



Overcoming accumulation: Is a capitalist steady-state economy possible?

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ABSTRACT

This article critically reviews the case for a steady-state, zero growth economy posing the question whether such an economy can be stable and socially just, given that in the current global economy lack of growth is synonymous with crisis. The SSE thesis is analysed within a framework of Marxian political economy concluding that a stable and just SSE is possible, but not feasible within the social relations of capitalism. Using the Marxian analysis of capital accumulation, the article then considers whether the reforms proposed by ecological economists can form an effective countervailing force to the drive for accumulation. The conclusion is that such reforms can be successful, but only in so far as they are complemented and brought to their logical conclusion by a wider attempt to transcend the capitalist relations of production.

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1. Introduction

Many ecological economists argue that a sustainable relation between the human economy and its natural environment requires a transition to a 'Steady-State Economy' (SSE). Herman Daly defines this as an economy with "a constant flow of throughput at a sustainable (low) level, with population and capital stock free to adjust to whatever size can be maintained by the constant throughput" (Daly, 2008: 3). Economic development in this context is the qualitative improvement of human life and the goods we consume, rather than the expansion of GDP or the quantitative amount of goods produced. Proponents of

the SSE in the sense that Daly advocates it do not reject economic growth altogether; the problem is from this perspective that we have entered a stage of 'uneconomic growth' where the loss in natural capital (and the ecosystem services provided by them) exceeds the benefits of increased consumption (Daly and Farley, 2004: 16, 441; Daly, 2008, 2). So although not all proponents of the SSE are against growth per se, the consensus is that economies should at least be able to cope without GDP-growth.

Such arguments are rejected out of hand by mainstream economists from the neoclassical as well as the Keynesian schools of thought (Friedman, 1962; Krugman, 1999). For them, growth is an intrinsic good, the only way for societies to progress and 'develop'. Why the idea has become so entrenched is not hard to see. After all, periods without growth are precisely those when capitalist

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economies lapse into crisis, resulting in all the unemployment, bankruptcies, pressures on government finances and general social want commonly associated with recessions. To be precise, ‘recession’ and ‘depression’ are defined in economics as periods of GDP ‘degrowth’. That mainstream economists would therefore reject proposals to constrain GDP should not surprise anyone.

But the idea of the SSE is also criticised from an entirely different perspective. Marxist economists and ecologists like John Bellamy Foster, James O’Connor and Joel Kovel (Foster, 2009; Foster and Magdoff, 2010; Kovel, 2007; O’Connor, 1994) argue that capitalism cannot be made ecologically sustainable, exactly because the drive to growth is such a central feature of capitalist reproduction. Realising an economy that would not transgress planetary limits would, according to these theorists, involve more than a reform of the current system; it would require completely different, socialist relations of production.

This paper evaluates the incipient debate between proponents of the SSE and their Marxist critics about the requirements of a functioning, ecologically sustainable economy. Section 2 introduces the debate by analysing an exchange between Richard Smith, who criticises Daly’s idea of an SSE within the coordinates of capitalism, and Philip Lawn who argues that capitalism can be made to respect the limits of an SSE (Daly, 2010; Lawn, 2011; Smith, 2010). Section 3 will proceed to elaborate the main arguments in Marxian political economy in support of the case that a capitalist SSE is not possible. Section 4 will look at the possibility of tracking the effects of growth limits in Marx’s reproduction schemes. Section 5 will discuss Minqi Li’s long-term profit rate model for an economy under growth limits. Section 6 will then draw the implications for accumulation under growth limits. Section 7 will finally test the feasibility of the SSE as proposed by prominent ecological economists by evaluating whether any of the main reforms proposed by the proponents of SSE makes sense, despite Marxian critiques. This can in theory be the case if the proposed reforms can at least form an effective countervailing force to the underlying cause for the growth dynamic identified by Marxian economics as the drive to capital accumulation.

2. The Debate between Richard Smith and Philip Lawn

Any serious treatment of the question whether a capitalist SSE can work will have to identify underlying causes of the growth drive of the world economy. In this regard, a recent exchange between Richard Smith, Herman Daly and Philip Lawn has been highly illuminating. Before evaluating the debate, the definitions of the words capitalism and socialism employed in it have to be made absolutely clear.

Although they propose the same kind of steady state, Daly and Lawn do not use the term capitalism in the same sense, and both employ definitions of the words capitalism and socialism that differ from the ones Marxists would use. Lawn explicitly uses the term capitalism for his vision of the SSE, whereas Daly does not (Daly, 2010). Instead, Daly sometimes proposes a move in the direction of what he calls “socialist democracy” (Czech and Daly, 2004: 102), or alternatively argues that his SSE is different from both capitalism and socialism (Daly, 2010).

By capitalism, Daly means free market ideology and/or a neoliberal configuration of the economy (Daly, 2010). With Lawn, the term refers to an economic system in which the dominant part of production of goods and services is based on private property of capital and market exchange (Lawn, 2011: 2). Daly uses the term ‘socialist democracy’ as meaning a social–democratic configuration of capitalism, and ‘socialism’ as referring to a Soviet style centrally planned and state owned economy (Czech and Daly, 2004). Like Daly, Lawn means by ‘socialism’ a system in which the state owns most of the productive capital and organises the distribution of goods (Lawn, 2011: 2). Despite their differing usage of the term capitalism, Lawn and Daly share a general vision of an SSE based on private ownership and markets, regulated by a strong interventionist state. Such a perspective cannot really be called socialist beyond the sense of

social–democratic, as it proposes no changes to the main characteristics of the capitalist organisation of production.

