

Chapter for inclusion in forthcoming book
“Schumpeter’s *Capitalism, Socialism and Democracy*
A Twenty first Century Agenda”
Edited by
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Routledge – 2018

Secular Stagnation and Creative Destruction: Reading Robert Gordon
through a Schumpeterian Lens*

7 November 2017

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Returning to Schumpeter’s *Capitalism, Socialism and Democracy* after seventy-five years is not at all an antiquarian exercise. On the contrary, it is vitally important for anyone trying to understand our current political economic situation. Schumpeter sought to make sense of the turbulent decades that had produced the First World War, the Bolshevik Revolution, the Great Depression, and the Second World War. Schumpeter was, above all, a theorist of historical discontinuity; he did not see societies or economies moving along some smooth trajectory, but rather, he emphasized disruption, creative destruction, and the likelihood of deep economic downturns.

In this sense, Schumpeter’s approach contrasts sharply with the views that have dominated the social sciences since the 1950s. In parallel with the emergence of the United States as the dominant global power after World War II, the social sciences have generally emphasized continuity, linearity, and stability. This is most evident in neo-classical economics

* I am grateful to the editors and to Larry Hirschhorn, Matthew Keller, and Marian Negoita for feedback on an earlier draft.

with its focus on the propensity of market economies to achieve equilibrium, but similar themes are echoed across the social sciences. In sociology and political science, for example, much work emphasizes path dependence – the tendency for social or political development to proceed along the same track that had been established sometime in the past.

However, it is now clear that the Global Financial Crisis that exploded in 2008 has basically returned us to Schumpeter’s world of discontinuity and disruption. Even ten years after the dramatic events that required a massive rescue of many of the world’s leading financial institutions, the world economy has barely recovered its earlier dynamism. Central banks continue to use unconventional methods such as massive bond purchases and negative interest rates to avert another economic downturn. The term “secular stagnation” that last flourished in the 1930s and early 1940s has returned as a diagnosis of this period of significantly slower global growth. Moreover, the presumption of global political and military stability that has been part of the post-World War II world has also been punctured. The ferocity of the Syrian Civil War, just 900 miles from Europe’s Southern border, and the Russian incursions into the Ukraine have raised the specter of a broader military conflict.¹

Since our conventional social science with its focus on continuity and stability cannot make sense of these dramatic shifts, we must return to the insights of scholars such as Schumpeter who sought to make sense of an epoch of discontinuities.² This essay does this by elaborating a Schumpeterian critique of the important recent book by Robert Gordon, *The Rise and Fall of American Growth*. Gordon argues that the extraordinary century of U.S. economic growth from 1870 to 1970 has ended, and we have entered a new period in which major headwinds make it highly likely that economic growth will continue to occur at a much slower pace than before 1970. While Gordon certainly recognizes a major discontinuity, or break, in

historical development, I will argue that had he used the intellectual tools that Schumpeter provided, he would have been able to develop a much more powerful explanation for that discontinuity.

This essay is developed in four parts. The first part explains Schumpeter's view of long economic cycles and shows how that idea has been further developed by later scholars. The second part summarizes the core arguments of Robert Gordon's book and lays out a critique. The third part brings Gordon into dialogue with Schumpeter and offers an alternative explanation for Gordon's findings. The final part is a conclusion.

2. SCHUMPETER AND NEO-SCHUMPETERIAN THEORIES

In *Capitalism, Socialism, and Democracy*, Schumpeter expressed his skepticism about theories of secular stagnation that were common in the 1930s and early 1940s. Schumpeter's Harvard colleague, Alvin Hansen (1938) was one of the most famous proponents of this line of analysis. But in his Chapter 10, Schumpeter takes direct aim at those who claim that capitalism faces a crisis because of the vanishing of investment opportunities. He characterizes the view of his opponents as follows:

According to this view, we have been witnessing not merely a depression and a bad recovery, accentuated perhaps by anti-capitalist policies, but the symptoms of a permanent loss of vitality which must be expected to go on and to supply the dominating theme for the remaining movements of the capitalist symphony ... (111).

Schumpeter also notes the similarities of this diagnosis to the views of an earlier generation of economic thinkers between 1873 and 1896 who also imagined that they were living through the end of the capitalist symphony. No paragraph break hereSchumpeter's argument grew out of his massive study, *Business Cycles* (1939), in which he sought to explain the

development of capitalism from 1787 onward. In that work, Schumpeter made use of the framework elaborated by the Soviet economist, Nicolai Kondratief.

