-way relationship between the rate of profit and the rate of investment – the former influences investment decisions, and (at the macro level) the latter is closely related with the former (as exemplified in the 'Cambridge equation' further discussed below). Capacity utilisation is itself demand-determined and thereby closely based on the rate of investment. In a private sector economy, the lower rate of investment in a ZGE would involve lower capacity utilisation, and a lower employment rate. Our analysis includes the government sector, and we focus on the use of the budget deficit to secure full capacity utilisation from a demand perspective, and then that full capacity along with adequate capital stock to reach full employment.

The rate of profit

The 'Cambridge equation' of the growth rate of GDP equal to propensity to save out of profits times the rate of profit is strongly suggestive of a close relationship between the rate of profit and the rate of growth, and that a zero rate of growth would be associated with a zero rate of profit[1]. In turn, this raises questions about the future of capitalism, if the rate of profit were

[1] Pasinetti (1962), Bortis (1993).

indeed zero. The Cambridge equation is derived in the context of a private closed economy with no savings out of wages and does not make explicit allowance for depreciation. In our macroeconomic analysis, there is allowance for savings out of wages and for government activity in the form of budget deficit. Under those assumptions we can further examine the relationship between the rate of growth and the rate of profit, and under what conditions a zero rate of growth does not lead to a zero rate of profit,

In the case where there is a balanced budget (or absence of government activity), then eqn. (A10) in the appendix provides the corresponding rate of profit. The net rate of profit there depends on the rate of growth, depreciation rate, capacity utilisation, and the propensities to save out of wages and out of profits. In the case of zero growth, the rate of profit may be negative. The autonomous component of savings is treated as negative (and hence having a positive effect on rate of profit) and savings out of wages would depress the rate of profit. The rate of profit would remain positive provided that the right hand side of eqn. (A10) is positive, which is the propensity to save out of wages times the difference between depreciation rate and the achieved output to capital stock ratio minus autonomous savings (which is likely to be negative). Net savings would be zero under zero growth and net investment.

This condition relating to zero net savings can be interpreted in two ways. On the one side, the capital stock is constant, and the ownership of that capital stock may change as assets are bought and sold. On the other side, the wealth of the society is also remaining constant, and the transfer of ownership may be on an inter-generational basis, and ownership of wealth is related with pension arrangements. The young and working are saving and acquiring financial (and other) assets, while the old and retired are dissaving and (directly or indirectly) selling financial assets.

Consider now the case where budget deficit is used to ensure full capacity utilisation (eqn. A9 in appendix). From eqn. (A11), under conditions of zero growth, the rate of profit would be boosted by savings out of profits times ‘animal spirits’, budget deficit, and by autonomous consumption (negative autonomous savings), and diminished by savings out of wages. There are linkages between the budget deficit and savings in the sense that the budget deficit is necessary if the savings are to be realised. The sustainability of a positive rate of profit would be based on the sustainability of budget deficit and the sustainability of (dis) savings out of

wages. Continuing budget deficits would, of course, mean a continual rise in the public debt (and in so far as there are interest payments on the debt a continual rise in interest payments). In so far as net savings would be required, then (for a closed economy) a budget deficit would be required to balance the difference between savings and investment. If net investment is zero, then net (of depreciation) savings can only be positive to the extent to which there is a budget deficit.

A continuing budget deficit would mean a continually rising stock of government debt, and rising interest payments, if a positive rate of interest is paid on the stock of debt. The budget deficit *d* is the primary budget deficit plus interest payments, and rising interest payments would then be associated with a declining primary budget deficit, and hence some combination of rising taxes and declining government expenditure (other than interest payments).

In the setting of zero net investment, net private savings comes out equal to the budget deficit. The budget deficit would lead to continually rising debt ratio (under conditions of zero growth). The continuing budget deficit is sustainable in so far as the private sector seeks to continue to save. However, when the savings behaviour of the private sector is negatively affected by the cumulated holdings of government bonds, then the net private savings may decline to zero, the budget deficit similarly declines to zero, and debt ratio stabilises (Cahen-Fourot and Lavoie, 2016). Insofar as rising household wealth diminishes the effective propensity to save out of income, then the savings rate would tend to fall, and the need for a budget deficit to sustain full employment diminish.

