

## **E.1. STEADY-STATE POLITICAL ECONOMY**

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## E.1. STEADY-STATE POLITICAL ECONOMY<sup>1</sup>

### I. INTRODUCTION

Our scenarios of Balanced Equitable World and Green Sustainability World both conclude with the establishment of a **steady-state economy**. What does “steady-state” actually mean, and how might a steady-state economy actually work in practice?

Discussion concerning the nature of a steady-state economy is closely related to but importantly separable from discussion of limits to economic growth and more generally of the nature of a Green economy. A steady-state economy may be desirable even in the absence of limits to growth, and it’s possible to imagine, say, a futurist anti-Green, authoritarian regime commanding a perfectly well-functioning steady-state economy. In this Attachment I focus on the nature of steady-state economics independent of any necessary relation to biogeophysical limits to growth or to Green economics.

### A. STEADY-STATE ECONOMICS: SOME BASICS

#### A.1. Key Definitions

1. Throughput - The flow of material and energy resources used to generate output.

2. Output - Throughput manipulated by humans to enhance well-being. Equivalently, all final goods and services produced by an economy.

3. Well-being - The broadest and most general sense of human satisfaction, contentment and happiness. Equivalently or alternatively, human flourishing or *eudaimonia*.<sup>2</sup>

#### A.2. What Stays Steady?

We can distinguish three sorts of steady-state economy, based on *what it is* that stays steady:

1. Steady Throughput: *Throughput* is produced and used at constant flat rates intended to be indefinitely sustainable. However, technological innovation can allow *output* to grow.<sup>3</sup>

2. Steady Throughput and Output: *Throughput and output* are produced at constant flat rates intended to be indefinitely sustainable. However, social and cultural innovation can allow *well-being* to grow.

3. Steady Throughput, Output and Well-Being: *Throughput, output and a satisfactory level of well-being* are produced at constant flat rates intended to be indefinitely sustainable.

These correspond, respectively, to the **Techno-Green**, **Subjective Green** and **Green Minimal Case** growth scenarios described and discussed further in **Attachment A**. [NB: Much of Attachment A is germane to the topic of steady-state economics. The final working paper may incorporate material from that Attachment into this one.]

*Throughput* is measured in units of mass (e.g. kilograms) and energy (e.g. joules) per unit of time (e.g. years). *Output* is measured in units of economic activity or, arguably, value (e.g. dollars). *Well-Being* is impossible to measure, except imperfectly via postulated indicators or self-reports.<sup>4</sup>

*Throughput* is important because it makes *output* and thus *well-being* possible. *Output* is important because it makes *well-being* possible and is the link between *throughput* and *well-being*. *Well-being* is important because it’s what we’re presumably aspiring to in the first place.<sup>5</sup>

One reason that *output* has come to assume the central role it has in human affairs is that it can be represented by a single, simple, unitary measure. The myriad sorts of *throughput* are incommensurable and *well-being* is effectively unmeasurable.

Each sort of steady-state economy comes with merits and challenges, as noted in **BOX E-1**.

The plausibility and desirability of different aspects of the three sorts of steady-state economy calls for careful review and discussion, but for now we focus on a narrower set of selected topics. Section B touches on relevant highlights of the history of steady-state economics. Section C briefly considers policy measures commonly proposed to generate, sustain or accompany a steady-state economy. After these preliminaries, Part II reviews macroeconomic thought and theory regarding steady-state economics, Part III highlights four important outstanding questions, and Part IV concludes.

Commentaries on the nature of a steady-state economy are not always clear as to whether they are addressing economies of steady-state *throughput only* or economies of steady-state *throughput and output*.<sup>6</sup> In most contexts the distinction is important, and ambiguity should be avoided.<sup>7</sup>

## **B. BRIEF HISTORY**

Noted liberal economists **John Stuart Mill (1848)** and **John Maynard Keynes (1930)** wrote of their expectations that perhaps within a century or two science, technology and free markets would allow “the economic problem” to have been solved, with a steady-state economy as the likely result. This would come about not as a response to resource shortages or ecological limits, but to the satiation of human desire for goods and services. The prospect of a steady-state economy was implied in much of the environmentalist writing that began after World War II and explicitly in **The Limits to Growth (1972)**. Among the first to apply modern economic thinking to the question of how a steady-state economy might work in practice was **Herman Daly (1977)**. Throughout the 1980s the topic received only passing attention outside of deep ecology networks, and economic aspects of environmental problems were mostly addressed using conventional neoclassical and Keynesian economic theory. In 1989 the **International Association of Ecological Economists (IAEE)** was founded to bring a number of alternative economic approaches, tools and perspectives, notably including Daly’s steady-state perspective, to bear on environmental topics. Interest in questions involving economic growth and the environment grew in the late 1990s and 2000s with mounting concern over **climate change**, suggestions that we might be entering a period of **secular stagnation**, the rise of the European **DeGrowth movement (~ mid-2000s)**, the onset of the **Great Recession (2008-2009)**, growing concern over **economic inequality** marked by **Occupy Wall St. (2011)** and the reception accorded the work of **Thomas Piketty (2014)** and others. Economists **Peter Victor (2008)** and **Tim Jackson (2009)** were among the first to apply macroeconomic modeling to the topic of steady-state economics. The **Center for the Advancement of the Steady State Economy (CASSE)** was founded in 2007, and the first academic conference focused explicitly on steady-state economics was held in 2010 at Leeds University, UK. In 2012 the IAEE journal **Ecological Economics** published a special issue devoted to DeGrowth that included discussion of steady-state economics. In 2016 the journal published a special issue devoted to ecological macroeconomics with a strong emphasis on steady-state topics.<sup>8</sup>

## **C. POLICY ELEMENTS**

**Daly (1977)** was among the first to propose a necessary and sufficient set of policy elements intended to guide the creation of a steady-state economy. These are:

1. Harvest rates of renewable resources should not exceed regeneration rates.
2. The rate of emission of wastes from use of renewable resources should not exceed the natural assimilative capacities of the ecosystems into which the wastes are emitted.

## **BOX E-1. THREE SORTS OF STEADY-STATE ECONOMIES**

### **1. Steady Throughput**

- Ensures an indefinitely sustainable level of material and energy resources, including waste sink resources.
- Allows continued growth of economic output via technological innovation: productivity gains via process innovation and quality gains via product innovation.
- Is compatible with both free-market and statist political economies. In either case, strong national and international public sector institutions would be needed to ensure compliance regarding rates of throughput.
- As technology-generated process and product innovations continue, an increasingly greater part of the natural world will necessarily become artifactualized.

### **2. Steady Throughput and Output**

- Ensures both sustainable resource use and a sustainable, non-increasing, level of economic goods and services, measured as GDP or some other measure of aggregate economic activity.
- Reduces the *necessity* of continuous technological innovation, other than any that is necessary to offset capital depreciation and resource depletion. However, the innovation process itself, including institutions of savings, investment, finance, training, industrial policy, technology assessment, patenting and licensing and more, would need to be subject to greater public sector oversight and control.
- Effectively mandates public sector responsibility not only for the particular level of sustainable output but for the distribution of that constant level of output among households.
- Is unlikely to be compatible with free-market economic institutions, except perhaps at the most local levels.
- Note that the depiction of *growth* in this economy, as being generated by “social and cultural innovation,” and measured mostly in notional units of *well-being* rather than dollars, is not what most people today would understand as *growth*. Typically, they understand this sort of well-being improvement as a complement to, rather than as an equivalent of or substitute for, conventional economic growth. This isn’t to say that a new understanding of *growth* can’t be attained. But it would neither be quick nor easy.

### **3. Steady Throughput, Output and Well-Being**

- Some argue that once the State has guaranteed sustainable, equitable levels of output, incomes and public services, it’s largely up to individuals, along with the smaller or larger communities of which they may be members, to work out how subjectively well they might be.
- Others argue that the public sector can and should actively seek to shape the formation of values, beliefs and behaviors so as to impart a deep and ideally universally shared experience of well-being. They argue that the State already strongly shapes the experience of well-being as a function of its decisions on the levels and allocation of output, and that many other public decisions will also shape well-being. In this case efficiencies of scale and composition can be realized by acknowledging this important public sector role.
- Some contend that the link between output and well-being is weak, at least beyond some relatively modest level of output, and that it would be both easier and more important to work towards widely shared high levels of subjective well-being than to try to ensure a fully equitable distribution of a fixed level of output. Others differ strongly, holding that differentials of goods and services generate differentials of power and influence, which inevitably result in differentials of subjective well-being.

3. The rate of depletion of non-renewable resources should not exceed the rate of creation of renewable substitutes.

These policies generate an economy of **steady throughput**. For many authors the next move is to affirm the ability of technological innovation to continually turn this steady flow of throughput into increasingly more valuable units of output. Often, these authors also affirm market capitalism as the most efficient and practicable economic system available for this task, subject only to admittedly strong public sector control over stocks and flows of throughput.<sup>9</sup>

Other authors go further and propose economies of **steady output**. These include all proposals that show the rate of GDP growth slowing to zero and remaining at that point indefinitely, or perhaps undergoing a period of negative growth before stabilizing at zero growth. Examples include most of the macroeconomic models constructed to investigate steady-state dynamics, including those noted in Section II.C below; many of the integrated assessment models used to study the economics of climate change; and the two archetypal scenarios of Balanced Equitable World and Green Sustainability World used in this working paper outline.<sup>10</sup>

Policies to ensure well-being, including **steady well-being**, take a myriad of forms. It's generally assumed that the growth of output correlates positively with the growth of well-being, subject perhaps to diminishing returns. GDP is a measure of output, not of well-being, although it's long been treated as such. There is an extensive literature on the metrics of well-being, including alternatives to GDP as a measure of output and/or well-being.<sup>11</sup>

Proposed policies, principles, guidelines and practices involving all these sorts of steady-state economies, and commonly suggested by steady-state economy advocates, are shown in **BOX E-2**. Many, such as those shown in section A.1, focus on reducing throughput. Others, such as those shown in section A.2, focus on reducing output (and, as a consequence, also reducing throughput). Many have an impact on throughput and output only indirectly. All are intended to have a positive impact on well-being. We forego a full discussion of these proposals; brief comments are included in the endnotes.

Two important broad observations are worth noting here. One is that any chance of realizing a package of policies such as those shown in BOX E-2 would call for a higher degree of consensus and communalist commitment, at local, national and global levels, than exists now or has ever before existed. A second is that as challenging a task as it would be to establish a global economy of steady-state *throughput*, the task of establishing an economy of steady-state *output* would be orders of magnitude more challenging.

## II. MACROECONOMIC THEORY AND THE STEADY STATE

What light might macroeconomic theory cast on the nature of and prospects for a steady-state economy?

Contemporary macroeconomic theory is dominated by the *New Consensus*.<sup>12</sup> Simply put, the New Consensus studies fluctuations in economic activity over the *short run* (a few months to a few years) by looking mostly to **Keynesian aggregate demand theory**, and studies the growth of economic output over the *long run* (decades, generations and centuries) by looking mostly to the largely neoclassical **Solow Model**, grounded in aggregate supply theory.<sup>13</sup>

This orthodox New Consensus has been challenged over the years by a diffuse body of *heterodox* macroeconomic thought, with little impact. In the wake of the Great Recession this heterodox thought has received new attention.

We'll want to see what macroeconomic theory, both orthodox and heterodox, might tell us regarding both a world of steady-state *throughput only* and a world of steady-state *throughput and output*. We'll also want to see what

## **BOX E-2. POLICIES, INSTITUTIONS AND PRACTICES NECESSARY FOR OR SUPPORTIVE OF A STEADY-STATE ECONOMY [ See the Endnotes for comments ]**

### ***A. Primary measures for a steady-state economy***

#### **I. Restrict Supply**

1. Government ownership and administrative rationing of strategic key resources.
2. Regulation of supply (extraction, processing and marketing) of key resources via legal bans or quotas.
3. Regulation of supply of key resources via market mechanisms [e.g. cap and trade, taxation].

