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Jeroen van den Bergh & Ivan Savin

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RESEARCH ARTICLE

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The role of interest in the unsustainability of growth: analytical findings using an accounting model

Jeroen van den Bergh[a,b,c] and Ivan Savin[a,d,e]

[a]Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona, Barcelona, Spain; [b]ICREA, Barcelona, Spain; [c]School of Business and Economics & Institute for Environmental Studies, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands; [d]ESCP Business School, Madrid campus, Madrid, Spain; [e]Graduate School of Economics and Management, Ural Federal University, Yekaterinburg, Russia

ABSTRACT

In the context of the long-standing debate on growth-versus-environment, notably the possibility that serious environmental policies will slow down growth, the question has been raised if interest can be compatible with zero growth. We develop a simple accounting model that describes the value added of the financial sector being positively associated with interest income. This allows us to derive formally that interest is compatible with zero growth for both simple and compound interest. The findings indicate that on its own, interest or compound interest does not add to the growth of gross domestic product (GDP). What matters instead is whether savings – be it from interest or other income – are invested productively or not. In other words, the condition for non-growth is that interest income is either directly spent by the creditor or indirectly by the debtor, rather than being invested in capital expansion, education, or innovation. Such investments would result in a more productive economy generating economic growth. These findings generalize, and add transparency to, previous studies which used more complicated models involving particular theoretical assumptions about the functioning of the macroeconomy.

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Interest; limits to growth; post-growth; steady-state economy; environment

Introduction

There is increasing concern that the pace of growth in industrialized economies is environmentally unsustainable or that serious environmental policies will slow down growth. This claim has renewed attention to the question: is lending at interest compatible with a sustainable non-growing economy? The common wisdom was that no, it is not. Drawing on Frederick Soddy's (1926) work, various authors have argued that there is a conflict between an economy with positive interest rates, where debt can grow exponentially, and a real economy that is subject to environmental and resource limits (e.g., Daly 1980; Martinez-Alier 1987; Farley et al. 2013). In the light of increasing awareness of the macroeconomic consequences of environmental and resource constraints (Victor 2010; van den Bergh and Kallis 2012; Roth 2017), a handful of recent ecological macroeconomic models have, however, found that positive interest rates can be compatible with a non-growing economy as long as there is no net saving in the economy (Berg, Hartley, and Richters 2015; Jackson and Victor 2015; Cahen-Fourot and Lavoie 2016). In this article, we develop an accounting model to analyze how interest affects economic growth. Two claims about interest are sometimes conflated in the literature (e.g., Cahen-Fourot and Lavoie 2016, 167; Berg, Hartley, and Richters 2015, 13); namely, whether it is positive *simple interest* or the *compounding of interest*, that is the lending of income from interest (or interest income), that is incompatible with a stationary economy. We will therefore devote attention to both simple and compound interest.

Let us begin by defining some terms. One textbook definition states that "[w]hen money is invested continuously, it earns compound interest, meaning that interest is earned on past interest" (Samuelson and Nordhaus 2009, 522). Another book defines compound interest as "an arrangement in which interest is paid not only on the original deposit but on all previously accumulated interest" and distinguishes it from "*simple interest*, in which interest is paid only on the original deposit" (Frank et al. 2015, 493, emphasis in original). Compounding of interest often occurs in savings accounts, where the interest income earned by the creditor in one period is lent, often to a different

CONTACT Jeroen van den Bergh jeroen.bergh@uab.es Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona, Barcelona, Spain

debtor, in the next period. Since the term "compound interest" is often associated with a single fixed loan or savings account, to avoid any misunderstandings, we use a slightly different term "compounding of interest" to denote a broader interpretation in a macroeconomic context of multiple creditors, debtors, and a (possible) combination of expanding or contracting loans.

The literature also pays attention to the stationarity of the economy. Godley and Lavoie (2007, 73) define a stationary economy as one in which "there is no change in financial stocks, that is, there is no saving." With the latter, they mean that net saving in the economy is zero, which does not prevent that some individuals can save and others can compensate this by consuming more than their income. From a post-growth perspective, the most important aspect of a stationary economy is that gross domestic product (GDP) does not increase, hence Jackson and Victor's (2015, 32) emphasis that the term "stationary state" describes an economy in which there is zero growth in the flow of GDP. However, zero GDP growth does not necessarily imply a stationary economy since other stocks and flows may be changing, so here we use the term zero growth to denote specifically an economy with no growth in GDP (that may or may not also be stationary).