It would also be the case that in so far as net private savings behaviour does decline to zero, then if there is positive savings out of profits then there would need to be negative savings out of wages (including the autonomous component). There is again the question of the sustainability of that pattern of savings and dis-savings.

A requirement for long-term stability is that the financial balances of each sector have to equal zero, for otherwise the ratio of financial assets or liabilities to income for each sector would grow over time, though income itself would be constant. In the model of Hein and Jimenez (2022), the sectors of workers, rentiers, corporations, government are identified. Under the financial balance condition, the retained profits of corporate sector would be zero, with all net profits are paid as dividends to rentiers. Workers and rentiers spend their net income after tax on consumption goods, and government would have to operate with a

balanced budget (under which interest payments on government debt is equal to primary surplus). With these conditions in place, a zero growth (and hence zero net investment) economy would have positive profits and positive rate of interest. From the perspective of this paper, this provides an illustration that there are conditions under which there would be zero growth with positive profits, but leaves open whether how those conditions would be brought about – in the Hein and Jimenez (2022) approach that includes zero savings by workers and by rentiers.

Two points can be drawn out of this. First, there are conditions under which a zero rate of growth could be associated with a positive rate of profit. There can be issues of the sustainability of those conditions (e.g. continuing budget deficit in the absence of adjustment of savings behaviour). Further, there are questions of the mechanisms which would lead to sustainable conditions, and the degree to which there would need to be government interventions such as placing limits on savings.

Second, from the post-Keynesian analysis, it would appear highly likely that the rate of profit and the rate of growth are positively related (as in the 'Cambridge equation'), and hence lower growth would involve a lower rate of profit. There may be mechanisms which could be used to keep the rate of profit above zero, but it would still be the case that the rate of profit would be much lower under zero growth. A zero rate of net profit could be readily be seen to be incompatible with capitalism based on the pursuit of profits, a sharply lower rate of profit may similarly undermine the capitalist system.

Although falling outside the formal scope of our model, consideration could be given alternative ownership arrangements (e.g. social, communal, or public). These could be placed under the heading of 'not-for-profit' organisations in which the driving force would not be seeking expansion of profits, though such organisations in a market economy are generally required to 'break even'. These organisations can be viewed in terms of having a 'double bottom line' in that while revenue should exceed costs, they pursue other objectives (and some would argue for 'triple or more bottom lines' where there are a range of economic and social objectives).

In a post Keynesian framework, the profit share m and capacity utilisation are negatively related, and hence a lower profit share would entail a higher degree of capacity utilisation. There is a positive profit share which enables full capacity utilisation without budget deficit provided that depreciation minus autonomous savings times capital-output ratio, minus

propensity to save out of wages times full capacity utilisation, is positive. It remains to ask what the variable labelled *m* would cover. In the capitalist version it is a gross profit margin and as such it covers depreciation, interest payments, as well as profits. Under the not-for-profit case, it would cover depreciation and any charges which were levied as 'cost of capital' in the form of interest payments.

Banking system and monetary growth imperative

We now turn to the nature of the banking system and any related monetary growth imperative. Our analysis is grounded on the endogenous money theory (e.g. Moore, 1988, Graziani 2003). We argue that the so-called monetary growth imperative does not operate. As explained below, any drive for growth does not come from the monetary sector but would come from the real sector.

Several authors have argued that the creation of money by commercial banks as described above is incompatible with a near zero growth economy, therefore locating in the monetary system the existence of a growth imperative (e.g. Binswanger M., 2009, 2015; Binswanger H.C., 2013; Farley et al. 2013). As a result, it is argued that modern economies face an unacceptable future between ecological catastrophes or devastating defaults on bank debts. According to these scholars, the existence of a monetary growth imperative (MGI thereafter) stands at two junctures, namely in the nexus between money creation and consumption decisions of workers (households more generally) on one side, and in the interplay between money creation and profit decisions of commercial banks (financial businesses more generally), on the other hand.