In contrast, Marxist critics of the SSE use the word capitalism to mean a society in which the production of goods and services is mostly carried out by workers, wage-earners, for the profit of employers, the owners of capital. This profit is realised through the sale of goods and services in a (more or less) competitive market (Kovel, 2007: 51ff; Smith, 2010: 31). This is also the definition I will stick to in this paper. Socialism, in this vocabulary, would be a democratic, classless arrangement of production relations in the sense of a ‘free association of producers’ (Foster, 2009: 277; Kovel, 2007: 256; Marx, 1990: 171; Smith, 2010: 42). It is important to keep in mind this idea of socialism, as such a conception based on workplace democracy is fundamentally different from either a social democratic configuration of capitalism or Soviet style bureaucratic state ownership and planning.

2.1. Does ‘Profit or Die’ Mean ‘Grow or Die’?

In his article ‘Beyond growth or beyond capitalism?’ Richard Smith criticises ecological economists who propose a steady-state capitalism for assuming that economic growth is an option to be taken or rejected by policy makers. He instead affirms the view of orthodox economics that growth is an inherent necessity of any possible configuration of capitalism:

[C]apitalism cannot exist without constant revolutionising of productive forces, without constantly expanding markets, without ever-growing consumption of resources. (...) [I]t was precisely this market-propelled “motor” of economic development that for Karl Marx so sharply distinguished the capitalist mode of production from all previous historical modes of production (Smith, 2010: 29).

Smith sees the maxim of “grow or die” as one of the fundamental principles of capitalist development (Smith, 2010: 31).¹ He has three arguments in support of this claim. First of all, he argues with Adam Smith that the continuously increasing division of labour raises productivity and output, which drives producers to find new markets for new products. Secondly, he contends that competition pushes producers to conquer market share to benefit from economies of scale and be able to re-invest more in technological improvements. His final argument is that modern corporations are under sustained pressure by shareholders to grow *in order to* maximise profits. Smith corroborates this last point by reviewing the options of the auto industry to increase profits. Automakers can enhance their profit margin by *intensifying* production – by reducing the costs of inputs, wages and using productivity – enhancing technology. Such measures, he argues, have their limits, as competitors can employ the same strategies and wages cannot be reduced below subsistence. On the other hand, profits can be increased *extensively*, by increasing sales. He therefore concludes that, “*in the real world, (...) few corporations can resist the relentless pressure to ‘grow sales,’ ‘grow the company,’ ‘expand market share’ – to grow quantitatively*” (Smith, 2010: 34).

As capitalist economies are predominantly made up of firms operating in this way, the drive to growth he sees in corporations pertains just as well to the economy as a whole. He concludes that capitalism cannot do without quantitative growth. The crisis that resulted from the financial crash in 2008 is for him a window to what a really-existing capitalist SSE would look like (Smith, 2010: 34), i.e. a capitalism without growth is destructive. Consequently, Smith

¹ Philip Lawn accuses Smith of misusing the term development here. It should be clear however that Smith does not use the word to mean a “*process of ‘betterment’ or ‘qualitative improvement’ [that] occurs when economic activity increases benefits more than costs.*” (Lawn, 2011: 3) Rather, what is meant is simply the process of capitalist reproduction as it unfolds concretely through time.

criticises Daly's argument that capitalist economies can be made to develop qualitatively without having to grow quantitatively as a highly unrealistic scenario. Reducing consumption of resources means reducing consumption of goods, therefore cutting back on production and so increasing unemployment and risking recession, which is why the rat race of the consumer society needs to be kept going.

In response to Smith's criticism of the SSE, Philip Lawn offers to my knowledge one of the best answers by pro-capitalist ecological economists to their anti-capitalist critics (Lawn, 2011). To Smith's argument that "the mantra of 'grow or die' is a law of survival", he replies that the real law of survival in the competitive marketplace is 'profit or die', not 'grow or die', and that profit-making does not at all necessarily lead to growing a business (Lawn, 2011: 9).

In his rebuttal of Smith's first argument of a 'grow or die' dynamic, Lawn argues that Adam Smith in his time did not foresee diminishing returns to scale, both at the level of the individual firm and that of the economy as a whole (Lawn, 2011: 9). It is therefore not the case anymore that the only limit for the expansion of sales is the limit of markets. Lawn refutes the second argument of Richard Smith by noting that there are limits to economies of scale, and that therefore the expansion of single firms would not continue indefinitely (Lawn, 2011: 11).² Smith's final reason to assert firms follow the mantra 'grow or die' is that CEO's are under constant pressure from their shareholders to maximise profit. Here Lawn responds that, while shareholders are indeed interested in profit maximisation, this does not have to lead to growth at all:

"[T]he ways that a business manager can maintain or increase the profitability of a firm (...) can be sorted into three basic categories. They are (1) increase output and sell more; (2) produce better quality goods and sell the same quantity of output at a higher price (revenue rises and costs remain unchanged); and (3) produce the same quantity of output more efficiently" (Lawn, 2011: 10).