Previous studies have assessed that interest-bearing debt per se is not inherently incompatible with a stationary economy. For example, Jackson and Victor (2015, 46) say that the results in their article "suggest that it is not necessary to eliminate interest-bearing debt per se if the goal is to achieve a resilient, stationary or quasi-stationary state of the economy." Similarly, Cahen-Fourot and Lavoie (2016. 163) conclude that "a positive interest rate [is] compatible with a full stationary economy." Likewise, Richters and Siemoneit's (2017, 114) abstract states that their conclusion is that "interest-bearing debt-money with private banks does not lead to an "inherent" growth imperative."

The contribution of the current article is to strip all the unique theoretical assumptions of the previous models to achieve a bare-bones accounting model that offers a transparent tool for assessing the connection between interest and growth. Since previous studies addressed the issue using rather complex models with many assumptions and numerical simulations, it has not always been clear what assumption was causing what result precisely, or how general the patterns obtained were. Instead, our accounting model is parsimonious, avoiding unnecessary behavioral, institutional, or macroeconomic assumptions. This approach allows us to obtain a more general and clearer perspective on the relationship between interest and growth, and thus verify findings of previous models.

The remainder of this article is organized as follows. The next section describes the model and performs an analysis with it. We then discuss our results in the context of the aforementioned macroeconomic models that have shown that a non-growth economy can be compatible with positive interest. The final section presents our conclusions.

A debtor-creditor accounting model

Background

We develop a simple accounting model with a debtor (borrower) and a creditor (lender) and use it to examine two scenarios, namely where the creditor spends income from interest payments by the debtor, and where she lends it. The debtor receives income from selling her productive output and any money she borrows, and her expenditures consist of her purchases, the interest she pays on previous loans, and any repayment of the loan principal. Correspondingly, the creditor receives income from interest payments and any loan repayments, and her outgoings consist of her purchases and any expansion of the loan.

An important element of our model is that income from interest is not part of GDP, but the value added of the financial sector is. Essential for our finding is that in each year value added of the financial sector is positively associated with interest. Possibly, such association may vary over time but for a healthy financial sector, it seems pertinent that the long-term association is positive. In other words, a higher interest rate leads to higher value added and little debt not being repaid. Some question whether the financial sector creates value added, but we side with those who think it does, despite problems in estimating it, as for other service sectors. According to Haldane and Madouros (2011), the productive value and contribution to the GDP of the financial sector lies in the management of risk. In particular, banks screen the productive potential of borrowers, while lenders remunerate banks in return.[1]

The model

Equation (1) describes the balance of income and expenditure of the debtor:

$$Y_{d,t} + E_t = C_{d,t} + rL_{t-1} + \gamma F_t + R_t \qquad (1)$$

where $Y_{d,t}, E_t, C_{d,t}, r, L_t, \gamma, F_t, R_t \geq 0$ denote labor income, the expansion of the loan, consumption by the debtor, the fixed interest rate on loans, the total size of the loan, fraction of cost of financial services

paid by the debtors, financial-sector value added, and (partial or whole) repayment of the loan, at time t.[2]

We define the financial-sector value added F_t as positively associated with interest payments while not larger than these (captured by β):

$$F_t = \beta r L_t (0 < \beta < 1) \tag{2}$$

The cost of these services is divided between the debtor (γF_t) and creditor ($(1-\gamma)F_t$) with $0 \leq \gamma \leq 1$. Then total income is equal to $Y_{T,t} = Y_{d,t} + F_t$. Profits in the financial sector are consumed by its owners:

$$C_{F,t} = F_t \tag{3}$$

Since only debtors engage in the production of non-financial activities, $Y_{d,t}$ can also be interpreted as the value of non-financial firms.

Next, the balance of income and expenditure for the creditor is as follows:

$$rL_{t-1} + R_t = C_{c,t} + (1-\gamma)F_t + E_t \tag{4}$$

with $C_{c,t} \geq 0$ denoting consumption by the creditor. Equation (5) describes the change in the size of the loan:

$$L_t - L_{t-1} = E_t - R_t \tag{5}$$

with $L_0 \geq 0$ being the initial loan, which has been originally saved by the creditor for the purpose of lending.