Several theoretical and empirical analyses have called into questions both justifications for the ascribed MGI. Starting with the nexus between money creation and consumption decisions, the MGI is associated to the choice by agents of continuously increasing their savings. Therefore, it is the dynamic of the saving rate, rather than the creation of money by commercial banks, which should be investigated, before determining the conditions under which this dynamic is incompatible with a near zero growth economy. Cahen-Fourot and Lavoie (2016), Jackson and Victor (2015), and especially Richters and Siemoneit (2017) offer empirical insights on this issue.

As for the nexus between money creation and profit decisions of banks, the crucial condition for the MGI is the necessity for commercial banks as a whole to increase their equity capital (assets) when making loans, and hence creating deposits (liabilities), such that to have a

constant ratio between assets and liabilities (e.g. Binswanger, 2009, 713). However, in a stationary state of zero growth, loans are made and fully paid back, hence deposits destroyed, such that the assets and liabilities of commercial banks remain constant. As in the previous case, it is the dynamic of the retained earnings, i.e. equity capital, rather than the creation of money by commercial banks, which should be investigated, before determining the conditions under which this dynamic is compatible or not with a near zero growth economy.

Rates of interest

We now consider the relationship between rates of interest and the rate of growth, and specifically the implications of a zero rate of growth for rates of interest. There are of course many interest rates relating to different financial assets and liabilities, and to some degree the different interest rates are correlated (though the correlation may be rather low in some cases, e.g. between policy rate of interest set by central bank and interest rate on pay-day loans). The policy interest rate set by the central bank serves as an anchor for the spectrum of interest rates. We focus here on the rate of interest on bank loans and on bank deposits: it has to be recognized that for both loans and bank deposits there is a spectrum of interest rates, depending on factors such as perceived risks of loan default and the term period for deposits. It has generally been the case that the interest rate on bank loans is above and the rate on bank deposits below the policy interest rate.

There have been arguments advanced for a 'fair rate of interest' as the basis for the rate of return on financial assets (e.g. bank deposits, government bonds). The notion of the 'fair rate of interest' (Pasinetti, 1981), which 'in real terms should be equal to the rate of increase in the productivity of the total amount of labor that is required, directly or indirectly, to produce consumption goods and to increase productive capacity' (Lavoie and Seccareccia, 1999, 544). The 'fair rate of interest' paid on financial assets would in effect preserving the value of those financial assets relative to output per person. Applied to the context of pensions (and more generally a life cycle approach), the 'fair rate of interest' would in effect enable a person to preserve the relative value of their savings over time. Of course, in practice, consideration of administrative costs etc. could well reduce the return to pensioner. The 'fair rate' would be zero in the context of zero growth, and would be compatible with a revolving fund whereby payments into pension funds and similar are balanced by payments out in the form of pensions. This discussion suggests that where financial assets are used in the framework of

private pension arrangements, a ZGE would involve a rate of interest on deposits (and more generally on financial assets) of zero (or slightly below bearing in mind administrative costs). The interest rate on bank loans could be above zero, particularly where allowance is made for set-up and monitoring costs, and default risks. In the context of a zero growth economy (particularly if it is identified as a 'stationary state'), the requirements for loans in so far as they relate to new businesses and structural changes would be far from clear. In a stationary state, next year would look very much like this year in terms of structure of production, and there may not be the 'churn' of businesses, which is common place now. Yet, business owners retire and their place is taken by others, and the new businesses require funds. In a quasi-stationary state, the risks associated with business operations, the fluctuations in economic activity and in profitability, and the probabilities of failure and bankruptcy would be diminished. The rate of interest on loans could be lower reflecting the lower risk factors involved, but presumably would be above zero to reflect remaining risk factors, and monitoring costs and to provide profits for banks and other financial institutions.

Employment and unemployment

In a zero growth economy, there would be an initial and thereafter constant level of GDP. We can consider the level of paid employment (measured in labour hours) which corresponds to that (annual) level of GDP.

From the 'supply' side, employment *E* can be written as *h.f.F* where *h* is average hours worked per annum, *f* proportion of work force employed, and *F* is (potential) work force. From the demand side, at full capacity utilisation, employment would be given by $\frac{u^*K}{qv}$ where *q* is (hourly) labour productivity. The equality between employment hours actually supplied and demanded would give:

(2) $$hfF\ q = \frac{u^*K}{v}$$

There are the simplifying assumptions that labour productivity (per hour worked) is constant with respect to the level of output and to the hours worked, and that an hour worked is an hour worked.