These options for increasing profitability correspond to Smith's reasoning that companies can increase profits intensively, by cutting labour and/or input costs (Lawn's option 3), or extensively by selling more products (option 1). Of these three, Lawn argues that only the first leads to growth. (The option to produce better quality goods is not considered by Smith.) So Lawn seems here to show possibilities for capitalists to make profits while not spurring economic growth. In any case, he argues that the possibility of increasing profits without leading to aggregate growth makes a capitalist SSE possible on a macro-economic level. To deal with the unemployment generated by the tendency of capitalists to cut back jobs and wages, he proposes a government instituted Job Guarantee (a reform proposal I will deal with in Section 7). Lawn therefore believes that a steady-state capitalism is perfectly viable as an ecologically sustainable economy. In what follows, I will evaluate whether Lawn points to a serious possibility for a capitalist steady-state that develops qualitatively but not quantitatively, i.e. profit making without (throughput) growth.

It is uncontroversial that Lawn's first course of action would lead to growth in both throughput and GDP terms. The third does not lead to growth at all. Instead, this option leads to a lowering of demand, which can lead to products being left unsold. If anything, this option leads to a reduction of GDP. This option however, does have its limits, as wages, work hours per product and input costs cannot be cut indefinitely, and because competitors will try to keep up with efficiency improvements. Lawn's second option would lead to GDP growth but not to throughput growth, as greater revenues would be achieved by using the same amount of inputs. However, in this case

² Lawn also argues in the same passage that economies of scale are efficient and desirable in a Steady State Economy as well. This argument is not included here because it does not contradict Smith's claim that the drive to achieve economies of scale gives firms an incentive to grow.

there is a build-up of the difference between the money values to be realised in the market because of higher prices for the same amount of products and the constant wages with which these products should be bought, creating a lack of demand. There are two ways out of this dilemma. Either the increase in values could be allowed to accrue to wages instead of profits, or the profits gained by selling superior goods could be used to consume goods rather than to reinvest. Neither of these options makes sense from the perspective of profit-maximising players in a competitive market. Investors are if anything interested in lowering wages, and firms need to reinvest profits to stay ahead of the competition.

So Lawn's argument that the profit motive of shareholders does not have to lead to a growing economy can be characterised as wishful thinking. Even if governments could force through regulations that would restrict firms to developing quality goods while providing the demand for higher prices in the market, they would put firms within their borders at a serious competitive disadvantage and therefore risk capital flight. The failure of the EU emissions trading scheme to contribute significantly to the reduction of CO₂ emissions is very telling in this regard (Rest, 2011: 162). If a group of strong industrial states like the EU cannot successfully carry out such a limited scheme, where is the empirical basis for the belief that only a lack of "political will" to institute an array of "Daly-like institutions" stands in the way of a transition to a SSE?

3. A Marxian Economic Analysis of Accumulation in the Steady-State Economy

The analysis advanced here draws on a definition of capital that is quite different from the one used in mainstream economics and ecological economics. Where John Stuart Mill and Herman Daly write about a constant stock of capital, for example, they mean a constant amount of 'physical wealth', including the means of production (Daly, 1972: 13f). This is a definition of capital completely different to Marx's. Capital, in the context of Marxian political economy, is defined as 'value set in motion', invested to make a profit, following the cycle of money to commodity to money plus profit (M–C–M'). As wealth thrown into circulation with the purpose of reaping as high a profit as possible, capital has to go through certain stages, and can therefore be found in different forms, whether as money, means of production, commodities, or the labour power bought from a worker. The simple formulation M–C–M' shows the stages (money, commodity, principal plus profit) that capital goes through to make a profit. For example, profits made through (unequal) exchange exploit the difference in prices of some good at two different times and/or places. Different kinds of capital achieve this profit in different ways, but they all can be reduced to the M–C–M' cycle.

This accumulation process leads to an expansion of money values, not expansion of throughput per se. It is therefore necessary to first address the question whether this difference renders moot the discussion of capital accumulation that follows. There is no denying the possibility of improving resource use efficiency under capitalism. Since the invention of the first steam engine, resource use efficiency clearly has improved continuously. At the same time, however, the increase in efficiency has historically developed at a pace slower than GDP growth, reflecting a general rise in throughput through the history of capitalism. The so-called 'Jevons Paradox' can explain this general historical tendency (Alcott et al., 2008; Foster, 2009: 124ff). Philip Lawn contends in the same article in which he responds to Richard Smith that the Jevon's Paradox does not pose an insurmountable challenge for a capitalist SSE (Lawn, 2011: 23). The reasoning behind this claim goes beyond the scope of this article. However, it can be argued that the possibility of decoupling throughput from GDP growth is limited even under the best of circumstances.

Decoupling can, on paper, overcome direct limits to growth, or at least push them further into the future. But this can only be true if the

adaptation of the overall technological mix employed in production, transport and distribution leads to improvement of resource efficiency at a rate faster than the rate of economic growth. Put more precisely, if growth is to be accomplished under conditions of absolute throughput limitations, then the rate of efficiency improvement has to be higher than the rate of GDP growth.