Kondratief identified long economic waves of forty to fifty years. At the beginning of each of these waves, a handful of key technological advances produced dramatic growth in productivity and self-reinforcing dynamism. However, after twenty to twenty-five years, dynamism would slow and the economy would face serious barriers and extended periods of stagnation or slow growth. This contractionary phase could last as long as twenty to twenty-five years, and then a new wave of expansion would occur.³

Schumpeter wedded this framework to his view of the disruptive role of the entrepreneur. Schumpeter starts with the economy operating at some kind of equilibrium, but quite suddenly innovators, often working simultaneously in different industries, introduce new products and new processes that compete directly with established business models. The disruption drives profits and capital towards the new groups and will also accelerate economic activity. However, it also forces economic actors around the economy to retool their plans as they attempt to respond to the disruption. The response is often excessive optimism resulting in too rapid an expansion of productive capacity. At some point, the bubble bursts and firms begin a rapid process of retrenchment, and the economy enters recession. Under certain conditions, the recession can become a depression, and, following Kondratief, the resulting period of stagnant growth can continue for decades.

There are points in his analysis where Schumpeter suggests that changes in government policy are necessary to make possible a new period of expansion. For example, in his discussion of the first Kondratief from 1787 to 1842, he recognizes that railroad building began in the 1830s, but he also emphasized that momentum was extremely limited:

Comparative slowness of beginnings is accounted for also by the fact that the entrepreneurial task of breaking down the resistance of the environment proved astonishingly difficult. Impediments, such as constraint to pay tolls to canal companies in cases of competition, local jealousies obstructing necessary connections, and so on, were not overcome until much later (Schumpeter 1939, vol. I, 291).

Since railroad building was the big driver of the next Kondratief cycle (1843-1897), it follows that railroad entrepreneurs were ultimately successful in changing the political environment to break down these constraints. In fact, he discusses at length the importance of government land grants as a mechanism that allowed railroad entrepreneurs to float the bonds that provided the immediate financing needed to pay for railroad construction.

Schumpeter also recognizes that at certain points in history, it has been government officials who have played the entrepreneurial role of breaking down barriers to technological advances. For example, in discussing German economic development in the early years of the 19th century, he describes the entrepreneurial role of German princes in setting up some of the most advanced manufacturing and mining operations (Schumpeter 1939, Vol. 1, 284). In this sense, Schumpeter anticipated by almost 75 years Mazzucato's (2013) discussion of the "entrepreneurial state".⁴

A group of Neo-Schumpeterian scholars have built on these insights to construct a somewhat revised theory of long waves that sees action by the public sector as critical to the start of a new period of expansion. One strand of this work is the Social Structures of Accumulation perspective developed initially by David Gordon, Richard Edwards and Michael Reich in the United States (Gordon 1980; Gordon et al. 1982; see also Kotz et al. 1994 and McDonough et al. 2010).⁵ Another strand is the work of Christopher Freeman and Francisco Louçã (2001) and of Carlota Perez (2003) developed at the Science Policy Research Unit at the University of Sussex in England.⁶

For both of these groups, Franklin Roosevelt's New Deal in the United States represents the paradigmatic example of government policy facilitating a new period of economic expansion – the thirty glorious years of economic growth after World War II.⁷ The basic argument is that the 1910s and 1920s in the U.S. were decades of economic expansion driven by electrification and the mass production of the automobile. Just as in Schumpeter's model, these entrepreneurial breakthroughs led to vastly exaggerated expectations that culminated in the 1929 crash and the Great Depression. The crux of the problem was that the U.S. had developed the technologies of mass production without facilitating mass consumption. During the 1920s, wages of industrial workers lagged far behind productivity growth, and farm incomes also stagnated. Moreover, the U.S. had not yet developed the infrastructure to extend credit to consumers, so purchasing power lagged far behind the capacity to produce (Block 2015).

Across a number of fronts, Roosevelt's New Deal carried out reforms that were intended to create a mass-consumption economy. One critical piece was the development of a new system of mortgage financing that made possible the accelerated process of suburbanization after World War II. Another piece was made up of agricultural and labor policies that allowed both farmers and industrial workers to enjoy higher incomes that allowed them to participate more fully in a consumer-driven economy. There were also critical investments in infrastructure and ultimately the design of global institutions, including the IMF and the World Bank, to stabilize the global economy in the post-War period.