There are potentially numerous combinations of *h, f* and *F* which would satisfy equation (2) (for given labour productivity), and the question arises as to what factors would influence which particular combinations actually occur. From this simple formulation, it can be asked how far individual and collective decisions on the desired values of *h*, *f* and *F* (labelled *h*, f**

and *F**) would satisfy equation 2, and then how the division between the three would be determined. How should the required labour in terms of labour hours be divided between average hours and employment ratio? The 'adjustment' of average hours of work may come through many routes including through employment legislation on length of working week, trade union bargaining, norms set by public sector employment etc. The degree of adjustments to total employment hours would obviously depend on the degree to which the move to a ZGE involved lower output (e.g. if consumption levels were maintained but investment lowered leaving GDP at a lower level) and over time the pace of any productivity gains.

The concept of full (paid) employment can be approached from a social perspective and from an individual perspective (though with much interrelationship). From an individual perspective, full employment can be envisaged in terms of individual preferences for income (from paid employment) and leisure time. The conventional labour supply function illustrates this in the sense of mapping out the hours an individual would seek to work given the prevailing real wage – which could include non-participation in the paid work force. The individual perspective is not one of 'free choice' and the preferences and opportunities being socially conditioned. The social perspective concerns issues such as who is expected to undertake paid employment (for otherwise they would starve), age of entry into and exit from work force.

Individuals may seek to work hours different from the average compatible with full employment and correspondingly a different level of income. Consider an individual who seeks a higher income through working longer hours, in effect increasing their supply of labour. In so far as the level of demand is unchanged, if that increase in supply is to come into effect, it would replace the employment of others (including self-employment).

Let us label the socially chosen employment variables as *h*, f** and *F**, and hence

(3) $h^* f^* F^* \; q = \frac{u^* K}{v}$

The question now arises as to whether each of the three values corresponds to what individuals would (on average) choose, and in so far as they do not what would be the consequences. For example, the socially constructed retirement age would set the length of working life and thereby the size of the working age population. But would individuals on average wish to retire (from paid employment) at the retirement age, and what would the

effects be if on average individuals wished to work past the retirement age. To illustrate the issues, let us focus on average (annual) hours of employment. This can be expressed as seeking to work h^ hours where h^ > h*. This could correspond to a desire for higher level of consumption than would come from Q* $= h^* f^* F^* q$ divided by the population. Higher consumption is then valued by those individuals (even if the argument that higher GDP, including consumer expenditure, does not bring higher economic and social welfare is correct, that may not be accepted by part of the population).

Our post Keynesian model is demand-driven, and in turn demand is driven by investment and accumulation. Investment expenditure has the ability to expand ahead of savings through the provision of bank loans. Consumer expenditure has in the Keynesian and post Keynesian literature been constrained by household income with the implicit assumptions that even if some households borrow, households as a whole were not net borrowers, and that households are not able to vary their income to fund higher consumer expenditure. Consumer expenditure is treated as a passive response to the level of income, for a given propensity to spend. Seeking higher consumption than hitherto can take the form of a higher propensity to consume (lower propensity to save). The drive for higher consumption level could be a relative drive coming from inequality, or an absolute one.

Some individuals seeking to work more hours could be successful provided that aggregate demand expanded accordingly, which could be the case in so far as the purpose of working more hours was to generate income and increase consumption. It would also require there being sufficient productive capacity available. The alternative route is that some working more hours than the norm in effect displace others, leaving a degree of underemployment.

Productivity

Productivity (in terms of output per person hour) may continue to rise, albeit slowly, in a zero growth environment. There would be forms of 'learning by doing', reflected in an equation which relates cumulative productivity with cumulative output. 'Learning by doing' here is interpreted broadly to include improvements in the organisation of production, development of more advanced machinery etc. But the growth of productivity through 'learning-by-doing' could be anticipated to be relatively slow without the overall stimulus of a growing economy – perhaps of the order of 0.5 per cent per annum or less. Further, a slow growth of productivity would do rather little to change the thrust of the analysis above, provided that the benefits of rising productivity is taken in the form of reduced working time.