The above equations result in the following accounting matrix of the economy, underpinning its stock-flow consistency in line with Godley and Lavoie (2007):

	Debtors	Creditors	Non-financial firms	Financial firms	Total
Consumption	$-C_{d,t}$	$-C_{c,t}$	$C_{d,t} + C_{c,t} + C_{F,t}$	$-C_{F,t}$	0
Interests	$-rL_{t-1}$	rL_{t-1}			0
Bank fees	$-\gamma F_t$	$-(1-\gamma)F_t$		F_t	0
Profits and dividends	$Y_{d,t}$		$-Y_{d,t}$		0
Change in loan	$E_t - R_t$	$-(E_t - R_t)$			0
Total	0	0	0	0	0

Note that we do not need to address further issues of stationarity/stability as our model does not include capital accumulation, labor-productivity improvements (through education or learning), technological innovation, or other factors that might cause growth. The reason is that it is just an accounting model.

Scenario 1 – simple interest due to consuming income from interest

Here we consider the case that the creditor consumes income from interest net of financial service cost, that is, does not lend it out to the debtor. According to Equation (4) this means that $rL_{t-1} - (1-\gamma)F_t = C_{c,t}$, which combined with Equation (2) indicates that the net expansion of the loan is zero, or $E_t - R_t = 0$. According to Equation (5) then $L_t = L_{t-1} = L_0$, with L_0 the initial loan. In other words, the loan is constant over time, and simple interest applies. From Equation (2) we then obtain that $F_t = \beta r L_0$ is constant. We abstain from growth factors like education and technical innovation, which means the debtor's labor income is stationary or that $Y_{d,t} = Y_d$ for all t. Then Equations (1), (4), and (5) can be respectively written as:

$$Y_d = C_{d,t} + rL_0 + \gamma F_t \tag{6}$$

$$rL_0 = C_{c,t} + (1-\gamma)F_t \tag{7}$$

$$L_t - L_{t-1} = 0 \tag{8}$$

From these equations we can derive GDP ($Y_{T,t}$) according to the expenditure approach as the sum of the three types of consumption (since there are no investments, government expenditures, imports, and exports):

$$Y_{T,t} = C_{c,t} + C_{d,t} + C_{F,t} = Y_d - (\gamma + (1-\gamma))F_t + F_t = Y_d \tag{9}$$

Hence, we find that if the creditor consumes and thus does not lend her income from interest, then only simple interest arises in the model. The net expansion of the loan is zero, and simple interest applies to the existing loan. The same amount of interest is paid each period. Total consumption in the economy then equals labor income which is constant over time. In other words, lending/borrowing, even via a financial sector that charges for services, only leads to a reshuffling and not an increase of money. Hence, simple interest does not translate into, or require, a rising total income (or GDP). In other words, a non-growing economy can be consistent with interest per se.

Scenario 2 – compound interest due to lending of income from interest

Now we alter Equation (4) to reflect the case where the creditor does not spend the interest income on

consumption but lends it out at interest. It means $C_{c,t}=0$, $E_t>0$ and $R_t=0$.[3] This translates into a continuous expansion of the loan to the debtor. Equations (1), (4), and (5) then become:

$$Y_{d,t}+E_t=C_{d,t}+rL_{t-1}+\gamma F_t \tag{10}$$

$$rL_{t-1}=\left(1-\gamma\right)F_t+E_t \tag{11}$$

$$L_t-L_{t-1}=E_t \tag{12}$$

Combining Equations (10) and (11) gives:

$$Y_d=C_{d,t}+(\gamma+\left(1-\gamma\right))F_t=C_{d,t}+F_t \tag{13}$$

Using this result, we can derive GDP as:

$$Y_{T,t}=C_{c,t}+C_{d,t}+C_{F,t}=0+\left(Y_d-F_t\right)+F_t=Y_d \tag{14}$$

Hence, GDP is also constant in the case of compound interest. In other words, a non-growing economy can be consistent with compound interest.

Next, combining Equations (2), (11), and (12) gives a solution for L_t:

$$L_t=\frac{1+r}{1+\left(1-\gamma\right)\beta r}L_{t-1}=\left(\frac{1+r}{1+\left(1-\gamma\right)\beta r}\right)^t L_0 \tag{15}$$

This equation shows that the size of the loan is ever increasing at an exponential rate which takes the form of compounding by a factor that increases in the interest rate and decreases in the cost of financial services. Note, though, that this increase approaches zero if $(1-\gamma)\beta$ is close to one (but it always remains slightly smaller than one as $1-\gamma\leq 1 \text{and}\, \beta<1$). From the debtor's point of view the compounding occurs because they pay interest on borrowed interest income from the previous period, which is added to the principal loan in each period. From the creditor's point of view the compounding results because they are paid interest on their lent interest income from the previous period.