The improvement of use efficiency, however, also has its absolute limits, even if one assumes that there are no cost-related difficulties associated with recycling, installing less wasteful production technologies, reorganising the labour process to reduce unnecessary resource inputs and the like. The second law of thermodynamics clearly means that efficiency can never improve beyond 100%. In practice, no technology ever even comes close to that kind of percentage. In any conversion of energy from one form to another, some quantity is lost as excess heat, light, etc. But, as established above, resource use efficiency has to keep rising faster than the rate of economic growth. So, for economic growth to be possible despite absolute throughput limits, the economy would eventually have to be steered towards some kind of economic infrastructure approaching a fully operational 'cradle to cradle' closed loop system for using natural resources (Braungart and McDonough, 2002).

During the transitional period, if one wants to stay within the parameters of a capitalist mode of production, the investments required for such a transition would need to be either carried out by the state or (expected to be) profitable enough for private investors to undertake them. At the same time, the state would need to successfully avoid general economic and financial crises to create the investment climate in which such long-term and large-scale investment plans are actually taken. For this purpose, too, enough profitable investment opportunities would have to be created for capital to keep accumulating. Furthermore, one would also have to successfully limit corporations through regulation so that they refrain from profitable investments that do not fit the plan for achieving an SSE. As really existing capitalism is currently having enough trouble to find sufficient profit opportunities as it is, one can conclude that indefinite GDP growth despite absolute throughput limits is highly unrealistic.

So how, then, does the dynamic of capital accumulation lead to growth? The idea in Marxian political economy is that a portion of the surplus (that part of total revenue not paid out by capitalists in wages) must be invested in expanding production and productivity for a company not to lose out in competition. But as Herman Daly noted in 'Towards a steady-state Economy', if the surplus is not to lead to growth, "then it must be consumed[.] (...) Accumulation in excess of depreciation, and the privileges attached thereto, would not exist" (Daly, 1972: 27). Daly draws ethical conclusions from this statement, but oddly enough does not pursue the obvious economic implications – that the accumulation of capital (on a protracted basis at least) could not be possible in the SSE! But if this is so, as Minqi Li asked in his article 'Climate Change, Limits to Growth, and the Imperative for Socialism', "then what's the point of being a capitalist?" (Li, 2008: 29).

Following this perspective, the central conceptual problem with ecological economics that stops the discipline from taking a more critical position on the possibility of a steady-state capitalism, is the failure to see capital as value in motion. The use of the concept of capital as a *static stock variable*, implicit also in definitions of natural capital, obscures the ongoing process of capital accumulation. According to John Bellamy Foster, this kind of thinking is precisely why the incompatibility of capitalism and the steady state have not been properly understood:

"The principal characteristic of capitalism (...) is that it is a system of self-expanding value in which accumulation of economic surplus – rooted in exploitation and given the force of law by competition – must occur on an ever larger scale" (Foster, 2002: 36).

According to Marxists, ecological economists do not see why growth has become such an imperative and taboo for capitalists,

governments, and mainstream economists alike in the first place. The problem with having no economic growth in a capitalist society is that it leaves no other process than the 'creative destruction' of capitalist crisis to re-establish the basis for profit making. This leads to losses for the owners of firms that go bust in the process, but it also poses a threat to the capitalist class as a whole insofar as crisis leads to the rise of political movements interested in radical change.

So how do ecological limits, especially in terms of resource throughput, impact on the accumulation process? On this point, there are significantly different perspectives on how to deal with the relation between economics and ecology. The first perspective is that of the so-called 'ecological Marxists' grouped around the journal 'Capitalism, Nature, Socialism'. This school of thought within Marxism argues that the tendency of input costs to rise because of environmental constraints poses a "second contradiction of capitalism" in its own right, with the potential of rising input prices to culminate in crises of underproduction (O'Connor, 1994, 1998). Theorists like John Bellamy Foster also see the effect of ecological limits to growth on the accumulation process as a tendency for the prices of raw materials and energy sources to rise (Foster, 2009). Foster however rejects focussing on the economic effects of ecological crises as an economism that downplays the severity of the impact of capitalism on the world ecology as such, i.e. biodiversity, the integrity of ecosystems' regenerative capacities, and so on (Foster, 2009: 206ff). He also sees "little evidence that these costs constitute serious, insuperable barriers to accumulation (...) today" (Foster, 2009: 208) interesting as this debate and many others between Marxists on various questions of ecology might be, they need not concern us here. One can instead simply list the ways in which ecological and resource effects play into the accumulation process.

Increases in oil prices, for example, are widely known to lead predictably to increases in unemployment, which affects aggregate demand, and so create a dialectical interplay between what ecological Marxists call the first and the second contradictions of capitalism.³ The approach here is to trace within a general model of the accumulation process the different possible causes for disruption, and see where ecological factors play into the general accumulation cycle. A good way to schematise the accumulation process is offered by elaborating the classical M–C–M' scheme of accumulating profit to show the necessary steps for the accumulation of productive capital, where M stands for money, C stands for commodity, LP stands for labour power in the production process, and MP for means of production:

$$M^1 \rightarrow C (LP^{2.5} / MP^{3.4}) \rightarrow {}^6 M'$$

The numbers in superscript correspond to David Harvey's succinct summary of the possible ways the accumulation process can derail, leading to economic crisis: insufficient money capital (1), scarcities or political difficulties with labour supply (2), inadequate means of production (3), inappropriate technologies and organisational forms (4), resistance or inefficiencies in the labour market (5), and lack of demand backed by money to pay for products in the market (6) (Harvey, 2010: 47).