A more significant aspect may well arise from continuing research and development, formally or informally, in a zero growth environment. Much research, of course, take place in a not-for-profit environment (e.g. public universities), and often driven by factors ranging from curiosity through to seeking ways to improve medical conditions. There have though been debates of the relative importance of 'scientific curiosity' and the profit motive (given the costs involved). Development and 'bringing a product to market' are more likely to be driven by profit considerations. The issues of the role of the public sector in the financing of research and development in light of the long lead times, externalities and uncertainties involved are well-known.

Basic research in the sciences would also continue. Although the zero growth economy would obviously have to constrain the drives to growth of GDP, the drives for 'human betterment' would likely continue. Our desires for better health, better education etc. would continue; other drives, such as space travel may also continue. In so far as R&D leads to improved processes of production and thereby higher productivity, the remarks in respect of learning by doing apply.

Research and development itself is a component of GDP. Would R&D need to be constrained in the case of a zero growth economy? It has been conventional to divide R&D into new production process and new products. In so far as there are improvements in the production process, this would be reflected in rising labour productivity and the remarks above would apply. But the development of new products may be demand stimulating, and as such would raise demand and thereby GDP. There could though be advances in knowledge, which could improve human welfare at the same time as GDP either declines or stays unchanged. Medical advances could be a major example: consider for example the development of a 'wonder drug', which greatly eases pain and is available at relatively low costs; hitherto the pain was managed at much greater costs. The lower production costs would imply lower GDP (as a measure of output).

Creative activities which produce lasting outputs (e.g. writing novels, painting pictures, recording music) would continue and lead to a rising stock of novels, paintings, recorded music etc.. To the extent to which having a wider range of novels, paintings, music available adds to people's welfare, then economic welfare could be rising even in a zero growth situation.

Concluding comments

From the theoretical perspective adopted in this paper, the rate of economic growth depends on the growth of demand (with particular emphasis on investment), and the ways in which the growth of demand interacts with the growth of supply. The drive for a zero growth economy does not arise through the growth of supply (labour, productivity etc.) being zero, rather arises from perception that zero growth is needed for environmental sustainability. A major question is then how the growth of demand could adjust to the requirement of zero growth. Environmental degradation may well itself lower the growth rate as production becomes more difficult and the 'repair' costs (for environmental damage) rise. Those 'repair' costs can often be included in the measure of GDP though are more akin to compensating for environmental damage. The main point here is that 'market forces' and government policies which are often invoked to aid the alignment of the rate of growth of demand with the rate of growth of supply are not operable in conditions of zero growth arising from environmental considerations, and alternative policies have to be sought.

Under conditions of zero growth, net investment would need to be close to zero. What we termed 'animal spirits' on future growth prospects would have to adjust accordingly, but there are no clear mechanisms through which such adjustment would arise. Moves to a zero growth economy in the face of the climate emergency would involve major restructuring of the economy include shifts from investment to consumption, as well as transitions to a low carbon economy. There have to be ways of guiding the drive for net investment to zero, and these can include credit controls and rationing, restraints on investments of firms and government. Economic policy has often been directed towards raising the rate of investment: now the direction of policy would be towards dampening 'animal spirits' and investment consistent with zero growth, that is net investment close to zero.

A zero growth economy could be akin to a stationary state economy, though it would be more likely to be an economy involving change and innovation, albeit at a slower pace than in the past century or more. Innovations, which comes in the form of rising productivity, can be accommodated in the zero growth economy through appropriate reductions in paid working time. Innovations, such as medical advances, may involve growth of economic well-being, alongside some growth of GDP.

In a post Keynesian analysis, the rate of profit and the rate of growth are related, and there is a tendency for a low to zero rate of profit under conditions of zero growth. With net investment close to zero, a budget deficit would be required to ensure full capacity utilisation,

under conditions of positive savings. Alternatively measures to limit net savings to (or close to) zero would be required. A continuous budget deficit under conditions of zero growth would lead to continuously rising public debt, which could invoke changes in saving behaviour towards zero net savings. Full employment of labour would also require sufficient productive capacity. The maintenance of working time (hours per week through to entry/exit from work force) consistent with zero growth may encounter difficulties in so far as those who wish to work longer hours may do so (e.g. through taking on two jobs, through self-employment).