#### **II. Reduce Demand**

1. Reduce time spent in employed labor [through law, material incentives, moral suasion and cultural change].
2. Reduce promotion of consumption [e.g. ban, restrict and discourage selected forms and content of advertising].
3. Reduce demand for consumer goods, luxury goods and unhealthy goods via taxation, regulation, education.
4. Stabilize population.<sup>14</sup>

#### **III. Restrict and Channel Savings, Debt, Investment and Innovation**

1. Move from fractional reserve banking to 100% reserve requirements (to increase the cost of innovation, to discourage consumption and to encourage price stability).<sup>15</sup>
2. Restrict capital mobility so that financial resources are more directly tied to the real assets they represent.
3. Prioritize development of technologies that increase resource productivity rather than resource throughput, while ensuring that increased productivity does not itself generate increased throughput via bounce-back.<sup>16</sup>

### ***B. Secondary measures often advocated as supportive of a steady-state economy***

1. A comprehensive global monitoring system to support policies that restrict supply.
2. A comprehensive global “cooperation and coordination” regime to support and help administer all policies.
3. Downgrade the IMF-World Bank-WTO. Use them to support mercantilist and social corporatist policies that restrict rather than facilitate trade. Alternatively, disengage more fully from international commerce, free trade, free capital mobility and globalization; adopt tariffs and other policies to protect national resources.<sup>17</sup>
4. Reform aid to poor countries: instead of large interest-bearing loans share knowledge and provide micro-loans.
5. Reformulate the definition of GDP and other accounts to more accurately measure human & planetary well-being.
6. To reduce consumption establish maximum incomes policy.
7. To ensure minimal economic justice establish minimum incomes policies and job guarantees.
8. To ensure full economic justice establish schedules for all incomes.
9. Publicize research showing that beyond a certain level increased GDP doesn’t increase happiness.<sup>18</sup>
10. Reform education to promote non-materialistic values.
11. Grant fewer patent monopolies on “inventions” that are actually discovered facts of nature.
12. Enclose remaining natural capital commons via public trusts (e.g. land trusts, sky trusts).
13. Free the non-rival commonwealth of knowledge and information from private enclosure and prices.
14. As part of 100% reserve banking reform adopt sovereign monetary policies and support creation of local currencies.
15. Promote the supply of and demand for services rather than products, low consumption services rather than high consumption services, and service contracts rather than service and/or product purchases.
16. Remember that as radical as many of these proposals sound most can be introduced incrementally.

*Sources:* Daly (2013, 2008, 1991a, 1990, 1973), Hardt and O’Neill (2017), CASSE (2017), Dietz and O’Neill (2013), Jackson (2009), Latouche (2009) and Victor (2008).

macroeconomic theory might tell us regarding the *transition* from our current world of positive economic growth to a future world of zero growth.

## A. ORTHODOX THEORY: THE NEW CONSENSUS

Assume that we've already made a successful transition from a growth economy to a steady-state economy. What light might orthodox **New Consensus** macroeconomic theory throw on the workings of a steady-state capitalist economy, **in the short run?**

Model I in **BOX E-3** is a simplified **Keynesian IS-LM model**.<sup>19</sup> If a transition to a steady-state throughput-only economy has already been made, the effects of the new supply restrictions will have propagated throughout the economy and moved the IS curve to the left, followed by lower output, higher prices, more unemployment, and eventually new equilibrium values for all variables. The model isn't intended to say anything about longer run economic activity, including activity that could raise output, lower prices and reduce unemployment.

Now suppose we transition to a world not only of steady-state throughput but of ***steady-state output as well***. Model I appears to be completely compatible with such a condition. Equation (7) shows the level of output  $\bar{Y}$  to be *fixed*, which is, of course, precisely our definition of an economy of steady-state output. Equation (6) shows that short-term aggregate demand  $Y$  fluctuates above and below  $\bar{Y}$ .

But this is too simple. In an economy of steady-state output, interest rates would be close to zero, as would investment and savings.<sup>20</sup> It's possible to imagine scenarios of increasing dis-investment, with capital stock depreciating over time and output spiraling down to very low levels before stabilizing. The simple Keynesian IS-LM model was not designed to address these sorts of scenarios.

How about ***the long run?*** What can Model II, the **Solow Model**, suggest about the long-run growth dynamics of a steady-state economy, whether of steady-state *throughput only*, or of both *steady-state throughput and output*?

In the mid-1970s the Solow Model was criticized for ignoring natural resources as factors of production and noted economists set out to remedy this. These efforts and their results are discussed in detail in Attachment B.4 addressing the limits-to-growth debate. When modified to include natural resources the Solow Model suggests that:

1. An economy of ***steady-state throughput*** can be achieved, and sustained indefinitely, if continued technological innovation allows for unitary or greater elasticity of substitution between scarce natural resources and capital, so as to offset declining essential natural resource stocks. If technological innovation allows for continued growth of total factor productivity as well, continued positive output growth could be realized, at least until such time as absolute limits to the growth of total factor productivity are reached.<sup>21</sup>
2. An economy of ***steady-state output*** can be realized if, and only if, output-enhancing technological innovation has ceased. At the same time, however, elasticity-enhancing and/or productivity-enhancing technological innovation will need to *continue*, as noted above, in order to offset declining essential natural resource stocks.<sup>22 23</sup>

In both cases, this analysis appears to call for and countenance the eventual near-complete replacement of the natural world with technological artifacts. And in the second case it appears to call for a Janus-faced regulatory regime in which technological innovation is to be encouraged for process innovations but prohibited from being applied to product innovations. The distinction between these two sorts of innovations is clear in many instances but ambiguous in many others.<sup>24</sup>

### BOX E-3. THREE MACRO MODELS: 1 KEYNESIAN, 1 NEOCLASSICAL, 1 POST KEYNESIAN

#### I. KEYNESIAN IS-LM MODEL

- (1)  $Y = C + I + G + NX$
- (2)  $C = C(Y - T)$
- (3)  $I = I(r)$
- (4)  $Y = C(Y - T) + I(r) + G + NX$
- (5)  $M/P = L(Y, r)$
- (6)  $Y = \bar{Y} + \theta(P - P^e)$
- (7)  $\bar{Y} = F(K, L)$

Market equilibrium is found by solving equations (4) and (5) for  $Y$  and  $r$ .

#### II. SOLOW GROWTH MODEL

- (1)  $Y = AK^\alpha L^\beta$       [ $\alpha + \beta = 1$ ]
- (2)  $\dot{L} = nL$
- (3)  $\dot{A} = gA$
- (4)  $\dot{K} = sY - \delta K$

it can be shown by derivation and definition that:

$$(5) \quad g = \frac{\frac{dY}{dt}}{Y}$$

#### III. GENERIC POST KEYNESIAN MACROECONOMIC GROWTH MODEL

- (1)  $Y = C + I + G + NX$
- (2)  $Y_d = Y - T$
- (3)  $C = C^* + cY_d$
- (4)  $S = Y - C = I$
- (5)  $I = sR$
- (6)  $I/K = sR/K$
- (7a) let  $I/K = g$
- (7b) let  $R/K = r$
- (8)  $g = sr$

$Y$  = aggregate demand / output

$C$  = consumption

$I$  = investment

$G$  = government spending

$NX$  = net exports

$T$  = taxes

$r$  = real interest rate

$M$  = supply of money

$P$  = price level

$M/P$  = real money balances

$P^e$  = expected price level

$K$  = capital

$L$  = labor / population

$A$  = total factor productivity

$\alpha$  = capital's share of output

$\beta$  = labor's share of output

$n$  = labor / population growth rate

$s$  = savings rate

$g$  = total factor productivity growth rate

$\delta$  = rate of depreciation

$\theta$  = parameter of price stickiness

$L(Y, r)$  = demand for money balances

$Y_d$  = disposable income

$C^*$  = fixed consumption

$S$  = savings

$R$  = profits

$c$  = marginal propensity to consume

$dY/dt / Y$  = output growth rate

$\bar{Y}$  = output (fixed)

The analytic disjuncture between short-run and long-run economic activity seems intuitively problematic. One would think that short-term behavior regarding savings, investment, consumption and more would have some bearing on long-term economic growth, and that a transition to a long-run output growth rate of zero would have significant impact on short-term behaviors.

Questions still unresolved, and new questions, concerning the nature of and prospects for a steady-state economy are shown in **BOX E-4**. New Consensus macroeconomics wasn't crafted with many of these questions in mind. We'll now see if heterodox theory might be of more help.

## **B. HETERODOX THEORY**

### **B.1. Heterodox Schools of Economic Thought**

*Heterodox theory* has attracted attention from ecological economists and others concerned about long term economic growth and the human future, and from others unhappy with orthodox New Consensus theory for neither warning us of the 2008 financial crisis nor having useful remedies to offer afterwards.

**BOX E-5** shows a selective list of heterodox economic schools, approaches and perspectives. Many of these pre-date Keynes, others were inspired by and build on Keynes, and others have independent and more recent origins. Some have contributed importantly to contemporary economic thought, others were important once but are less so now, and others have been marginal since their inception.<sup>25 26</sup>

It would be useful to do a full review of the ways in which one element or another of each of these heterodox approaches might be relevant to the topic of steady-state economics, but in this short note we'll pass on that.<sup>27</sup> Rather, we focus on just one of these heterodox approaches, that of **Post Keynesianism**. This school of thought has generated particular interest among ecological economists and others addressing questions of the sort raised by the prospect of steady-state economics.

### **B.2 Post Keynesian Economic Theory, Ecological Economics and Economic Growth**

Post Keynesian economics began as an effort to build on and extend the ideas introduced in Keynes' *General Theory* (1936). Its early proponents were some of Keynes' closest colleagues at Cambridge, including Joan Robinson, Roy Harod and Nicholas Kaldor. Post Keynesianism has developed several strands over the decades, but is united in its contention that the purported "Keynesian" economics that grew to prominence in the 1950s and '60s, as well as the New Consensus that dominates macroeconomics today, incorporate too much of the orthodox classical thinking that Keynes was challenging, and too little of Keynes' original pathbreaking analysis.<sup>28</sup>

Current Post Keynesian theory is characterized by two major defining features:

**1. The primacy of the principle of effective demand.** Effective demand is the major determining variable of economic behavior, driving both short-run fluctuations and long-run economic growth. In this regard investment determines savings, rather than the converse as in neoclassical theory.

**2. The importance of dynamic historical time.** There is no equilibrium state to which an economy naturally and inevitably gravitates. Nor are there "natural" rates of unemployment, levels output, etc. Economies are complex and undetermined. Historical events matter, as do the actions of real, existing institutions.