The tendency of rising input costs is the most importantly direct economic effect. Rising resource costs also have a direct effect on consumers through commodities like heating gas or oil, water, or petrol for cars. Potentially, the production of certain depleting resources will no longer be able to expand no matter what price increase can be met by demand. For instance, no matter how much the price of oil will rise, oil production will still one day reach its peak.

³ This is not meant to imply that ecological Marxists are not capable of tracing such interplays, but rather that there is no particular reason to conceptualise a new, qualitatively different contradiction separate from the one developed by Marx.

So two identified ways in which ecological limits constrain the accumulation process are as follows:

$$M \rightarrow C(LP^2/MP^{1.3}) \rightarrow {}^2 M'$$

- 1) Costs of raw materials and energy resources used in the production process. This could be seen as a special case of point (3) above.
- 2) Costs of energy resources used by consumers and households. A rise in petrol or electricity prices lowers money-backed demand for other products (6) and can cause labour and political struggles to flare up (2).
- 3) Limits to the supply of raw materials and/or energy sources. This could also be defined as a problem of inappropriate technologies, in the sense that technologies can be inappropriate by requiring insufficiently available resources (4).

Theoretically, one could go much further and start listing more indirect effects such as productivity losses and rising health costs from the spreading of malaria caused by climate change. The most important thing here, though, is the outline of a framework by which the dynamics between different effects can be traced at least qualitatively.

4. Marx's Reproduction Schemes Applied to Steady-State Capitalism

This section will demonstrate how Marx's reproduction schemes can be used to investigate the effects of limits on GDP growth. In Capital, these schematic models serve to analyse capitalist reproduction "as conditioned not just by the mutual relations of the value components of the social product but equally by their use-values, their material shape" (Marx, 1991: 470). All in all, Marx's reproduction schemes are an effort to "not (...) just map out monetary flows, but rather to establish the basic exchanges required by capitalist reproduction as a unity of production and circulation, of use value and value, and, above all, as a class process that is both material and social" (Burkett, 2004: 462). The following discussion sticks to the most rudimentary form of Marx's reproduction schemes describing 'simple reproduction' and 'reproduction on an expanding scale' as presented in Volume I of Capital. In this version, the material side of the economy is left out for reasons of methodology and simplicity. One could, however, apply growth limits on more elaborate reproduction schemes in a similar manner.

Simple reproduction is precisely the 'Stationary State' of which John Stuart Mill wrote (Mill, 2004). Marx, like Daly, points out that in these circumstances all surplus value (beyond the rate of depreciation) would have to be consumed: "If [surplus value] serves the capitalist only as a fund to provide for his consumption, and if it is consumed as periodically as it is gained, then other things being equal, simple reproduction takes place" (Marx, 1990: 712). In this situation, the class relation between capitalist and worker is reproduced in each period, and the amount of surplus value extracted from the workforce remains constant as well. This is not hard to visualise in a numerical example, where C is the total capital laid out, c represents constant capital (means of production and raw materials), v represents variable capital (wages), and s stands for surplus value created by the workers.

Reproduction Scheme 1: simple reproduction

Period 1: 100 C → 80c + 20v + 10s → 100 C' + 10s cons.
 Period 2: 100 C → 80c + 20v + 10s → 100 C' + 10s cons.
 Etc.

But, of course, this is not the way that capitalist production is normally conducted. The simple consumption of a constant amount

of surplus value appropriated on the basis of ownership of the means of production (while taking care they are maintained of course) is naturally a form of income from wealth, but it looks a lot more like the rent of a landlord than capitalist profit. After all, no part of the initial investment or surplus value created (by workers) is being used to expand the value of the initial investment.

To continue the cycle through which capital can realise more value for itself, the capitalist must re-invest part of the surplus as capital. This process of reconversion of surplus value into capital is what Marx calls capital accumulation (Marx, 1990: 725). For this process of accumulation to take place, "a part of the annual surplus labour must have been applied to the production of additional means of production and subsistence, over and above the quantity of these things required to replace the capital advanced" (Marx, 1990: 727). This requires either an increase in the productivity of labour, an increase in the workweek, or additional workers. So "surplus-value can be transformed into capital only because the surplus product, whose value it is, already comprises the material components of a new quantity of capital" (Marx, 1990: 727). In another numerical example it is easy to see the difference. Suppose that, in the example used above, 80% of the surplus value is reinvested, while proportions between c and v remain fixed. Assume also that the newly hired workers produce at the same rate of exploitation (s' = s/v, which is 50% in this example), without increases in productivity or the workweek, and 20% is consumed. In that case, the reproduction on an increasing scale would look like this:

Reproduction Scheme 2: expanded reproduction

Period 1: 100 C → 80c + 20v + 10s → 108 C' + 2 s consumed
 Period 2: 108 C → 86.4c + 21.6v + 10.8 s → 116.64 C' + 2.16 s consumed
 Etc.

Different results would of course obtain if one introduced different parameters. In the real world those parameters change all the time. But here this example suffices to show the effect of re-investment (above the rate of depreciation) in relation to simple reproduction. The concrete result of capital accumulation (assuming here that growth is possible) is thus both the realisation of capitalist profit, and economic growth. "The cycle of simple reproduction alters its form and, in the words of Sismondi, changes into a spiral" (Marx, 1990: 727).