References

Binswanger, H.C., (2013): *The Growth Spiral: Money, Energy, and Imagination in the Dynamics of the Market Process,* Berlin: Springer.

Binswanger, M., (2009): Is there a growth imperative in capitalist economies? A circular flow perspective, in: *Journal of Post Keynesian Economics*, 31 (4), 707-727.

Binswanger, M., (2015): The growth imperative revisited: a rejoinder to Gilányi and Johnson, in: *Journal of Post Keynesian Economics*, 37, 648-660.

Bortis, H., (1993): Notes on the Cambridge equation, in: *Journal of Post Keynesian Economics*, 16, 105-126.

Cahen-Fourot, L., Lavoie, M., (2016): Ecological monetary economics: a post-Keynesian critique, in: *Ecological Economics*, 126, 163-168.

Chomsky, N., Pollin, R. (2020): *Climate Crisis and the Global Green New Deal: The Political Economy of Saving the Planet*, London: Verso.

Farley, J.C., Burke, M., et al., (2013): Monetary and Fiscal Policies for a Finite Planet, in: *Sustainability*, 5, 2802-2826.

Fontana, G., and Sawyer, M. (2021): The macroeconomics of near zero growth of GDP, mimeo

Hein, E., and Jimenez, V. (2022): The macroeconomic implications of zero growth: a post-Keynesian approach, forthcoming

Hickel, J. and Kallis, G. (2020): Is green growth possible?, in: *New Political Economy*, 25(4), 469-86

Jackson, T., Victor, P., (2015): Does credit create a 'growth imperative'? A quasi-stationary economy with interest-bearing debt, in: *Ecological Economics*, 120, 32-48.

Lavoie, M. and Seccareccia, M. (1999): Interest rate – fair in P.A. OHara (ed.) *Encyclopedia of Political Economy*, London: Routledge, pp. 543-545.

Pasinetti, L. (1981): *Structural Change and Economic Growth*, Cambridge: Cambridge University Press.

Pasinetti, L., (1962): Rate of profit and income distribution in relation to the rate of economic growth, in: *Review of Economic Studies*, 29, 267-279.

Pollin, R., (2021): The industrial policy requirements for a global climate stabilization project, in: *International Review of Applied Economics*, 35(3-4), 389-406.

Richters, O., Siemoneit, A., (2017): Consistency and stability analysis of a monetary growth imperative, in: *Ecological Economics* 136, 114-125.

Appendix: Outline of economic model presented in Fontana and Sawyer (2021)

(A1) $\frac{NI}{K} = \alpha_0 + \alpha_1(u - u^*) + \alpha_2 rn$

where *NI* is net investment, *K* a measure of the capital stock, *u* capacity utilisation, u^* desired capacity utilisation, *rn* is net rate of profit.

The net rate of profit is $rn = \frac{mu}{v} - \delta$ where m is the gross profit share linked with the mark-up of prices over wages, and *v* the capital-output ratio, which in general is treated as exogenously determined and δ is the rate of depreciation. The parameter α_0 is treated as including effects of 'animal spirits' and expectations on future growth.

Savings are modelled as follow:

(A2) $\frac{NS}{K} = \beta_0 + \beta_1(\frac{mu}{v} - \delta) + \beta_2 \frac{(1-m)u}{v}$

where N*S* is net savings, and the second and third terms on the right-hand side of the equation reflect total savings out of net profits and total savings out of wages, respectively. The parameter β_0 reflects the autonomous, component of savings, namely the obverse of the autonomous component of consumption, and it is generally assumed to be negative.