Several auxiliary features can be identified, some of which derive in part from the two major features. The **distribution of income and wealth** matters, both structurally as a factor influencing short-range fluctuations and long-run growth, and normatively as an outcome of concern. **Radical uncertainty, bounded rationality and the rejection of homo economicus:** It is seriously mistaken to regard persons or firms as rational, perfectly informed

**BOX E-4. QUESTIONS CONCERNING A STEADY-STATE ECONOMY THAT ARE INADEQUATELY OR PROBLEMATICALLY ADDRESSED BY ORTHODOX / NEW CONSENSUS ECONOMIC THEORY**

*Some key questions that bear on the prospects for a steady-state economy and that are inadequately or problematically addressed by orthodox/mainstream/New Consensus theory are shown here.*

- What roles might short-run fluctuations in aggregate demand and other macroeconomic values play regarding long-run output growth rates?
- What impacts would a transition to a long-run GDP growth rate of zero have on the short-run behavior of output, income, consumption, savings and other macroeconomic variables?
- How are income and wealth differentials generated in the course of both short-run and long-run output growth and how might these differentials in turn effect both the level and the rate of short-run and long-run output growth?
- Should the primacy given the Cobb-Douglas production function, which displays smooth and continuous substitution among factors of production, be given instead to more realistic production functions showing increasingly costly and inelastic substitution?
- How might the role and dynamics of natural resources, and especially finite natural resources, best be incorporated into short- and long-run growth models?
- Is the notion that economies tend towards equilibrium realistic? Is the notion that this equilibrium be considered *normatively optimal* appropriate?
- What bearing does the hugely and rapidly expanding global financial sector have on long-run economic growth?
- In the Solow Model technological innovation has the effect of increasing total factor productivity by a percent or two, and occasionally more, every year or so. But this hardly captures the full impact of technological innovation on economic activity, much less on the wider social and institutional world in which technology is embedded. How can we capture these full impacts in our models?
- Both neoclassical and New Consensus theory assume that all economic decisions are made by rationale agents seeking only to maximize utility, well-being or profit. This is a stunning simplification of the way the world actually works. Can we do better than this?

For more see Rezai and Stigl (2016), Lavoie (2015), Jackson et al. (2014), Kurz and Salvadori (2010) and Holt and Spash (2009).

## BOX E-5. HETERODOX SCHOOLS OF, APPROACHES TO, AND PERSPECTIVES ON ECONOMIC THEORY

*Selected Heterodox schools, approaches and perspectives are shown here. See endnotes for more.* <sup>29</sup>

**1. Post Keynesian Economics.** Seeks to revive and extend original core Keynesian insights. Key themes: centrality of effective demand and income/wealth distribution; links between money and output; rejection of Walrasian equilibria and atomistic individualism; radical uncertainty; path dependence; reciprocal influence of short run and long run.<sup>30</sup>

**2. Institutional Economics.** Emphasis on the decisive ways in which institutions generate and shape economic behavior. A broad, diverse field intersecting with e.g. political economy, economic history, behavioral and evolutionary economics. Includes Smith, Marx and other foundational authors along with many current ones.

**3. Behavioral Economics.** Seeks a more realistic, finer-grained understanding of economic phenomena by focusing on cognitive/behavioral/psychological dynamics. Key topics: heuristics, framing, risk tolerance, bounded rationality, Prospect Theory, Dual System Theory, portfolio choice. Increasingly influential in the mainstream.<sup>31</sup>

**4. Evolutionary Economics.** Understands economic activity, institutions and systems in terms of variation, competition, selection, growth, reproduction, scarce resources and adaptation. Economic activity generates innovation and transformation, *not* equilibria or diminishing returns.<sup>32</sup>

**5. Transformational Growth Theory.** Economic growth is more than just more output. Rather, markets and technologies generate products and processes that in turn transform those markets and technologies, along with institutions of investment, distribution, savings, labor mix and more, including social and cultural institutions.<sup>33</sup>

**6. Ecological Economics.** Sees human economic activity as a component of a larger natural ecosystem with many interdependencies and feedbacks. Emphasizes strong sustainability and distributional equity (including intergenerational equity), and rejects perfect substitutability of capital for nature.<sup>34 35</sup>

**7. Islamic Economics.** Grounds economic practice, institutions and theory in Koranic scripture. Provides ethical structures for market transactions, wages and profits, property rights, distributional equity and care for the poor. Prohibits interest but allows work-arounds. Claims to combine best features of capitalism and socialism.<sup>36</sup>

**8. Gandhian Economics.** Grounded in Hindu principles of *Satya* (truth), *Ahimsa* (non-violence) and *Aparigraha* (non-possession). Rejects simplistic concept of people as mechanically seeking to maximize material self-interest. Opposed to “multiplication of wants,” as unsustainable and spiritually deadening. Rather, affirms meaning and community.

**9. Feminist Economics.** Understands and explicates economic practice and theory using a feminist framework to correct for past omissions and commissions and to bring new perspectives and resources to bear on the economic challenges of our time.

**10. Marxian Economics.** Private ownership of capital generates great disparities and instabilities and eventual collapse. Non-capitalists (working class, proletariat) can organize for political and economic democracy.

welfare- or profit-maximizers. **Money matters:** nominal values influence real dynamics; e.g. firms and households have debts and assets denominated in dollars that drive behavior.

### ***Post Keynesianism and Ecological Economics***

Scholars have identified themes, methods and tendencies that Post Keynesian economics and ecological economics have in common or that appear complementary. Some of these are noted in **BOX E-6**.

Post Keynesian economics and ecological economics have differences and deficits as well. Post Keynesian economics has focused, as might be expected, on the standard set of macroeconomic topics: recession, employment, growth, money, interest rates, investment, etc. (Note though that one *non*-standard topic that Post Keynesian economics has emphasized is the distribution of wealth and income). Like orthodox economics Post Keynesian economics has accepted with little question the desirability of increasingly greater economic output.

Ecological economics, for its part, has neglected macroeconomic analysis. One reason for this is that orthodox macroeconomics, as we saw, is grounded in assumptions that play down the importance of many ecological questions from the outset. It's also possible that the mostly negative reaction given the (admittedly problematic) macroeconomic modeling that underpinned *The Limits to Growth* (1972) discouraged further efforts along these lines. In any event the construction of an ecological macroeconomics is now recognized as a priority initiative and Post Keynesian economics may be in a position to play a significant role. For full discussion of the interface of Post Keynesian and ecological economics see the *Sources* shown in BOX E-6.

### ***Post Keynesian Economic Growth and Steady-State Economics***

How does Post-Keynesian economics treat the topic of economic growth and what light might it shine on the nature of and prospects for a steady-state economy? Hardt and O'Neil (2017, p 202) succinctly describe the Post Keynesian growth model:

“... (A)ggregate demand is the key driver of economic growth. A key determinant of aggregate demand is investment, which is considered autonomous. Important assumptions in Post Keynesian theory are the constancy of the capital-output ratio and the practice of firms to keep a proportion of capacity unutilized to respond to demand changes. Investment is generally modelled as a function of capacity utilization and the profit rate but this can be complemented by other factors, such as a parameter reflecting “animal spirits”... By including capacity utilization in the investment function, the long-term path of capital accumulation, and hence economic growth, is driven by aggregate demand. Through the inclusion of profits the path of the economy is also influenced by the income distribution, which is considered to be determined by institutional factors.” [They reference Kemp-Benedict (2014), Lavoie (2006), Taylor et al., (2016), and Fontana and Sawyer (2016).]

Now refer back to **BOX E-3**, showing our three simplified macroeconomic models. We've already discussed the **Keynesian IS-LM model** (Model 1) and the **Solow growth model** (Model II) that together underpin the New Consensus. Model III is our much-simplified **Post Keynesian growth model**.

Model III begins with an aggregate demand equation (1) identical to that of Model I (IS-LM) and it ends with equation (8) showing the rate of economic growth as a function of the savings rate and the rate of profit. By contrast Model II (Solow) has no aggregate demand function and ends showing a value for the rate of economic growth (5), but this value is simply the exogenously given rate of total factor productivity growth. By further contrast, Model I (IS-LM) doesn't generate an aggregate output growth value at all – that's not what it's for. Rather, it shows the short run fluctuation of aggregate demand ( $Y$ ) around an exogenously-specified “natural” and fixed level of output  $\bar{Y}$  [equation (7)].

#### **BOX E-6. POST KEYNESIANISM AND ECOLOGICAL ECONOMICS: SOME COMMONALITIES**

- \* Both acknowledge that any useful economic theory has inherently normative elements in its structure as well as its choice of focal topics and that the values it embodies should be acknowledged rather than denied.
- \* Both reject the core neoclassical postulate of a natural, normatively optimal equilibrium to which all economic activity will gravitate if allowed to do so through free and fair markets.
- \* Both reject the methodological individualism of neoclassical economics in which atomistic individuals are the locus of normative concern and agency and are perfectly rationalistic welfare-maximizers operating with perfect information and perfect foresight.
- \* Both also reject the neoclassical production function in which capital and labor are effortlessly and infinitely substitutable, and in which natural resources, if included at all as a factor of production, are likewise treated as perfect substitutes with respect to capital and/or labor.
- \* Both stress the importance of institutions in the operation of any real-world economy, both emphasize the importance of history and historical time, and both understand that outcomes are often path dependent.
- \* Both have a strong interest in questions concerning the distribution of wealth and income, both normatively as an outcome and structurally as a factor that shapes other outcomes, notably including savings, investment and output.<sup>37</sup>
- \* Both affirm methodological pluralism, on the grounds that any systems as complex and undetermined as an economy or an ecology, much less the larger system of which the economy and the ecology are co-evolving components, present many, partial and overlapping facets to any set of observers, and can thus be most usefully understood using a wide mix of methods.<sup>38</sup>

*Sources:* Holt et al (2009), Hardt and O'Neill (2017), Kronenberg (2010), Rezai et al (2013), Spash and Shandl (2009) Gowdy (1991) and Rezai and Stagl (2016).

Note further that in Model III (Post Keynesian), the all-important level of investment  $I$  is a function of the exogenously-specified savings rate [equation (5)], whereas in Model I (IS-LM) investment is a function of the endogenously solved interest rate  $r$  [equation (3)].

While both the Solow Model and the IS-LM Model converge towards stable equilibrium values of output and other key variables, the Post Keynesian Model does not converge towards an equilibrium. Rather, motion over time is a function of historical factors, notably the rate of savings and the level of profit, that determine Investment and contribute to aggregate demand.<sup>39</sup>

What might the Post Keynesian model suggest about the nature of and prospects for a steady-state economy?

Note first that we're talking about an economics of steady-state *output*, as we were with the New Consensus models. Even given the critique of GDP shared by many working with Post Keynesian theory, and even given the incorporation of natural resource throughput, the use of output as the focal metric is almost universal.

Post Keynesian theory suggests that an economy of steady-state output would come to pass when entrepreneurial profits ( $R$ ), or alternatively when the savings rate ( $s$ ), have declined to zero. This is not too different from the conclusion of the New Consensus models that an economy of steady-state output would come to pass when the growth rate of technology innovation ( $g$ ) has declined to zero. The Post Keynesian result appears to more helpfully show the rate of output growth as endogenously grounded, as compared to the fully exogenous " $g$ " of the Solow Model. But the Post Keynesian " $R$ " and " $s$ " are themselves strongly shaped by a complex mix of technology, animal spirits, and social and political factors, all of which are just as abstract, qualitative and indeterminate as is the Solow " $g$ ".

Although the Post Keynesian model has yielded specific results regarding the general causes of economic growth and the nature of a steady-state economy, it's not clear if these results are significantly more informative or useful for our purposes than are the results obtained using the Solow model, which are themselves of questionable use.

There are, however, a number of important related questions that Post Keynesian theory may be in a particular position to help us address. To do this, however, we need to apply Post Keynesian theory to the construction of computational macroeconomic models.

### **C. POST KEYNESIAN COMPUTATIONAL ECOLOGICAL MACROECONOMIC MODELING**

A presumed sign of maturity of any macroeconomic theory is the development of computational models that can both shed light on theoretical questions and generate information useful for real world policy and lifeways decisions. Hardt and O'Neill (2017) reviewed twenty-two ecological macroeconomic modeling efforts and explicated the sorts of questions they were designed to address, their theoretical grounding, the modeling techniques employed, and other notable features. Four of these models were specifically designed to study the dynamics of steady-state economies. They were constructed by Tim Jackson of Surrey University, Peter Victor of York University and colleagues. They are described briefly in **BOX E-7**.