Having reviewed Marx's stylised extrapolation of what happens without and with capital accumulation, i.e. simple reproduction and reproduction on an increasing scale, one can apply these schemes to what happens when capital accumulation is attempted under conditions of environmental constraints that do not allow growth to take place. Here the contradiction between capital accumulation and the SSE comes back into view. Let us first of all consider this situation along the lines of the investigation of simple reproduction and reproduction on an increasing scale.

Reproduction Scheme 3: accumulation with growth limit

Period 1: 100 C → 80c + 20v + 10s → 108 C' + 2 s consumed

So what would happen in period 2? Because we must assume the economy cannot grow, no investment in new machines and workers is possible, nor is an increase in productivity. Therefore the extra 8C' cannot be invested profitably, and is either consumed, devalued, or both. The only way for capital to keep accumulating at the same rate (C + s = 118.80), therefore, is to pay workers less for the same amount of output, thereby increasing the rate of exploitation (s/v) while the sum of v + s remains equal (30). And because c + v has to add up to the total investment laid out (C = 100), the composition of the capital laid out has to be as follows:

Period 2: $100 C \rightarrow 88.80c + 11.20v + 18.80 s \rightarrow 116.64 C' + 2.16 s$ cons.

In the real world, the reduction of wages could also be complemented by firing workers if productivity rises, reducing benefits, increasing efforts to avoid taxation, successful lobbying for state subsidies, etc. All these possible ways to squeeze out or obtain extra surplus value, however, are necessarily limited, and on the long run socially unsustainable. It therefore seems unavoidable for this reason to expect the rate of profit to fall under zero growth, and ultimately approximate 0.

5. Minqi Li's Long Term Profit Rate Model

Apart from reproduction schemes as applied above, there are other attempts at models capturing the contradiction between capital accumulation and growth. Economist Minqi Li came up with a simple model designed to shed light on precisely this question: “*Can a zero growth society be compatible with an economic system based on the pursuit of profit and accumulation?*” (Li, 2007: 26) This model described the long-term ($\lim_{t \rightarrow \infty}$) profit rate (R), for any given percentage of profits in total GDP (Π/Y) as dependent on the growth rate ($\Delta Y/Y$) and the share of net investment in profit ($\Delta K/\Pi$). In formula form, the model looks like this:

$$\lim_{t \rightarrow \infty} R = (\Pi/Y) * (\Delta Y/\Delta K) = (\Delta Y/Y)/(\Delta K/\Pi)$$

(Li, 2007: 28)

If Li's model is accurate, the long-term average profit rate would fall to zero if either the rate of growth were zero or if the share of net investment of profits would fall to zero. These two possibilities are precisely the two explored above in the reproduction schemes. In case of growth limits, the profit rate would eventually fall to zero. We can trace this back to the third reproduction scheme (accumulation with imposed growth limits) to see a quantitative reason why this is so; when growth is impossible, further accumulation of profits by capital can only have the effect of continuous transfers of income from wages to income from property. The other possible cause of the profit rate falling to zero would be that the net share of investment in profits would fall to zero. This is precisely the case if all surplus would be consumed (beyond replacing worn out capital goods), which is the case in simple reproduction.

These implications corroborate, from a Marxian theoretical perspective, there is a fundamental contradiction between capital accumulation and the limited nature of the planet. For Li, they also shed a new light on Marx's law of the tendency of the rate of profit to fall: “*Given positive net investment shares, a zero or negative economic growth rate implies that the profit rate would have to fall towards zero. This would confirm the 'law of the tendency for the rate of profit to fall'*” (Li, 2007: 29). The results obtained from Li's model again clearly indicate a tendency towards prolonged crises rather than a harmonious stable equilibrium in which there is room for redistribution and a focus on qualitative improvement of use values (Li, 2007:33).

6. Implications of Accumulation without Growth

The final conclusion about accumulation under zero growth can now be drawn: Accumulation without GDP growth can only be sustained through crisis, which has the effect of transferring income and wealth from (the state and) workers to capital. In other words, if profits cannot be made by growing the pie, it is to be done by cutting the rest in smaller slices. The only way out of this for those who want to continue earning income from surplus value is to somehow stop accumulation altogether and settle for a constant surplus as described by reproduction scheme one. I agree here with Li that such a solution would be quite unlikely: “*Under normal conditions, it seems always*

'rational' for individual capitalists to use a portion of their profit for the purpose of accumulation. One might say that the capitalist class as a whole faces an insoluble 'prisoners' dilemma'” (Li, 2007: 30). But even if the capitalist class resolved its prisoners' dilemma and successfully agreed to refrain from accumulation, simple reproduction should not be relied upon as an equilibrium that is in any way stable:

“However, given the unstable nature of the capitalist economy, instead of leading to a stable state with zero net investment, the fall of the profit rate could lead to a general collapse of the investors' confidence. In that case, the net investment share could become negative (...) Not only there would be no more capital accumulation, but capitalism would also fail to maintain simple reproduction” (Li, 2007: 30).