The size of the loan is ultimately limited by the money supply in the economy. But if Equation (9) is to hold true, this supply must adapt and increase – which has been called a "monetary growth imperative" (Strunz, Bartkowski, and Schindler 2017). There are different views on this point. One perspective is that debt growth is limited by behavioral factors (which are not part of the accounting model). In other words, an extension of the loan may be stopped once consumption reaches the subsistence level, because of individuals' own choice or because banks evaluate the respective debtors as incapable of paying higher interest. Another view stresses other behavioral aspects, namely that debtor and creditor are myopic, resulting in an increase of the debt until interest payments become unaffordable for the debtor (in which case they will ultimately die and stop borrowing). More factors and viewpoints are discussed in Strunz, Bartkowski, and Schindler (2017) who conclude that the literature (both within mainstream and heterodox schools) is divided about whether such an imperative exists. Anyway, if the monetary supply were to increase, without an equivalent increase in production and consumption (economic growth), this would translate into increasing prices or inflation, and hence a rise in nominal but not real GDP. Since we do not model prices, this falls outside the scope of our analysis.

Comparison with previous ecological macroeconomic models

Here we relate our findings to previous results from the ecological macroeconomic models mentioned in the first section. Richters and Siemoneit (2017) have presented a detailed review and stability analysis of these models; they also examine two models by Godley and Lavoie (2007), which although not constructed for the purpose of examining interest income still yield relevant insights. They all follow Godley and Lavoie's (2007, 73) definition of a stationary economy as one in which there is no saving because this would imply a change in stocks. To achieve a stationary state, consumption must therefore equal disposable income (Jackson and Victor 2015, 39; Berg, Hartley, and Richters 2015, 13; Cahen-Fourot and Lavoie 2016, 165). By considering the case that not all interest income is consumed, we instead can examine in a transparent way what happens if the creditor does not spend (all) the interest income on consumption but lends it out at interest. We find that this is compatible with a non-growing economy.

In other words, interest per se is theoretically compatible with a non-growing economy, contrary to some earlier arguments (e.g., Douthwaite 2000). Our model outlined above confirms this more generally and analytically by minimizing the number of theoretical assumptions. We have shown that both simple and compounding interest – regardless of whether creditors spend or lend out interest income – are compatible with zero growth. Moreover, this is under the condition that value added of the financial sector is proportional to interest payments.

In the three recent ecological macroeconomic models (Jackson and Victor 2015; Berg, Hartley, and Richters 2015; Cahen-Fourot and Lavoie 2016), the basic mechanism for avoiding compounding is the same as in our simple model: creditor consumption. In other respects, these models are much more complex, including a government sector that taxes and spends, and a differentiation between households and firms. These models show that if one subset of households is saving, with output at a stationary level, the other sectors are facing a steadily rising debt. Hence, they have as a condition for zero growth that there is no saving. Our model is consistent with this, but shows that also if there is savings, in terms of lending out of interest income, zero growth is feasible.

To clarify key differences further, Table 1 compares the types of agents between our approach and previous models. In Jackson and Victor's (2015) model, the government pays interest to the central bank which returns all profits to the government, so such loans are effectively interest free. Firms pay all post-depreciation income to households. They write that "We assume a funding model for firms in which firms' cash flow or retained earnings is equal to the depreciation, so that profits, distributed as dividends, are equal to profits net of depreciation," explaining in a footnote that relaxing this assumption "would immediately lead to positive net investment and accumulation of the capital stock" providing growth (Jackson and Victor 2015, 37, mathematical notation removed). Banks also pay out all income from interest to households. Those households consume all of their post-tax income, with government taxation set to ensure that consumption is equal to disposable income. Hence, firms do not retain profits, and banks do not retain interest income – both pay them out to households. In turn, households are prevented from earning interest upon their interest income by ensuring that household consumption equals their disposable income. Jackson and Victor (2015, 29) further explain that "For a stationary state solution, as Godley and Lavoie (2007, 73) point out, the net lending of the household sector NL_0^h must also be equal to zero." So, to reach a stationary state where no sectors have increasing stocks, households must not be saving; and without saving there can be no lending of interest income. Though the results of their simulations are robust to various shocks and variations, and even to the transition from a growing to a stationary state, compounding of interest is impossible in that stationary state.

Table 1. Our model compared with previous models.