This isn't the place for a full review and critique of these and related models. Rather, in Section III (following) we describe work done with them to address selected questions concerning the nature of and prospects for a steady-state economy.

## BOX E-7. THE JACKSON-VICTOR DYNAMIC MACROECONOMIC MODELS

1. **LOWGROW** models the Canadian economy from 2000 through 2035. **Key sources** are Victor and Rosenbluth (2007) and Victor (2012, 2008). An interactive version can be accessed at:

[http://www.pvictor.com/MWG/Computer\\_Models.html](http://www.pvictor.com/MWG/Computer_Models.html)

2. **SIGMA** models a medium-size industrial economy over the course of a century. **Key source:** Jackson and Victor (2016). Interactive version: <http://www.prosperitas.org.uk/SIGMA#>

3. **FALSTAFF** is similar to *SIGMA* but has a more developed monetary/financial/banking sector. **Key sources** are Jackson et al (2014), Jackson and Victor (2015) and Jackson et al (2015). An interactive version can be accessed at:

<http://www.prosperitas.org.uk/FALSTAFF#>

4. **GEMMA** is an advanced model currently in development. It builds on *SIGMA* and *FALSTAFF* and includes multiple economic sectors, expanded ecological elements, financial systems and measure of economic inequality. **Key source** is Jackson et al (2014). No user interactive version is available as of December 2017.

\* All four models are scenario models rather than optimizing models.

\* All four models depict the economy of a single country. *LOWGROW* and *SIGMA* are closed economies; *FALSTAFF* and *GEMMA* include an import-export sector.

\* *LOWGROW* is an econometric model; the other three are stock-flow consistent (SFC) models. All have a systems dynamics structure and were constructed using the *STELLA* modeling software.

\* *SIGMA*, *FALSTAFF* and *GEMMA* draw on Post Keynesian economic theory, in which aggregate demand is the key driver not only of short-term business cycle fluctuations but of long-term economic growth. *LOWGROW* is a modified demand-driven growth model.

\* *FALSTAFF* and *GEMMA* contain expanded financial and monetary sectors.

\* *LOWGROW* shows income inequality by computing Canada's Human Poverty Index (HPI) using a formula developed by the United Nations Development Program (UNEP). *SIGMA* computes the rate of return to capital using a CES production function and uses that to compute the shares of income going to capital and to labor. *FALSTAFF* and *GEMMA* compute both income and wealth for capitalist and wage-earner households.

### III. SELECTED KEY QUESTIONS REGARDING A STEADY-STATE ECONOMY

#### 1. *Is a Steady-State Economy Compatible with Free-Market Capitalism?*

Many authors say or imply that a steady-state economy is compatible with free-market capitalism. They suggest that after tough measures have been taken to constrain throughput, and after other measures of the sort displayed in BOX E-2 have been institutionalized, free markets and the profit motive can be relied on to guide the production and allocation of goods and services most efficiently. The writings of Victor (2008), Jackson (2009), Lawn (2011, 2005), N. Smith (2013) and Harris (2010) align with this stance, albeit with qualifications that vary among authors. No less a figure than Robert Solow has weighed in as well:

“There is no reason at all why capitalism could not survive with slow or even no growth. I think it’s perfectly possible that economic growth cannot go on at its current rate forever... it is possible that the US and Europe will find that, as the decades go by, either continued growth will be too destructive to the environment and they are too dependent on scarce natural resources, or that they would rather use increasing productivity in the form of leisure... There is nothing intrinsic in the system that says it cannot exist happily in a stationary state.”<sup>40</sup>

Victor and Rosenbluth (2007) used the **LOWGROW** macroeconomic model to demonstrate that Canada can not only transition successfully to a stable economy of zero GDP growth under capitalism, and do so in the course of ~ 28 years, but that as part of this transition “Poverty can be eliminated, unemployment can be reduced to historically low levels, the government-debt-to-GDP ratio can be reduced, and international environmental commitments can be fulfilled...” (p 498). However, for this to happen, they say, policy measures would need to be adopted that redistribute income, provide food, clothing and shelter for the neediest households, redirect consumption and investment from private positional goods to public goods, channel continued productivity growth into increased leisure time rather than consumption, and discourage export industries and encourage imports.<sup>41</sup>

Many of those who argue for the compatibility of capitalism and a steady-state economy go the same route as Victor and Rosenbluth. They affirm free markets, private property, profit-maximizing firms and welfare-maximizing households, but then call for economic activity to be deeply and pervasively shaped and regulated by the state or other supra-individual institutions (e.g., worker collectives). Depending on the particulars, such economies might more usefully be thought of as market socialist, state capitalist or corporatist. Herman Daly has most often situated his proposals within neoclassical competitive market frameworks (see e.g. 1991b) but has at other times said that ecological economics transcends conventional ideological categories (see e.g. 2005).<sup>42</sup>

Other authors take a more explicitly critical stance and argue that a **growth imperative** or **growth requirement** lies at the very core of capitalism’s essential nature, and that steady-state advocates should acknowledge this rather than seek to elide it. For example, Gordon and Rosenthal (2003) construct a model that suggests that capitalist firms operating in a competitive market characterized by permanent annual GDP growth of 0% have no way to avoid repeated losses resulting from normal market fluctuations and uncertainties, with the odds being high that over a relevant span of time all of these firms will experience bankruptcy.

Many authors locate a particularly strong growth imperative in the dynamics of **interest-bearing debt** and associated monetary and financial institutions that lie at the heart of modern capitalism. They contend that economic growth becomes necessary and expected whenever a large bank loan that is to be repaid with interest is taken out. Borrowers would not take out the loan unless they believed that the use to which they intend to put the borrowed funds would generate returns sufficient to, at a minimum, pay back both the principal and the interest, and lenders wouldn’t make such loans without the same expectation. Given diminishing returns to

production and the dynamic of free market competition, output must *increase* if profits are even to remain *positive*. Given the large share of GDP represented by investment (~ 20% in mature industrial countries), these dynamics are powerful drivers of economic growth.

Binswanger (2009) constructs a model showing that bank credit expansion generates the need for a GDP growth rate of at least 0.45% if firms can expect to earn profits, and he suspects that the true necessary growth rate is actually closer to 1.0%. See also Douthwaite (2006) and Farley et al. (2013) for other arguments supporting the existence of a capitalist growth imperative.

Other authors differ. Jackson and Victor (2015) use their macroeconomic **FALSTAFF** model to depict an interest-bearing debt economy that is stable at 0% growth in GDP and resilient in the face of a variety of shocks to aggregate demand. Barrett (2017) tests the relative stability of growth and no-growth economies over a time span of 250 years. To do so he constructs a Post Keynesian model featuring the *financial instability hypothesis* proposed by Hyman Minsky (1992, 1986).<sup>43</sup> He finds that both growth and no-growth economies can remain stable, and for long periods, so long as firms do not change their *level of debt* or their *target level of debt* too rapidly. Cahen-Fourot and Lavoie (2016) use a Post Keynesian model to show that an economy featuring debt-based money and a positive interest rate can be stable even with zero growth in output. They note, however, that because of the obvious need under steady-state conditions to deal firmly with issues of distributive justice, it is unlikely that such an economy would be understood as capitalist.

Strunz et al (2015) identify five well-developed theoretical approaches to the study of money and economic growth and ask how each of these answers the question as to whether a steady-state economy is feasible under capitalism. The five approaches and the answers they appear to give are:

- 1) mainstream Solow-based growth theory: **YES**, *steady-state capitalism is possible*.
- 2) neoclassical/Keynesian synthesis: **NO**, *it is not*.
- 3) an idiosyncratic approach drawing on New Institutional Economics: **NO**.
- 4) an idiosyncratic approach developed independently by Binswanger (2009) and Hixson (1991): **NO**.
- 5) Post-Keynesian theory: **PROBABLY NOT**.

Some authors, including many socialists, emphasize the structural/political incompatibility of capitalism and an economic steady-state. R. Smith (2010) argues that the values and practices embedded in capitalist institutions, including those of the wider society structured by capitalism, take accumulationist goals as incontrovertible givens, and would quickly weed out any individuals or firms that seriously sought to behave otherwise. Blauwhof (2012) argues that even if as a result of mobilized popular demand a steady-state economy were to be established, it would be at constant high risk of being undermined and subverted so long as the means of production, and thus of accumulation and political power, remained in private hands. And Li (2008) offers a simple straightforward critique: in a true steady-state economy why would anyone want to be a capitalist in the first place?

Richters and Siemoneit (2017a, 2017b) evaluated over 100 studies addressing the question of the existence and nature of a capitalist growth imperative. They established a high bar by defining *growth imperative* as, on a micro level, “exterior conditions that make it necessary for an agent such as an individual, firm or state to increase its economic efforts to avoid existential consequences (e.g., unacceptable difficulties in achieving cost-covering revenues, or the experience of social exclusion)”, and, on a macro level, “a system-immanent mechanism that requires the economy to grow in order to maintain social or economic stability, independent of the will of the agents.” They then identify five economic and three social categories of growth imperative causation. The five *economic* categories involve 1) money, interest and credit; 2) profits, competition and capital accumulation; 3) technical progress, innovations and resource consumption; 4) politics, states and their institutions; and 5) personal reasons: striving for ‘more’, social pressure, accumulation and inequality. The three *social* categories involve

1) 'keeping up with the Joneses': consumption, social comparison and social exclusion; 2) expansion of possibilities: consumption as empowerment and accelerator; and 3) (inner-directed) striving for more success and wealth. Of the several hundred possible growth imperatives that they evaluate, they conclude that the only true growth imperatives they can identify are those that involve **technological innovation**. They argue that the development and use of process innovations, in a capitalist context and in response to resource shortages, generates cascades of commitments and expectations that necessarily generate greater output growth.

This brief note on the nature of the relationship between proposed steady-state economies and capitalism barely scratches the surface of the questions raised and the responses given. I'll return to this topic in the concluding comments.<sup>44</sup>

## **2. Does slowing or no economic growth generate greater economic inequality?**

In the working paper **Background Materials, Section II.B.2.**, I reviewed studies of the relation between economic growth and the distribution of income and wealth, most of which dated from the 1990s. The findings of those studies varied greatly.

A brief review of recent studies suggests that findings continue to vary greatly. Many studies suggest that high and/or growing inequality discourages economic growth; see Dierk and Vollmer (2013), Campos (2017) and OECD (2014, 2012). Other studies suggest the opposite, with greater economic inequality helping generate *higher* rates of economic growth; see Mallmen (2012). Some studies suggest that strong economic growth will *reduce* economic inequality; see Ben-David (2007). But other studies suggest the opposite, with strong economic growth leading to *greater* economic inequality; see Faridi and Kahn (2008) and Rubin and Segal (2015). Some studies claim that although many positive correlations can be found between greater economic inequality and slower economic growth, the evidence for causation is much weaker; see Schrage (2016). Other studies suggest that although greater income inequality decreases the output growth rate of high- and middle-income countries, it can *raise* the growth rates of poor countries; see Brückner and Lederman (2015). Finally, some studies find that the relation between growth and inequality varies greatly over time and place, and is highly sensitive to historical contingencies; see Atems and Jones (2015). For a note on additional recent studies see the **working paper outline, Discussion Note 3**.