The macroeconomic equilibrium condition that injections are equal to linkages means that gross investment plus government expenditure are equal to gross savings plus tax revenues, and hence that gross investment plus budget deficit (labelled *d*) are equal to gross savings:

(A3) $\alpha_0 + \alpha_1(u - u^*) + \alpha_2(\frac{mu}{v} - \delta) + d = \beta_0 + \beta_1(\frac{mu}{v} - \delta) + \beta_2 \frac{(1-m)u}{v}$

This can be solved to give the equation for the capacity utilisation (*u*):

(A4) $u\left[\frac{m}{v}(\beta_1 - \beta_2 - \alpha_2) + \frac{1}{v}(\beta_2) - \alpha_1\right] = \alpha_0 + d - \alpha_1 u^* - \beta_0 + (\beta_1 - \alpha_2)\delta$

As could be expected the scale of 'animal spirits' and the size of the budget deficit have positive effects on capacity utilisation.

Placing this equation for *u* into the investment equation gives the following for the rate of growth, based on growth of capital stock equals gross investment minus depreciation, relative to capital stock leads to:

(A5) $g = \frac{\left[\frac{m}{v}(\beta_1 - \beta_2) + \frac{1}{v}\beta_2\right](\alpha_0 - \alpha_1 u^*) + (d - \beta_0)(\frac{m}{v}\alpha_2 + \alpha_1) - \delta[\alpha_2\beta_2\frac{1-m)}{v} + \alpha_1(\alpha_1 - \alpha_2 - \beta_1\}]}{\frac{m}{v}(\beta_1 - \beta_2) + \frac{\beta_2}{v} - \alpha_1 - \alpha_2\frac{m}{v}}$

δ is the rate of depreciation of the capital stock, and again as would be expected 'animal spirits' and the budget deficit have positive impact on the rate of growth (provided the denominator is positive which would correspond to the 'Keynesian stability' condition.

The budget deficit which would secure full capacity utilisation, i.e. $u = u^*$ is given by

(A6) $$d^* = \beta_0 + u^* \left[(\beta_1 + (1 - \beta_2))\frac{m}{v} + \alpha_2 \frac{m}{v}\right] - \alpha_0 - (\beta_1 - \alpha_2)\delta$$

Which is the budget deficit equal to savings at full capacity minus investment at full capacity. Eqn. (A7) shows the rate of profit which secures full capacity utilisation without a budget deficit,

(A7) $$m^* \frac{u^*}{v} = \frac{\alpha_0 - \beta_0 - \beta_2 \frac{u*}{v} + (\beta_1 - \alpha_2)\,\delta}{(\beta_1 - \beta_2 - \alpha_2)}$$

The condition for zero economic growth (i.e. $g = 0$) (from eqn. A5 above) is:

(A8)

$$\left[\frac{m}{v}(\beta_1 - \beta_2) + \frac{1}{v}\beta_2\right](\alpha_0 - \alpha_1 u^*) + (d - \beta_0)\left(\frac{m}{v}\alpha_2 + \alpha_1\right)$$
$$= \delta[\alpha_2\beta_2 \frac{1 - m)}{v} + \alpha_1(\alpha_1 - \alpha_2 - \beta_1\}]$$

Eqn. (A9) shows the budget deficit d^{**} which would be consistent with zero growth and full capacity utilisation:

(A9) $$d^{**} = \beta_0 + \beta_1 \frac{mu^*}{v} + \beta_2 \frac{(1-m)u^*}{v} - \beta_1\delta$$

The relationship linking the net rate of profit and rate of growth can be obtained for a closed economy without a government (or with balanced budget):

(A10) $$rn = \frac{g + \beta_2\delta - \beta_0 - \frac{\beta_2}{v}u}{(\beta_1 - \beta_2)}$$

This corresponds to the 'Cambridge equation' with allowance for workers' savings and autonomous dissavings, depreciation. The rate of profit would be positive in a zero growth situation unless β_2 is sufficiently large, noting that β_0 is treated as being negative. It also indicates a positive relationship between rate of profit and rate of growth, suggesting that low rate of growth would be associated with low rate of profit.

Eqn. (A11) shows the rate of profit under the conditions of zero growth, with a budget deficit set to ensure full capacity utilisation:

(A11) $$rn = \frac{d{**} + \beta_2\delta - \beta_0 - \frac{\beta_2}{v}u*}{(\beta_1 - \beta_2)}$$