Model	Sectors	Who receives interest	Who pays interest
Ours	Creditors	Creditors	
	Debtors		Debtors
Binswanger (2009)	Firms		Firms
	Households		
	Banks	Banks	
Jackson and Victor (2015)	Households	Households	Households
	Firms	Firms	Firms
	Banks	Banks	Banks
	Central bank	Central bank	
	Government		Government
Berg, Hartley, and Richters (2015)	Households	Households	Households
	Industry	Industry	
	Government (+ banking)	Government (+ banking)	Government (+ banking)
Cahen-Fourot and Lavoie (2016)	Households	Households	
	Firms		Firms
	Banks	Banks	
	Government		Government

Berg, Hartley, and Richters (2015) aggregate the banking sector, the central bank, and the government sector; firms in the industry sector pay interest on loans to the government, which pays interest to households. Firms distribute all profits to households. Unlike Jackson and Victor, Berg et al. assume no immediate consumption out of interest and profit income at all, but instead that all household consumption is out of wealth and wages. Examining their model to establish the parameter space within which a stock-flow equilibrium is reached, the authors conclude that "[t]hough our model shows that positive interest rates do not necessarily imply exponential growth of government liabilities, this result crucially depends on consumption decisions by households" (Berg, Hartley, and Richters 2015, 13). Specifically, in order to remain in a stationary state, taxes and consumption must be sufficiently high to avoid household deposits increasing exponentially as the "[f]lows of interest payments from the government accumulate" (Berg, Hartley, and Richters 2015, 13). As in Jackson and Victor (2015), when the model is in a stock-flow equilibrium, the total income of households equals taxes and consumption, so no interest income is ever lent at interest. This level of consumption prevents the problem of compounding of interest occurring in their model.

Cahen-Fourot and Lavoie (2016) present a simpler static model and find, as they state in their abstract, that "a positive interest rate [is] compatible with a full stationary economy" (163). As in Jackson and Victor (2015) and Berg, Hartley, and Richters (2015), banks and firms do not retain their income but pay all income out as dividends to individuals, who do not lend but consume this income.

Conclusion

In this article, we have aimed to clarify the debate on the compatibility of interest with a sustainable

non-growing economy. We developed a simple accounting model to show that both interest per se and compounding of interest, due to lending income from interest against interest, are compatible with zero growth. In other words, even if (at least some) creditors lend a part of their interest, or even if banks receive a fee for connecting debtors and creditors, this does not itself translate into aggregate income growth in the economy. We formally showed these results using a simple and transparent accounting framework. Our main insight is that even if interest income is not directly spent by the creditor but lent out, the result is a stationary economy. The reason is that interest income is then spent by the debtor. In other words, the key condition for our finding is that interest income must ultimately be spent – rather than being invested to create a more productive economy that translates into economic (GDP) growth.

An explanation for this finding, that interest and zero growth are compatible, is that (compound) interest payments and income themselves are not productive in terms of creating value-added and thus contributing to GDP. Only when interest income is invested productively (e.g., in capital, education, or innovation) can it add to GDP growth. Our model findings show that on its own, interest or compound interest does not add to GDP growth. To see it differently, the fundamental reason for GDP growth can be regarded as increases in labor productivity. This can only come about through the mentioned investments in capital (machines), education (human capital), and innovation (indirectly affecting the productivity of machines and education). This issue goes beyond our basic model but could be further investigated developing a model with investment in productive capital along the lines of Binswanger (2009).

As previous macroeconomic models addressing this matter (sometimes as a side-issue) are rather complex, it is not always clear which of their assumptions was exactly causing what outcome. Instead, our model is limited to accounting relationships, avoiding unnecessary behavioral, institutional, or macroeconomic assumptions. This approach results in a clear and fundamental perspective on the link between interest, income, and growth. In addition, previous studies often use numerical simulation with some arbitrary or incomplete ranges of parameter values, which may suggest patterns but does not prove anything formally – as opposed to analytical solutions such as derived here. Economics is accounting plus (debatable) assumptions. By avoiding these assumptions, we have hopefully added a little clarity to the debate on interest versus growth.

Notes

1. Wang (2011) discusses the problems associated with empirically estimating the exact value added of the financial sector and argues that current figures may overestimate it. These estimates have grown since World War II from 2 to 8% for the United States, and since 1970 from 5 to 9% for the UK (den Haan 2011).
2. Note that the cost for mediating services by banks is additional to the interest payment – the latter goes to the creditor. In other words, F is not paid out of interest payment but is correlated with it. Alternatively, one could subtract the mediation cost from the interest payment so that the creditor gets less. But this would not change the essence of the model.
3. Repayment is zero as it does not make sense to expand the loan on one hand ($E_t > 0$) and repay it on the other hand ($R_t > 0$). In other words, if $E_t > 0$ this implies logically $R_t = 0$. And reverse, if $R_t > 0$ then $E_t = 0$ holds. Of course, one could argue that each expansion creates a separate deposit that is also separately paid back, but this does not undo the general approach outlined here. One might also consider E_t as the net expansion and R_t as the net repayment.