Piketty (2014) contends that slowing rates of economic growth generate greater economic inequality, and argues for a revival of economic growth in part to discourage such growing inequality. Jackson and Victor (2015) note that this contention poses a challenge for those environmentalists and others who look favorably at the possibility of a world of zero economic growth, but who also strongly oppose growing economic inequality. Jackson and Victor use **SIGMA** to test Piketty's contention. They find that a critical factor is the elasticity of substitution between labor and capital ( $\sigma$ ). If this elasticity is large ( $\sigma > 1.0$ ) firms facing slower economic growth are able to easily substitute new technology for labor, thus maintaining profits while wages and employment decline and inequality grows. In this case it would be difficult to keep income differentials from widening. On the other hand, if the elasticity is low ( $\sigma < 0.5$ ), substitution is difficult, and slowing economic growth would affect both labor and capital more equitably, so to speak.<sup>45</sup> In this latter case, Jackson and Victor suggest, redistributive taxation and a policy of government as employer-of-last-resort could go the final step and ensure that declining or no economic growth does not generate greater economic inequity. They admit, however, that low elasticities of substitution are historically associated with low levels of economic development, e.g. with the sorts of predominantly agricultural economies that prevailed prior to the 19<sup>th</sup> century. They suggest that "new forms of capitalism" might be able to promote systems in which labor is used intensively, along with selective new technology, to generate sustainable and just levels of non-growing economic output.

Some analysts believe that innovations in robotics and artificial intelligence are set to radically transform the nature of labor, capital and production, with uncertain impacts on the prospects for a steady-state economy and for the distribution of wealth and income. At first glance the impacts appear likely to be precisely the opposite of what Jackson and Victor say is needed to help prevent rising economic inequality.<sup>46</sup>

A *Realpolitik* analysis might suggest that, as a rule, economic inequality in developed countries can be expected to increase *regardless* of whether output is growing or declining. In prosperous times the wealthiest households are in a position to take best advantage of a wide range of opportunities in a wide range of markets. All wealth and income sectors might be doing well, but the wealthiest will do best. In times of recession the wealthiest are in a position to take best advantage of a wide range of opportunities to *protect* their assets and incomes. All wealth and income sectors may be hurting but the wealthiest will be hurt least. In either case, disparities of wealth and income increase.<sup>47 48</sup>

In the final analysis these studies of the relation between output growth and inequality in market economies, as useful as they might be in helping us think through the fine dynamics, might be beside the point. A true steady-state economy would likely be a highly administered economy, and the administering government would likely require a high degree of popular support. The degree of economic inequality would be an administrative decision, and would be set at a level commanding the necessary degree of popular support.

### **3. How might a reduction in labor supplied to market activity help build a steady-state economy?**

A reduced quantity of labor supplied to market activity is one of the most commonly proposed components of a steady-state economy. It's portrayed as a win-win proposal: less time spent in producing market goods and services will yield an immediate reduction of both throughput and output, and the newly available hours could be spent in personally fulfilling and socially valuable non-market activities, which in turn could generate greater aggregate well-being for all. An attractive feature of this proposal is its simplicity; it doesn't require a massive bureaucratic or other regulatory apparatus in order to work.

Further, there is historical precedent to inspire and to draw upon. In the late 1960s to mid-1970s large numbers of young people in the developed world began choosing life courses of low earnings and low consumption. More recently, surveys taken in ~ 1998-2000 show that between 20-30% of adults in the United States, Great Britain and Australia claim to have voluntarily permanently reduced their earnings and consumption at some point during the preceding decade.<sup>49</sup>

There are caveats, of course. The true impact of downshifting depends not only on the degree to which householders reduce their incomes but on the relative resource-intensity of their previous and their new work-time and leisure-time activities. Further, even if a strong majority of people in a society believe in the importance of downshifting and proceed to do so, how does society deal with the (say) 20-40% who prefer to keep working longer hours and to produce and consume more output? In addition, although it's conceptually simple any real-world universal adoption of work-time reduction, at effective scale, comes with practical complications. See Pullinger (2014), Nassen and Larsson (2010), Coote et al. (2010), Victor (2008) and Schor (2010, 2005) for detailed discussion of work-time reduction proposals.<sup>50</sup>

Work-time reduction proposals need to take into account the inter-related dynamics of throughput, output, and technological innovation. Downshifting generates an immediate reduction in *the level* of both throughput and output. However, the subsequent *rate of growth* of throughput and output may or may not be affected. If total factor productivity growth continues, output would sooner or later be back to its pre-downshift level and growing still. If we are interested in steady-state output, work-time reduction alone helps buy time but otherwise doesn't get us very far.<sup>51</sup>

This can be seen clearly in the working paper **Attachment D.2, Boxes E.1-E-2**, showing 12 countries/regions undergoing a work-life balance downshift of 40% (e.g. from a 5-day to a 3-day workweek), and a corresponding decrease in income and consumption, over periods of about 40-60 years. After that point, however, output resumes growing, even though paid worktime does not, and reaches its pre-downshift level within another 50-80 years. It's possible that the reduction in paid worktime could depress the rate of technological innovation and productivity growth and thus the rate of growth of output. But again, this just buys a few more decades until output is back to our pre-downshift level.

This dynamic – a decline in the level of a resource flow but not necessarily in the subsequent growth of output - applies to many policies often proposed to help bring about and sustain an economy of steady-state output. Two common examples are 1) population reduction and 2) greater efficiency of resource use. The achievement of an economy of steady-state output requires a cessation of output-enhancing technological innovation. See the working paper **Attachment D.2. Boxes F.1- F.2 and G.1-G.2** for a clear demonstration of this.<sup>52</sup>

#### **4. What would the transition from a growth economy to a non-growing steady-state economy entail?**

Assuming that a stable steady-state economy is possible, how would the transition from our current growth economy to a steady-state economy take place? The trajectories shown in **BOX E-8** call attention to key questions:

\* **What scale?** The four trajectories tell different stories and have different implications. In **Trajectory 1** we transition from our current level of per capita GDP to a steady-state level *higher* than we are at now and with no period of negative growth. In **Trajectory 2** we transition to a level of per capita GDP higher than we are at now but only after a period of negative growth. In **Trajectory 3** we continue to grow for some time, peak and then undergo a dramatic decline, and stabilize at roughly our current level of per capital GDP. In **Trajectory 4** we undergo a catastrophic peak-and-decline and finally stabilize somewhat above subsistence.

\* **What time-line?** Advocates of a steady-state economy tend to underestimate how long it is likely to take for a transition of such magnitude and consequence to actually happen. The trajectories shown in **BOX E-8** take place over at 100-200 years if the objective is a world of steady-state throughput only. If we desire (or are compelled) to transition to a world of steady-state *output* as well, we might proceed in two phases: 100-200 years to establish a world a steady-state throughput, followed by an additional 100-200 years to transition from there to a world of steady-state output.

\* **What degree of intentionality?** Will the transition be fully intended and planned for, with widespread popular support? Or will it be largely unplanned for, but once underway responded to and steered with a degree of intentionality? Or will it be completely unplanned for, with no intentionality in play except long after the fact, and then focused on survival?

Remarkably little attention has been given to such questions. Even if a stable steady-state economy is technically feasible, the real-world transition from a growing to a steady-state economy could be gravely destabilizing. On the other hand, Barrett (2017) and Victor and Rosenbluth (2007) construct models showing successful transitions. The degree of social and political support for such transitions is obviously germane.

Can a transition from a growth to a steady-state economy take place in one country, or would it be necessary for all or most countries to do so in some coordinated manner? Any transition from a growing to a steady-state economy in one country will entail a steady reduction in return to capital, and capital-holders will quickly take their capital abroad, setting off spirals of domestic disinvestment and contraction. Again, societal near-consensus and strong public sector leadership appear to be essential. See Victor (2008) for more on the challenges of transition.

## BOX E-8. FROM A GROWTH ECONOMY TO A STEADY-STATE ECONOMY: 4 TRANSITION TRAJECTORIES

Even if a steady-state economy, once established, is sustainable over the long run we still need to consider the process of *transition* from a growth economy to a steady-state economy. Four trajectories are noted here, discussed in the text and illustrated in **Figure E.8-1** below.

**Trajectory 1. Planned Transition and Stabilization** - Visionary leaders and inspired mass populations begin a deliberate transition from our current growth economy to one of zero-growth/steady-state. This deliberate transition enables us to realize a steady-state level of output without having to undergo a period of aggregate economic contraction.

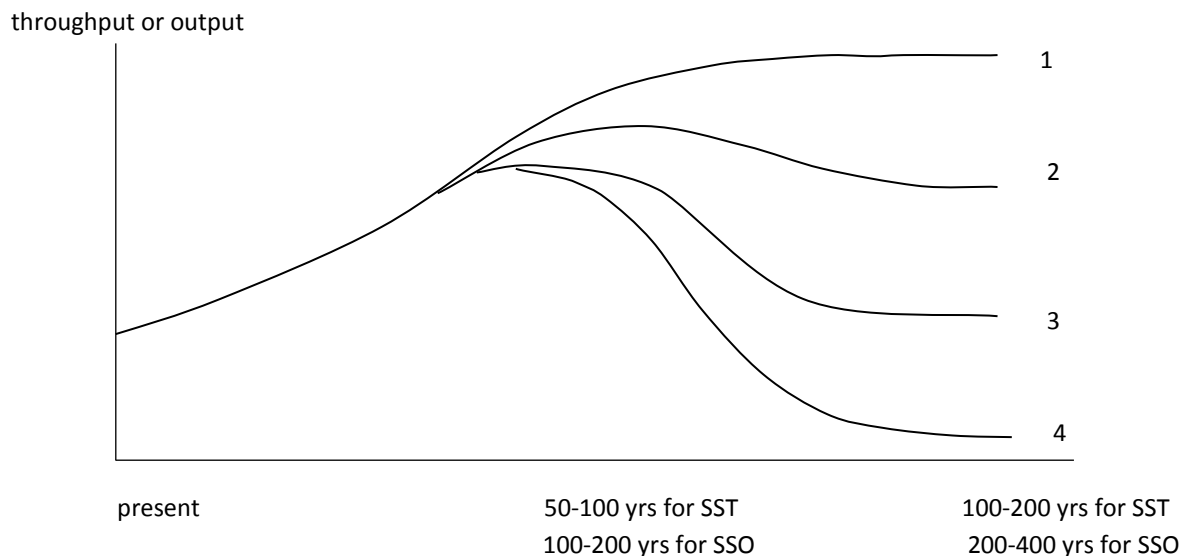
**Trajectory 2. Unplanned Contraction but Rapid and Smart Adaptive Response** – World output continues to grow for some time, peaks, and begins to decline. To prevent the decline from accelerating, motivated leaders and mass populations respond quickly and resourcefully. They avoid the worst consequences of an unplanned collapse or contraction, although still absorbing losses. Over a period of decades and generations a new, frugal, zero-growth/steady state world emerges, at a level of world output below that achieved in Trajectory 1 but greater than those of Trajectories 3 or 4.

**Trajectory 3. Unplanned Contraction and Stabilization** - World output continues to grow for some time, peaks, and then begins to decline. Coordinated responses are unsuccessful and loss and suffering are great, although local initiatives allow much of the worst chaos and violence to be avoided. Over a period of decades and generations a new, frugal, zero-growth/steady-state world emerges.

**Trajectory 4. Unplanned Catastrophic Collapse and Stabilization** –World output continues to grow for some time, peaks, and then collapses rapidly and catastrophically amid chaos and violence. Over a period of decades and generations a new, frugal, zero-growth/steady-state world emerges.

**Figure E.8-1. FOUR TRANSITION TRAJECTORIES TO A STEADY-STATE** <sup>53</sup>

[SST = steady-state throughput; SSO = steady-state output.]



#### IV. PRELIMINARY ASSESSMENT AND FINAL COMMENTS

We asked whether or not a steady-state economy is possible and if so under what conditions.

To address the question properly we need to distinguish between an economy of *steady-state throughput* and an economy of *steady-state output as well as throughput*.

An economy of steady-state throughput is not difficult to imagine. We already regulate the stocks and flows of many important resources. Doing so on a global scale would be a gargantuan feat of political-economic will, statecraft and engineering, but isn't conceptually foreign to us. For this discussion I'll suggest that it might be possible to transition to a world of steady-state throughput over a period of 100-200 years.