Such an argument can also be supported with concepts from neoclassical macroeconomics that are designed to capture the same observed tendency – that capital will generally be invested around the world where expected gains are highest. This is what formulae like the covered and uncovered interest rate parities are meant to express (Gärtner, 2006: 127). So to expect capital not to withdraw from an investment without any basis for gains at all would discount quite a bit of economic reality and theory. From this generally Marxian perspective, then, it seems that the only other way out of the contradiction is to intervene in the accumulation process, and change the exploitative social relations in the workplace that makes this process possible to begin with. But ecological economists have also proposed reforms to deal with the regressive tendencies of the SSE. These need to be judged on their ability to deal with the problem of accumulation as laid out above.

7. Capital Accumulation and Reform Proposals for an SSE

The Marxian analysis locates the problem of economic growth and the capitalist economy's relation to nature in a dynamic that is overlooked by most other disciplines, including ecological economics. The proposals made by ecological economists are therefore not specifically designed to deal with the dynamic of capital accumulation. But capital, even with the benefit of full capital mobility, cannot operate in a social and legal vacuum. Society is not 100% dictated by ‘the law of value’. Legislation, policy regulation as well as technological, ecological and social conditions slow down and set limits on the process. Instead of being dismissed out of hand (Foster and Magdoff, 2010: 13), the socio-economic reforms proposed by ecological economists should be re-considered with the benefit of the insights offered by Marxian analysis. A – non-exhaustive – list of social-economic reforms proposed by ecological economists would have to include:

1. Minimum and maximum income and wealth limits (Daly, 2008)
2. Progressive income taxes (Daly and Cobb, 1989; Daly, 2008)
3. Public employment programmes such as a Job Guarantee (Lawn, 2009)
4. Basic income (Daly, 1972)
5. Reducing the workweek (Daly, 1972)
6. Spreading ownership of wealth and businesses (Daly, 2008)
7. Organising Businesses as Producer Cooperatives (Booth, 1995)

How, then do these proposals impact on the accumulation dynamic? Proposals 1 to 4, and possibly 6 and 7 as well, can be summed up as measures taken by an interventionist state to redistribute the original distribution resulting from the existing configuration of the market. Rephrasing this concept in a way that links back to the Marxian analysis, this consists in the state *taking part of the surplus* produced in firms. Whether through benefits, public work schemes or a basic income plan, the effect of reforms (1), (2), (3), (4), and (6) is to take part of the surplus produced in firms and

redistribute it to the poor and the unemployed. In one respect, public work schemes are a special case as they allow for the possibility of determining politically what kind of use values should be created independently from market pressures. Even so, the distribution effect of such schemes is still precisely the same: to redistribute part of the surplus to create jobs for the unemployed.

Reducing the workweek (5) would not redistribute surplus but rather limit the amount of surplus that can be extracted from the workforce, with the objective of spreading jobs and enabling more leisure. So it is clear that these kinds of measures have the necessary effect of reducing the amount of profits investors can make and therefore endanger their bottom line. They would certainly have to if they are to keep the drive to accumulation in check. Nevertheless, history proves that there is at least limited political leeway for these reforms. In more interventionist (western) welfare states or 'developmental' states in 'developing' or 'underdeveloped' countries, such policies have been implemented, and they have certainly made a difference to income distribution and public welfare. There are however two problems with those 'statist' solutions to the problems of capitalism.

First of all, in a capitalist society the state itself is not an independent actor, but highly dependent on capital for a series of reasons. Beyond the degree to which politicians and officials have ideological dispositions favourable to the business class, or personal ties with it, there is the widespread, institutionalised lobbying that spurred political scientist Thomas Ferguson to formulate an 'investment theory of parties' for the United States (Ferguson, 1995). But there is also an even more structural way in which states are dependent on capital. Proposed reforms result in either taking an increased part of the surplus as taxes, or reducing the amount of surplus that can be produced by limiting the workweek. Ultimately, the activities and power of the state cannot be funded in another way than through taking part of the surplus. That makes the state in a capitalist society dependent on capital investment to create taxable income-creation in the first place (with the one possible exception of profits gained through public industry) (Harman, 1991). Indeed, most governments in the world have ministries of economic affairs whose principal job it is to make their country 'competitive' by creating the kind of 'investment climate' that convinces business to invest in the country. This creates an interest and a dependency that directly undermine and contradict the aim of slowing down accumulation. After all, firms strive to increase profits by increasing the surplus in relation to wages and other costs, while the reforms dealt with here would cut back the amount of surplus firms can generate and retain as profits.

The other reason why such welfare state reforms are flawed as a strategy is that, historically, other conditions (apart from growth) have to be in place for legislation so hostile to business to be implemented and defended. In most cases, advocates and beneficiaries of such reforms have to draw upon public support and be organised politically (and industrially). Even when such regulation is won, one leaves the structure of the capitalist class in place, with every incentive and all the resources to undo the regulation that restricts its expansion and reduces profit margins. Economist Rick Wolff points out that after the Great Depression in the 1930s, far-reaching reforms were introduced by the US government that were aimed at establishing both social security and full employment (through the Public Works Administration, for example, or the GI Bill). Legislation was also introduced to prevent the kind of financial speculation that led to the stock market collapse of 1929, i.e. the Glass-Steagall Act (Wolff, 2010). Roosevelt, who originally ran for president as a moderate balanced budget candidate, pushed through such radical reforms because of pressure from mostly illegally organised workers, populists, and socialists (Smith, 2006). But, as Rick Wolff argues, the internal organisation of the corporation was not changed, and therefore the capitalist class was left with the

resources and incentive to undo the legislation, which is precisely what happened. The process sped up in the 1980s during the turn to 'neoliberalism' that enabled the current crisis to develop:

"The 1970s crisis of a state capitalism allowed business to shift from evading to abolishing them. That was the content of the "Reagan revolution" begun in 1980. Together with wage stagnation and globalisation, profitability then commenced an historic upward surge." (Wolff, 2009: 7)

Many authors, like Naomi Klein and David Harvey, have documented the implementation and consequences of the Washington Consensus in other parts of the world (Harvey, 2005; Klein, 2007). Considering that we are in a new structural crisis made possible by another *laissez faire* form of capitalism, Wolff argues that it would be foolish to simply call for regulation again, expecting different results. Rather, "a new left strategy would enlarge its pursuit of classic state capitalist reforms to include transforming enterprises' internal organizations of production. The strategic goal would be for workers inside enterprises to displace their boards of directors and become their own collective boards of directors" (Wolff, 2009: 14). This brings us to the only reform proposal not yet reviewed here.

The idea of producer cooperatives is, instead of relying on the state to act as a regulating limit for capital accumulation after the fact, to change the way in which the surplus is owned and allocated by democratising the way businesses are organised. Producer coops tend to maximise income-per-worker instead of corporate profits (Booth, 1995: 227). Unlike capitalist corporations, coops can deal with a zero growth situation, as workers have no interest in firing themselves as soon as profitability slumps. But workers in producer cooperatives do produce for a competitive market and have an interest in profits. They even tend to invest more in expansion to create jobs, at least as long as there is significant unemployment (Booth, 1995: 234). This observation of a tendency to growth is also corroborated by Gorm Winther's and Richard Marens' study of cooperatives in the states of New York and Washington (Winther and Marens, 1997).

So how can the tendency towards growth in cooperatives be restricted? Booth, who is concerned with limiting economic growth, seems to argue that this tendency to re-invest the surplus in expansion can be limited by a policy of self-restraint on the part of the producer cooperative:

"By reducing the rate of forced savings through the immediate distribution of some portion of annual surplus earnings to workers, the pressure to grow could be reduced by reducing the pool of available capital" (Booth, 1995: 234).

Here Booth does not take into account the pressures of a competitive market that will force cooperatives to invest in expansion, under normal economic conditions. As long as cooperatives still have an incentive to grow, cooperatives would seem to be in the same kind of prisoner's dilemma as capitalist corporations. This problem would require, if not a complete abolition of commodity production for the market, at least some kind of effective regulation, whether provided by a state or an umbrella organisation set up by the cooperatives themselves. So replacing the structure of the corporation with the cooperative per se will not be enough to deal with limits to growth. It is unrealistic in any case to imagine such a change without similar transformations on various other levels of society. When cooperatives spread, they tend to form a conscious political movement, with much wider social, cultural and political ideas, aims and impacts (Lavaca Collective, 2007).

The recent experience of the Argentinean cooperative movement, which is by far the most promising example, illustrates that success depends on both industrial and political self-organisation but also on legislators and the judiciary (Lavaca Collective, 2007).

Expropriations were won by first defending occupied factories from the owners and police, and then by winning expropriation in court. Assuming the capitalist class will not let themselves be replaced without a political struggle, any movement that aims to promote the cooperative form of organisation in existing workplaces needs to be supported through other institutions, whether those of a state or new forms of political organisation, to survive.

8. Conclusion

In this paper I have argued that capitalism cannot be expected to lead to qualitative development within planetary limits. But does the re-evaluation of the socio-economic reforms in Section 7 lead to a conclusion that advocating welfare state reforms is useless because they fail to deal with the dynamics of capitalist reproduction, as Foster seems to argue (Foster and Magdoff, 2010)? Not exactly, at least not that way. Such reforms can be a step on the way to solving the problem, but are not capable of overcoming the basic problem permanently, which is the drive to accumulation. Neither can the single solution be proposing a cooperative form of business organisation. Instead, the strategies of redistributing surplus through reforms and changing the way it is produced and decided over should be seen as necessarily complimentary. Rick Wolff sums up this point rather well:

“As the savviest reformers and revolutionaries always understood, posing the issue as reform or revolution is a mistake. Revolution should rather be grasped as that supplement to reform which is indispensable to securing such reforms as can be won.” (Wolff, 2009: 14)

If a revolutionary social change is what is required to make a truly ecologically sustainable economy possible, the question is which actors would be capable of making this change happen. Here I am of the opinion that, environmental movements would do well to ally themselves with trade union struggles inside workplaces. This strategic orientation is central because workers, as the creators of the products and profits of corporations, are in a unique position to gain control over the qualitative decisions about what, how and for what purpose goods and services are produced. Widely dispersed homogeneous movements fighting for specific ecological issues might do very important work, but will not be able to make this kind of change happen without joining forces with a workers' movement that is once again on the rise in the context of a global economic crisis. A coalition like that could start to lead the way to a kind of socialism that is based on democracy at the workplace, the details of which are developed further by theorists like Albert (2003) and Devine (1988). In such a society, the vast majority of people around the world could participate in a collective decision making process about what kind of use values should be created according to people's needs and the limits of the planet's resources and ecosystems.

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