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ORCID

Jeroen van den Bergh http://orcid.org/0000-0003-3415-3083
Ivan Savin http://orcid.org/0000-0002-9469-0510

References

Berg, M., B. Hartley, and O. Richters. 2015. "A Stock-Flow Consistent Input-Output Model with Applications to Energy Price Shocks, Interest Rates, and Heat Emissions." *New Journal of Physics* 17 (1): 1. doi:10.1088/1367-2630/17/1/015011.

Binswanger, M. 2009. "Is There a Growth Imperative in Capitalist Economies? A Circular Flow Perspective." *Journal of Post Keynesian Economics* 31 (4): 707–7. doi:10.2753/PKE0160-3477310410.

Cahen-Fourot, L., and M. Lavoie. 2016. "Ecological Monetary Economics: A Post-Keynesian Critique." *Ecological Economics* 126: 163–168. doi:10.1016/j.ecolecon.2016.03.007.

Daly, H. 1980. "The Economic Thought of Frederick Soddy." *History of Political Economy* 12 (4): 469–488. doi:10.1215/00182702-12-4-469.

den Haan, W. 2011. "Why Do We Need a Financial Sector?" *VoxEU*, 24 October. https://voxeu.org/article/why-do-we-need-financial-sector

Douthwaite, R. 2000. *The Ecology of Money*. Cambridge: Green Books.

Farley, J., M. Burke, G. Flomenhoft, B. Kelly, D. Murray, S. Posner, M. Putnam, A. Scanlan, and A. Witham. 2013. "Monetary and Fiscal Policies for a Finite Planet." *Sustainability* 5 (6): 2802–2826. doi:10.3390/su5062802.

Frank, R., B. Bernanke, K. Antonovics, and O. Heffetz. 2015. *Principles of Economics*, 6th ed. New York: McGraw-Hill.

Godley, W., and M. Lavoie. 2007. *Monetary Economics: An Integrated Approach to Credit, Money, Income, Production and Wealth*. London: Palgrave Macmillan.

Haldane, A., and V. Madouros. 2011. "What is the Contribution of the Financial Sector?" *VoxEU*, https://voxeu.org/article/what-contribution-financial-sector

Jackson, T., and P. Victor. 2015. "Does Credit Create a 'Growth Imperative'? A Quasi-Stationary Economy with Interest-Bearing Debt." *Ecological Economics* 120: 32–48. doi:10.1016/j.ecolecon.2015.09.009.

Martinez-Alier, J. 1987. *Ecological Economics: Energy, Environment, and Society*. Oxford: Blackwell.

Richters, O., and A. Siemoneit. 2017. "Consistency and Stability Analysis of Models of a Monetary Growth Imperative." *Ecological Economics* 136: 114–125. doi:10.1016/j.ecolecon.2017.01.017.

Roth, S. 2017. "Marginal Economy: Growth Strategies for Post-Growth Societies." *Journal of Economic Issues* 51 (4): 1033–1046. doi:10.1080/00213624.2017.1391588.

Samuelson, P., and W. Nordhaus. 2009. *Economics*, 19th ed. New York: McGraw-Hill.

Soddy, F. 1926. *Wealth, Virtual Wealth, and Debt: The Solution to the Economic Paradox*. New York: Allen and Unwin.

Strunz, S., B. Bartkowski, and H. Schindler. 2017. "Is There a Monetary Growth Imperative?" In *Handbook on Growth and Sustainability*, edited by P. Victor and B. Dolter, 326–355. Cheltenham: Edward Elgar.

van den Bergh, J., and G. Kallis. 2012. "Growth, A-Growth or Degrowth to Stay within Planetary Boundaries?" *Journal of Economic Issues* 46 (4): 909–920. doi:10.2753/JEI0021-3624460404.

Victor, P. 2010. "Questioning Economic Growth." *Nature* 468 (7322): 370–371. doi:10.1038/468370a.

Wang, C. 2011. "What is the Value Added of Banks?" *VoxEU*, 8 December. https://voxeu.org/article/what-value-added-banks