Proponents of a world of steady-state throughput commonly assure us that output, that is, real goods and services, could continue to grow via continued technological innovation.

But for how long? Even extraordinary technological innovation eventually faces diminishing returns. And although new technologies can repeatedly leap over the configurational limits of old technologies, absolute limits eventually apply. Further, continued technological innovation means the continued technological reconfiguration of the natural world. This condition will increasingly be radically destabilizing and, I believe, increasingly socially unacceptable. In addition, our desire to ensure economic justice will likely constrain output growth.

I believe that some combination of these several factors will all but inevitably bring an effective end to the growth of output. For this discussion I'll suggest that this could happen within 100-200 years *after* the time at which global steady-state *throughput* is achieved. Taken together these estimates give us 200-400 years during which we might transition from our current world of throughput and output growth to a world of steady-state throughput and output.

In contrast to a world of steady-state throughput, a world of steady-state output is completely foreign to us.

By definition, a world of steady-state output is a world in which the level of output doesn't change, effectively forever. This level would be determined in part by biogeophysical constraints, in part by collective choice, and in part by events.

In this working paper I've considered several scenarios that display differing levels of steady state output. These are shown for reference in **BOX E-9**.<sup>54</sup>

A world of steady-state output is a world in which technological innovation that generates greater output is either prohibited or voluntarily foregone. So long as we are living above subsistence level, however, continued *process* innovation will be necessary to allow our steady level of output to continue in the face of capital depreciation and declining throughput of exhaustible resources, via enhanced substitutability and/or productivity.

Regardless of the level at which output finally stabilizes, we will be faced with an array of questions that the global human community has never before had to face. How do we decide which households get what shares of the fixed level of output? How would wages and salaries be set? How would savings and investment be handled, given that return on capital would be near zero? How would prices on goods and services be set? And who would determine what goods and services should be produced in the first place?

**BOX E-9. LEVELS OF GLOBAL PER CAPITA STEADY-STATE OUTPUT CONSIDERED IN THIS WORKING PAPER**

[All values converted to 2016 USD.]

***I. The Three Archetypal Scenarios*** [See Attachment B.2, Box B2-3]

- |                               |                       |
|-------------------------------|-----------------------|
| 1. Techno-Progressive World:  | NA (unlimited growth) |
| 2. Balanced Equitable World   | \$ 125,000            |
| 3. Green Sustainability World | 42,000                |

***II. The Climate Change Scenarios*** [See Attachment D.2, Boxes F.1, F.2, G.1, G.2]

- |                                      |         |
|--------------------------------------|---------|
| 1. RICE Scenario Display F.1 and F.2 | 132,000 |
| 2. RICE Scenario Display G.1 and G.2 | 54,000  |

***III. The Four Transition Scenarios*** [See Attachment E.1, Box E-8. + Endnotes 53 and 54]

- |                                 |        |
|---------------------------------|--------|
| 1. High                         | 48,000 |
| 2. Moderately High              | 32,000 |
| 3. Roughly Current (2016) Level | 16,000 |
| 4. Somewhat about subsistence   | 3,000  |

**Notes:**

\* The archetypal scenarios further show within-sector income distributions, by quintile.

\* The climate change scenarios further show trajectories for countries/geographical regions.

Note that it would not be possible for a person to work harder, longer or more creatively to earn more income unless a person or firm elsewhere in the world decreased their income by the same amount. Although it would be possible to earn greater income as one moves through a staged career ladder, it would not be possible for one generation to aspire to greater income than that of their parents.

It should be clear by now that a world of steady-state output would be far removed from anything resembling what today we would call a world of free-market capitalism. A steady-state output economy would necessarily be an almost fully administered economy, except perhaps at the most local levels. This administration would necessarily extend into many domains of our individual and community lives, including the allocation of educational opportunities and of careers.

In a steady-state economy there would likely be a trade-off between the level of output and the level of administrative control. The higher the level of steady-state output, the more complex the economy is likely to be, and thus the greater the level of administrative control needed. The more material well-being, the less individual freedom; the less material well-being, the more individual freedom. We'll likely need to develop understandings of both "material well-being" and "freedom" quite different from those most people hold today.

• • •

The stark reality is that the modernity that we've known and have been shaped by for the past ~ 350 years – about 14 generations - came about largely for the explicit *purpose* of facilitating economic growth. The project of greatly increasing the production and accumulation of more and better goods and services swiftly transformed the mind and culture of Europe and in short order the rest of the world as well.

Most everything that defines the human experience today, and that came to fruition *after* ~ 1670, has developed to support this drive for more and better goods and services. This includes science, the scientific worldview and techno-industrialism; capitalism as well as socialism; individualism, secularism and nationalism; rule of law as well as rule by party cadres; and world-scale imperialism and everything that followed in its wake, including anti-imperialism, national liberation and the development state.

This modernist inventory does *not* include the many more basic modes of human relationship and understanding that mostly developed well prior to ~ 1670: families, tribes, cities, commerce, religion, warfare, philosophy, the arts and much more. These have obviously been greatly shaped by the advent of the industrial order, and they've helped shape it in turn, but they emerged on the human scene much earlier and were not, and are still not, *dependent upon* industrialism and economic growth.

Economic growth is not a *feature* of modern society that can be acquired or set aside while the rest of society remains only minimally affected. It's part of a larger context *within which* modern societies exist. A society can shuffle its form of government from bourgeois democracy to social democracy to populist authoritarianism to military rule and then back to an earlier form. Each may be better or worse at promoting economic growth, and each may even seek to balance economic growth with other societal values. But over the past 350 years there is no record of any society anywhere seeking to *forego* economic growth (with the possible exception of Tokugawa Japan, ~ 1650-1850; see working paper DN 112). A modern society can change its laws on marriage and the family, or even its predominant form of religious belief, more readily than it can change its commitment to economic growth.

Economic growth is a world-defining phenomenon. It structures our aspirations, our self-understanding and our experience of self-worth, as individuals and as societies. If the prospect of increasing material reward were somehow suddenly and completely removed as a personal and social possibility, what would we aspire to, as

individuals and as societies? Obviously, there are individuals and small communities that are already, today, living frugal, non-accumulationist lives. But most of these rely, in big and small ways, directly and indirectly, on the material well-being of the larger society in which they live.

I'm not suggesting that there aren't good answers to the question of what we'd do without economic growth; indeed, this working paper is intended, among other things, to help in the formation of such answers. But I am suggesting that good, satisfying answers – answers that strong, responsible pro-growth advocates would need and want to take seriously – are not immediately at hand.

Marx and Engels (1848) famously stated that with the spread of industrial capitalism *all that is solid melts into air*. Some 170 years later we can say that if the prospect of economic growth was somehow suddenly removed from our understanding of the modern world, *all that is solid would melt into air*. We have no idea what a world of steady-state output would be like and how we would live in it.

• • •

The reasons we might desire a world of steady-state *throughput* are easily understood. We want to leave our descendants a planet at least as healthy and integral, and as capable of providing a sustainable and life-affirming level of material goods and services, as the one our forbearers left us. If technological innovation allows output to grow further while all these qualities maintain, all the better.

The reasons we might desire a world of steady-state *output* are less obvious. Why would we *not* want output to grow, assuming that appropriate and well-regulated technological innovation could allow it to do so without ecological harm or risk of exhaustion of essential resources? I can think of three possible reasons.

One reason could be a strong desire for a simpler, less materialistic, less consumption-driven world. A world of steady-state throughput would help dispose us towards such a world, but a world of steady-state output would dispose us even more strongly towards such a world.

A second reason could be a strong desire for a world of greatly reduced disparities of income and wealth. A world of steady-state throughput would likely require agreement on the equitable distribution of that throughput, but could otherwise allow the distribution of output to vary greatly. A world of steady-state output, however, would almost surely need to include agreement on the equitable distribution of that output as well.

A third reason could be a strong aversion to the prospect of a world in which nature has been all but completely replaced by technology. Remarkably, a world of steady-state throughput generates an incentive for *greater* replacement of nature by technology. By contrast, a world of steady-state output would have strong constraints on the replacement of nature by technology *built in*, so to speak. Any agreement on a desired level of steady-state output would to a large extent constitute agreement on an acceptable level of technological replacement of the natural world.

I find these reasons, taken together, compelling. But I realize that others might not, and I'm aware of the enormous difficulties that a world of steady-state output poses. It's not unreasonable for someone to take the position that we can and should aspire to steady-state throughput, affirm output growth through appropriate technological innovation, and still work to build a simpler, more just, less techno-centric world.

• • •

The preceding comments raise an intriguing question regarding *directionality*.

We say above that people might desire a world of steady-state output because they hope and believe that the achievement of such a world would dispose us towards the creation of a world of simplicity, economic justice, non-materialism, non-consumerism, ecologically integrity and technological responsibility.

But it's arguably the other way around. The case can be made that in order for us to achieve a world of steady-state output, we would need to have *first* built a world in which values of simplicity, economic justice, non-materialism, non-consumerism, ecologically integrity and technological responsibility are widely shared and lived. If we share and live such values, a world of steady-state output might just emerge as a consequence, not as a separate and distinct initiative.

It's easy to see that there's wisdom and practicality in approaching these challenges from both sides now.

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Given all that we've reviewed in this Attachment, what are we left with?

Here is a provisional tentative set of understandings and proposals regarding a future steady-state economy.

1. We should at this time aspire and plan to achieve a world of steady-state throughput.
2. As discussed earlier in the working paper outline, we should aspire and plan to achieve a world of economic justice, ecological integrity and technological responsibility.
3. We should aspire and plan to follow Trajectory 1, or perhaps Trajectory 2, shown in BOX E-8. If that should prove impossible we should be prepared to act as intentionally as possible in response.
4. It is not *necessary* at this time that we explicitly aspire to a world of steady-state *output*. Attempts to do so would likely prove dangerously divisive.
5. However, our desire to achieve steady-state throughput, together with our desires to ensure economic justice, ecological integrity and technological responsibility, will *strongly constrain* output growth.
6. It is highly likely that after some time even constrained output growth will become untenable, and we will need and want to transition to a world of steady-state output.
7. As a highly subjective guess I'd say that we might transition to a world of steady-state *throughput* over a period of perhaps 100-200 years, and to a world of steady-state *output* over an additional 100-200 years, giving a period of 200-400 years for a full transition to a world of steady-state output.
8. We have no idea, and *can have* no idea at this time, what such a world would be like in all its important regards.
9. The saving grace is this: that by aspiring to, and by successfully creating and living within, a world of steady-state throughput, as well as of economic justice, ecological integrity and technological responsibility, we will very likely be doing precisely the things that we need to do to prepare ourselves for an eventual transition to a world of steady-state output.

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## ENDNOTES

<sup>1</sup> In these notes we use the term “**steady-state**” to describe a quantity change per unit of time that remains stable, neither increasing or decreasing, i.e.  $dQ/dt = 0$ . The term was used by Daly in his earliest work and is widely used and understood. Jackson and Victor prefer “**stationary state**” because “steady state” is the term used to describe flows in the Solow growth model in which *the rate of growth* is steady, i.e.  $d^3Q/dt^3 = 0$ . “Stationary state” is also the term used by J.S. Mill in his 1848 essay on the topic. The term “**zero-growth**” was commonly used by environmentalists during the 1970s but is less frequently used now. The term “**degrowth**” is at times taken to mean a negative rate of output growth, at other times to mean an unchanging, flat rate of output, and more broadly by many Degrowth advocates to mean “a form of society and economy which aims at the well-being of all and sustains the natural basis of life.” See <https://www.degrowth.info/en/what-is-degrowth> .

<sup>2</sup> The first definition doesn’t necessarily include or imply any further definition of satisfaction, contentment and/or happiness and is compatible with the notion that further definition can be a matter of individual choice or creation. *Eudaimonia*, however, can be interpreted as pointing to some further, perhaps objective and/or universal, definitional elements of human flourishing, perhaps best articulated and offered or taught by philosophers, theologians or other very wise people.

<sup>3</sup> The term “indefinitely” is used in mathematics in lieu of the problematic term “infinitely.” In environmental or ecological economics it simply means a longer period than we need to worry about with regards to the topic at hand. Note that any steady-state flow of a non-renewable resource will eventually come to an end.

<sup>4</sup> The distinction I make between growth of **throughput** and growth of **output** is sometimes described as the distinction between **extensive** growth (a greater rate of throughput, and thus of output) and **intensive** growth (more clever and thus more valuable use of a *given rate* of throughput, which translates into a *growth* of output). A related distinction is sometimes made between **growth** and **development**, with the former referring to a physical or monetary increase, whether of throughput or output, and the latter referring to a qualitative improvement, which may or may not involve some sort of physical or monetary growth. In this usage, *development* usually implies a growth in *well-being*. A distinction is also sometimes made between **material** growth, which has finite limits, and **financial** growth, which does not; see e.g. Hahnel (2012).

<sup>5</sup> In Aristotelian terms Throughput is the *Material Cause* of Output, Labor is the *Efficient Cause* of Output, Imagination/Innovation is the *Formal Cause* of Output and Well-being is the *Final Cause* of Output.

<sup>6</sup> Or, for that matter, one of many relational configurations of throughput, output and well-being. See the Working Paper Outline, Attachment A, for examples and discussion.

<sup>7</sup> If you believe that technological innovation will be *unable* to generate continuously increasing output from a steady, non-increasing flow of throughput, at least beyond some short period, then this ambiguity may not be consequential. You can refer to a “steady-state economy” and the descriptor “steady-state” will accurately apply to both throughput and soon enough to output as well. But if you believe that technology has the potential to generate increasing levels of output from a flat flow of throughput for a long time to come, then the distinction is important. In this Attachment I’ve tried to be unambiguous on this count. Unfortunately, the repeated clarification can be intrusive, so at times I’ve left it to the reader to intuit what’s being said. I hope to find a better solution for the final working paper.

<sup>8</sup> In the wake of the Great Recession and growing economic inequality, orthodox macroeconomic theory faced a crisis of confidence. As a consequence many heterodox theories, frameworks and approaches that had long been

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pushed to the margins have been the focus of new attention. Ecological macroeconomics is both contributing to this revival and drawing upon it. For a useful brief history of ecological macroeconomics see Rezai and Stigl (2016).

<sup>9</sup> I haven't seen any comprehensive studies of a future steady-state economy that seek to identify in detail those throughputs that would need to be constrained, by how much, and via what policies or practices. I'll search again for these prior to preparation of the final working paper. I've seen partial analyses, mostly focused on acceptable rates of fossil fuel use.

<sup>10</sup> To further complicate the analysis and exposition, many authors whose concerns are primarily limited to steady-state throughput will none-the-less use output as their focal metric, as it is much more analytically tractable and widely understood.

<sup>11</sup> Brief discussion of the metrics of throughput, output and well-being can be seen in Attachment A of the working paper outline. I plan to treat these topics in more detail in the final working paper.

<sup>12</sup> Other names include the New Macroeconomic Consensus, New Consensus Macroeconomics, the New Keynesian Consensus and the New Synthesis.

<sup>13</sup> **Keynesian macroeconomic theory** was born in the experience of the **1930s Great Depression**. It argued that prevailing classical economic theory, which held that in a competitive economy prices would adjust to clear all markets and restore full employment, was wrong. Keynes said that in depressed situations households and firms prefer to hold onto money rather than invest it, creating a liquidity trap that prevents recovery. However, Keynes said, government spending could revive both consumption and investment, and re-establish full employment, through its direct impact on aggregate demand and secondarily through the multiplier effect of repeated rounds of income, savings and investment. During the **1950s-1960s** economists combined Keynes' aggregate demand theory with elements of classical market equilibrium theory to create a **Neoclassical Synthesis** that gained wide recognition. Two challenges arose in the **1970s-1980s**. One came from **Monetarists**, notably Milton Friedman, who emphasized the dangers of inflation and called for reliably long-term tight monetary policy, rather than flighty fiscal policy, to prevent it. The other came from **New Classical Economists** such as Robert Lucas, who argued that **rational expectations** would allow prices and wages to adjust quickly and smoothly to market shocks and establish themselves at optimal equilibria values with little need for government intervention, which in any event would necessarily be too late and wrongly calibrated. The **New Keynesians** responded by adopting portions of rational expectations theory and monetary theory as well, but still argued that "sticky" prices and wages, caused by menu costs, co-ordination failures and efficiency wages, did in fact prevent prices and wages from swiftly adjusting in response to aggregate demand or supply shocks. In the **1990s** economists from a range of theoretical schools established the **New Consensus**. It used New Keynesian theory to account for *short-run* fluctuations in economic activity, such as recessions, and used the mostly Neo-Classical **Solow Growth Model** to account for economic growth and related market behavior over the *long-run*. The New Consensus also re-emphasized the need for microeconomic foundations for macroeconomic theory, along with the importance of uncertainty, and it extended the Solow Model to bring **Endogenous Growth** into the macro models. The tenets of the New Consensus were reflected in the development of **Dynamic Stochastic General Equilibrium** (DSGE) models. These quickly became the workhorse models for much national and international economic analysis and policy. A recent intermediate macroeconomic text using the DSGE approach is Wickens (2011).

As noted earlier, however, the financial crisis of 2008 and its Great Recession aftermath dealt the credibility of New Consensus macroeconomics a hard blow. **Robert Solow** (2010) testified before a U.S. congressional committee that "... the DSGE model has nothing useful to say about anti-recession policy because it has built into its essentially implausible assumptions the 'conclusion' that there is nothing for macroeconomic policy to do... There are other traditions with better ways to do macroeconomics." In 2009 George Soros and others established the **Institute for New Economic Thinking** which, among other things, has sought to nurture more critical, unorthodox approaches to economic theory and policy.

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<sup>14</sup> Over the past 40 years population growth rates have been declining in countries throughout the world. Population is expected to grow to a global maximum of some 8-10 billion near the end of this century and then to begin a gradual decline. Well before that time population decline will have become a major concern in many countries, as it already has in e.g. Russia, Japan, Ukraine, Poland, Italy and Spain. Pro-natalist policies in these countries have had little impact to date.

<sup>15</sup> This proposal is one of a set of monetary reforms frequently proposed by steady-state economy advocates, along with the creation of sovereign money and local currencies. These are controversial. Dittmer (2013, 2015) argues that 100% reserve banking is a wholly impractical proposal intended to address questionable ends, e.g. the presumed growth imperative of debt-based money and the desire to constrain growth-inducing technological innovation. Proponents counter that loans for investments in appropriate innovative technologies could be obtained through time deposits. Proponents note as well that even well-regarded economists such as Milton Friedman and Martin Wolf (chief economist at the *Financial Times*) have expressed support for some forms of 100% reserve banking. Some proponents appear to support these monetary proposals out of a related but separable commitment to localism and to economies of small scale.

<sup>16</sup> This proposal addresses the Jevons paradox, discussed in Endnote 52 below.

<sup>17</sup> Daly (2008) argues that the WTO-WB-IMF complex is the closest thing we currently have to a world government, but that it's unaccountable except to international bankers and corporations, and that its mission is one of promoting global trade and economic growth in their interests. He offers a list of things these institutions could do if they were to act in the interests of building a steady-state zero-growth economy, e.g. impose penalty charges for both trade deficits and trade surpluses and create a world reserve currency in place of the U.S. dollar. Proposals of this sort might be compatible with our archetypal scenario of Balanced Equitable World. Daly's alternative proposal of disengaging "more fully" from international trade and all that that implies might be compatible with our archetypal scenario of Green Sustainability World.

<sup>18</sup> There is a large and growing body of academic research on Happiness. Recent survey research suggests that Happiness varies positively with household income when income levels are low, but follows a classic pattern of diminishing returns and tends not to increase once household income reaches levels of roughly \$75,000/year; see Short (2016) and Kahneman and Deaton (2010). Given these findings, advocates for a steady-state economy often appear perplexed as to why anyone would expend time and effort to generate household incomes greater than \$75,000. An obvious response is that people feel more strongly about relative income than they do about absolute income and are not happy when they find that they have lower incomes than do relevant others. There is much debate on these topics and on their implications for a proposed steady-state economy. Attachment A of the working paper outline includes a brief note on Happiness Studies and related material is found in working paper outline Endnotes 57-60. This topic will be addressed further in the final working paper.

<sup>19</sup> Model I (Keynesian IS-LM) is based on material in Mankiw (2016); Model II (Solow Growth) is drawn from Romer (2006); Model III (Post Keynesian) follows Erasmus University Rotterdam (2017).

<sup>20</sup> In a steady-state economy savings would still be necessary to cover 1) **depreciation** and 2) investment in appropriate **process innovation**. Further, money would likely be borrowed to cover **life-cycle investments**, e.g., education or home ownership. These loans would be paid back out of the stream of possibly higher income earned in the period after the loan is taken out. There's no contradiction between a world of zero output growth and a world in which people earn more as they advance in their careers, so long as there's no increase in lifetime earnings from generation to generation.

<sup>21</sup> See the Background Materials, Section II.A.1.b, for fuller discussion of the conditions needed to ensure steady-state throughput, as developed using neoclassical assumptions and analysis.

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<sup>22</sup> What constitutes a “robust” rate of total factor productivity growth? Nordhaus (1992) calculated the drag that natural resource constraints have on economic growth and found that output could continue to grow at historical rates so long as the rate of total factor productivity growth exceeded 0.25%/yr, that is, one-quarter of 1.0%/yr. This is comfortably below the 2.0% growth that has marked total factor productivity growth in developed economies for many decades, allowing Nordhaus to conclude that positive output growth is likely to obtain over the indefinite future. This result, barely more than a back-of-the-envelope exercise, is referenced repeatedly in support of the contention that technology can overcome resource limits to growth.

<sup>23</sup> Population would need to have been stabilized as well. But see endnote 14 above. How would a steady-state economy fare if faced with long-run absolute population *decline*?

<sup>24</sup> The distinction between product and process technologies seems clear in some instances but ambiguous in others and I’m not sure how useful the distinction is overall. The Model T automobile and the desktop computer were product innovations, while the assembly line and the internet were process innovations. In general, final customers see and judge product innovations directly, but neither see nor judge process innovations, other than indirectly as differences in cost, performance or reliability. MS-DOS might be considered both a process innovation and a product innovation. Amazon.com might be considered an entrepreneurial innovation: it combines process innovations (sorting and packaging lines and delivery systems) and product innovations (online shopping) to market mostly familiar, commonplace products. Complex taxonomies of innovation have been prepared but again I’m not sure how useful these are.

<sup>25</sup> Lavoie (2006) suggests that the heterodox schools of economic thought have common characteristics that distinguish them from orthodox neoclassical economics. These are, roughly: epistemological realism (vs instrumentalism), an organic or holistic ontology (vs individualism), reasonable rationality (vs substantive rationality), an analytic focus on production and growth (vs a focus on exchange and scarcity), and a political core that assumes a positive role for state intervention (vs an assumption of free market preference). Given these commonalities, might these heterodox schools in some sense be elements of a new, comprehensive approach to economic thought, waiting to be articulated, that overturns and replaces current orthodox economic thought? I don’t know.

<sup>26</sup> For a full survey of heterodox/alternative theories of economic growth see Setterfield (2010).

<sup>27</sup> As a partial example of such a review see Spash and Ryan (2012). They identify differences and synergies among neo-Marxists, critical institutionalists and post-Keynesians and they distinguish three “camps” of ecological economics: 1) new resource economics, 2) new environmental pragmatism, and 3) social ecological economics. Then they consider how each of the three heterodox schools of economic thought might address topics of special interest to each of the three camps.

<sup>28</sup> Introductory texts to Post Keynesian economics include Lavois (2015, 2006), Davidson (2011) and Holt and Pressman (2001). Also see Lee and Lavoie (2013).

<sup>29</sup> Lavoie (2015, 2014) shows about 25 schools of economic thought deemed heterodox, and other authors suggest additional ones. BOX E-5 displays 10 of these that have some clearly evident potential bearing on questions involving the nature of and prospects for steady-state economics. Sixteen additional heterodox schools identified by Lavoie and others are shown below. Some or many of these might also have special bearing on steady-state economics, and I hope to include notes on these in the final working paper. Many of the systems of economic thought shown below are not so much fully developed theoretical schools as they are topical or methodological networks, often relatively small in size. Still, there should be a place for consideration of even seemingly aberrant thinking, given the seemingly aberrant course upon which humanity has embarked. (NB: my labeling of the schools of thought shown in BOX E-5 and below follows Lavoie fairly closely but not exactly so.)

- 
- |   |                                       |
|---|---------------------------------------|
| 11. Institutionalists (old school)          | 19. The economics of conventions      |
| 12. Evolutionary Political Economy          | 20. Polanyi economics                 |
| 13. Social and humanistic economics         | 21. Gesellian economics               |
| 14. Schumpeterian economics                 | 22. Behavioral economics (old school) |
| 15. Development Structuralists              | 23. Neo-Austrian economics            |
| 16. French Regulation School                | 24. Agent-based modeling              |
| 17. Monetary circuit school                 | 25. Systems dynamics                  |
| 18. Social structure of accumulation school | 26. Georgian economics                |

<sup>30</sup> See Lavoie (2006, 2015), Davidson (2011), Holt and Pressman, eds. (2001), and Hold et al, eds. (2009.)

<sup>31</sup> See Kaheman and Tversky (1979) and Kahneman and Diener (2003). In 2002 Kahneman won the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel. See also the many good behavioral economics online bibliographic guides, e.g. <http://www.behavioraleconomics.com/books/>.

<sup>32</sup> The foundational Evolutionary Economics text is Nelson and Winner (1982).

<sup>33</sup> The major body of economic analysis identified as transformational growth theory is that associated with New School for Social Research economist Edward J. Nell. His key text is Nell (1998). See also Gualerzi (2010).

<sup>34</sup> A widely used introductory text is Daly and Farley (2010).

<sup>35</sup> Conventionally, *weak sustainability* allows the unlimited substitution of human capital and physical capital for nature, whereas *strong sustainability* sees human and physical capital as complements for nature rather than substitutes. There are many gradations between these polar conditions.

<sup>36</sup> See working paper outline Endnote 55 re *Zakat*, the Koranic injunction to Muslims to contribute a percentage of wealth annually for care of the poor. *Zakat* is one of the five pillars of Islam.

<sup>37</sup> For example: in many Post Keynesian models, economic growth is in major part a function of investment, which in turn is in part a function of the distribution of wealth and/or income. Such functional relationships don't appear in either the short-term Keynesian models of economic fluctuations or the long-term Solow models of economic growth.

<sup>38</sup> Post Keynesian economics and ecological economics also share the historical experience of being marginalized by the mainstream orthodox economic community. Mainstream economists felt that Post Keynesian economics was simply wrong and that the topics of interest to ecological economists could be best addressed using the orthodox tools of environmental economics. It's possible that this common rejection has helped bring these two heterodox schools together.

<sup>39</sup> As noted, New Consensus economics is criticized by Post Keynesians, and by others as well, for the foundational role it assigns to the concept of *equilibrium*. Critics maintain that equilibrium is a bogus concept that is, if anything, the *opposite* of how real economies actually behave. They claim that its central role was inspired by a combination of 1) physics envy, which allowed mathematically talented economists a wealth of opportunities to exercise and display their skills, and 2) its appeal to ideologically conservative economists and their backers as a tool that would allow a set of clearly normative, political questions to be portrayed as scientific ones. It's intriguing to note that advocates of steady-state economics, who have largely been critical of the equilibrium fixation of New Consensus economists, have chosen what might be considered an absolutist form of equilibrium as the foundation of their own work.

<sup>40</sup> Robert Solow, quoted in Stoll (2008).

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<sup>41</sup> Twenty-eight years is an unrealistically short period within which to expect that social and political changes of the magnitude represented by the model results could be achieved and thus raises questions about the structure of LOWGROW and/or about the assumptions made as part of the exercise. In the working paper archetypal scenarios I make the assumption that changes of this magnitude happen over a period of 100-200 years. In this Attachment I suggest that realization of an economy of steady-state output might require 200-400 years.

<sup>42</sup> This ideological looseness may in part be a tactical calculation. Some advocates of a steady-state economy may believe that they have a greater chance of gaining larger audiences if they portray steady-state economics as compatible with capitalism. Many avowed socialists argue that only under socialism will a steady-state “green” economy be possible, seemingly in hopes of attracting environmentalists to the socialist cause. Less commonly, other socialists argue that proposals for a steady-state economy are either dangerously misguided or are a product of class prejudice, as such proposals assign the working classes to an unnecessarily low level of economic well-being and sustain capitalist relations of production and thus of power.

<sup>43</sup> Hyman Minsky was an American economist noted (posthumously) for his studies on the nature of financial crises, largely conducted within Post Keynesian economic frameworks. His *financial instability hypothesis* suggested that speculative bubbles are not so much aberrations of efficient capital markets and investment behavior as they are the result of natural, even rational, inclinations on the part of firms, banks and consumers to incrementally take greater risks, using greater amounts of borrowed capital, the longer that a period of economic prosperity and growth persists.

<sup>44</sup> If steady-state capitalism is in fact an oxymoronic unicorn, what can be said about the nature of and prospects for steady-state *socialism*? A steady-state economy would require a high degree of centralized planning and coordination and for that reason, along with many others, it would appear to be not only compatible with but require some sort of socialist political-economic framework. Two objections are that 1) all past real existing socialism has been as committed to economic growth as capitalism has been, and 2) all past real existing socialism has failed. However, these aren't fatal objections. We've already suggested that a steady-state economy and society will need to have features that no economy or society has ever before had. We're on untrod terrain. I haven't seen any worked-through proposals for what a truly steady-state socialism might look like in practice. It's quite possible that a steady-state economy several centuries in the future would neither resemble nor be called “capitalism” or “socialism” as we understand them today.

<sup>45</sup> The elasticity of substitution ( $\sigma$ ) between labor and capital measures the proportional change in the capital/labor ratio (K/L) with respect to the proportionate change in the rate of technical substitution (RTS) along a production function isoquant:  $\sigma = \% \Delta (K/L) / \% \Delta RTS = d K/L / d RTS \times RTS/K/L$ .

<sup>46</sup> The past decade has seen a flood of commentary on the ways in which new developments in robotics and artificial intelligence (AI) will transform the workplace and the economy. Some predict that robots will replace massive numbers of workers, only a few of whom will have the skills needed for those few jobs left for humans. Proponents of this scenario include Silicon Valley notables such as Mark Zuckerberg (2017) of Facebook, who speak in support of a Universal Basic Income (UBI) to allow the displaced masses to exist without having to work. Others believe that the historical pattern will repeat itself: the use of robotics will generate greater income for firms and their stockholders, who will use it for consumption or investment, in either case eventually helping create new demand for labor. Educational institutions will provide needed training, perhaps with public sector assistance.

<sup>47</sup> I say *developed* countries because the growth/inequality dynamic for developing countries can be more complex. Dishwashers in urban restaurants can earn more than they did as poor rural farmers, and their children, educated in state-supported schools, will do better still. As poor rural farmers move to wage labor in the cities, economic inequality will in general decline. On the other hand, the dynamics of catch-up growth, in which modern technologies and business practices need only to be acquired rather than invented, allow small numbers of well

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positioned, trained, energetic and lucky individuals to amass prodigious wealth within a short number of years. The play of such dynamics can generate a variety of patterns of growth and distribution in developing countries.

<sup>48</sup> See the working paper outline **Background Materials II.B.** for statistics on global economic inequality. I plan to include a current summary of statistics on global economic inequality in the final working paper.

<sup>49</sup> See the working paper outline Discussion Note 59.

<sup>50</sup> It's unclear how many people would find work time reduction attractive. The prospect of taking a 40-50% reduction in wages or salary in return for time to "grow and prepare your own food, repair your own appliances... play games and watch movies and TV, visit with and help care for neighbors... and engage in social activism." [*find cite*] may appeal to many people, but certainly not all. Many advocates emphasize the need to "educate" citizens about the value of work time reduction, while others go further and say that it would be imposed by law. Frequently the argument for reduced work time appeals to values of individualist autonomy, desire and freedom: you'll be able to "take time off for a career break," "pursue personal growth experiences," "work when you want to," and "retire when you're ready" [*find cites*]. But such values are the antithesis of what we'll likely need to cultivate in a true steady-state society. Further, although many work situations are objectively oppressive and demeaning, others are not. Many people enjoy their work, and take pride in doing it well and in the contribution they thereby make to society. As many advocates of work time reduction acknowledge, it can only work if accompanied by a broader and deeper transformation of values, culture and civilization.

<sup>51</sup> There are as usual many additional caveats. It's possible, even likely, that the rate of productivity improvement via technological innovation would be negatively impacted by the universal adoption of a 3-day workweek (or equivalent). In that case it would take longer to return to the pre-downshift level of output.

<sup>52</sup> Note that we're not talking here about "**bounce-back**" or the **Jevons paradox**. These refer to situations in which efficiency savings reduce the price of a product and thus encourage greater quantities of it to be purchased, in the process wiping out any projected aggregate reduction in resource use. The Jevons paradox clearly doesn't apply to all products; if the energy efficiency of washing machines improves by 15%, most households aren't going to rush out and buy a second washing machine. But it's been documented for other products, such as automobile gasoline. If the price of gasoline drops by 15% drivers will tend to buy more of it and drive more miles. The extent to which the Jevons paradox might operate on the aggregate global economy is unclear. For more on bounce-back and the Jevons paradox see e.g. Owen (2010).

<sup>53</sup> Figuring very roughly, we might associate the four trajectories shown in BOX E-8 with dollar values as follows. Assume that the common Y- intercept marks the current per capita Gross World Product of \$16,000 (2016 USD PPP). Then the four trajectories suggest scenarios in which GWP/capita attains steady-state at these levels:

| <u>Trajectory</u>                          | <u>GWP/capita</u> | <u>Comparables (2016 USD PPP)</u>    |
|--|-------------------|--------------------------------------|
| 1) high, ~ 3 times today's level:          | \$ 48,000         | Taiwan (48,000), Germany (48,100)    |
| 2) moderately high, ~ twice today's level: | 32,000            | Slovenia (32,100), Israel (35,200)   |
| 3) roughly the current level:              | 16,000            | China (15,400), Costa Rica (16,400)  |
| 4) somewhat above subsistence:             | 3,000             | Tajikistan (3,000), Tanzania (3,100) |

Source: *International Monetary Fund* (2016)

[https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_GDP\\_\(PPP\)\\_per\\_capita](https://en.wikipedia.org/wiki/List_of_countries_by_GDP_(PPP)_per_capita)

<sup>54</sup> These sets of scenarios are from different sections of the working paper and were prepared at different times using different data sets and for different purposes. For the final working paper I might construct a single set of scenarios for common reference throughout the paper.

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