It was these Roosevelt era policies that laid the basis for the dynamism of the U.S. economy from 1945 to 1969. Yet as the Kondratief-Schumpeter argument suggests, an economic expansion based on the automobile and suburbanization began to experience greater strains by the later 1960s and early 1970s. The result were the growing economic difficulties experienced

by the U.S. and the global economy in the 1970s that gave rise to intense debates over economic policy choices. In the U.S., these debates culminated in a “Right Turn”, as Ronald Reagan’s administration launched a period in which the U.S. sought to fix the economy by massive tax cuts for the wealthy and big corporations, a reduction in the burden of government regulation, and cutbacks in public programs that benefited the poor and the middle class.

Analysts in the Neo-Schumpeterian tradition have divergent views on how to characterize the four decades that started with Reagan’s Presidency. Some argue that there was a neo-liberal long-wave upturn based on the computer and biotechnologies that began in the early 1980s and ran out of steam by the middle of the 2000s. Others have suggested that the entire forty-year period since the mid-1970s should be understood as the downward phase of the long cycle that began right after World War II. As in other down phases, there have been significant technological advances, such as the computer revolution, but in the absence of the appropriate social and economic policies, those technological advances have not been sufficient to generate the dynamism that is characteristic of the expansion phase of a long wave. But adherents of both of these positions agree that significant new public-sector initiatives are required to facilitate a new period of expansion that takes advantage of computer technologies and renewable sources of energy.

In sum, the core Schumpeterian insight is that there is no inevitability to the coming of a new period of economic expansion after a depression. His view is radically different from the Hayekian view that the downturn cleanses the economy and pushes wages, interest rates and raw material prices down to a level where business people again see the potential of profit in new investment activity. On the contrary, in a depressed economy, entrepreneurial agency is necessary both in the form of businesses trying to exploit new technological possibilities and in

actions, now typically undertaken by governments, to create the infrastructure and the social acceptance required to bring those new technologies to scale.

3. CRITIQUING GORDON'S ARGUMENT

Introduction

Robert Gordon's massive book, *The Rise and Fall of American Growth*, is important because it has arrived in the midst of a renewed debate about secular stagnation. While other analysts have developed theoretical arguments about stagnation, Gordon's book is an ambitious empirical study that seeks to analyze changes in the nation's standard of living over a century and a half.⁸ Gordon's argument is that the rapid improvement in the American standard of living that occurred between 1870 and 1940 was both unprecedented and impossible to replicate because it depended on a series of massive technological improvements – electricity, the automobile, and indoor plumbing – that have not been equaled by any subsequent technological advance. Gordon argues that from 1940 to 1970, the economy continued to benefit from those breakthroughs and a few related ones, such as television and commercial aviation, but that from 1970 onwards, the improvements in the standard of living pale in comparison to the heroic period from 1870 to 1940.

Gordon does not ignore the computer, the internet, and other advances in communications technology, but he argues that the slowdown in measured productivity growth in the 21st century indicates that technology is influencing a much more narrow slice of human life than in those earlier periods, and this means that we cannot expect the kind of dividends of economic growth that were experienced earlier. It follows that we have little choice but to reconcile ourselves to a period of slower economic growth. In this respect, his analysis is far

more pessimistic than that of Larry Summers (2016), who has argued that the problem of secular stagnation can be solved by aggressive government spending on infrastructure.⁹

There is much to admire in Gordon's massive study. As with Thomas Piketty's (2014) influential book, *Capital in the Twenty-First Century*, which is rooted in actual data on the distribution of income and wealth over many decades, Gordon's work rests on a rigorous effort to document how technological change has transformed everyday life. Moreover, in much of the book, Gordon is deeply skeptical that official economic data – the estimates of GDP – adequately capture the magnitude of the changes. He stresses repeatedly that important qualitative changes, such as increases in life expectancy, reductions in the physical toll that work imposed on the body, as well as the convenience of indoor plumbing, are not reflected in the economic measures. Gordon also mobilizes an encyclopedic knowledge of the history of specific technologies, such as the telephone, the assembly line, and a host of other critical innovations.

Gordon, a professor at Northwestern, also does not carry the ideological baggage of the nearby Chicago school of free market economics. On the contrary, Gordon repeatedly emphasizes the central role that the public sector has historically played in nurturing and supporting technological innovations. He explains, for example, that government efforts to advance war production during WWII literally doubled the economy's supply of machine tools and that huge investment contributed to the post-war prosperity. He also cuts against the grain of his discipline by arguing that New Deal labor reforms were a driving force in the rapid increases in manufacturing productivity in the 1940s and after.

Gordon is also wisely critical of certain distinct patterns of growth that characterize the U.S. While recognizing that suburbanization was central to U.S. growth for decades after World War II, he argues that the particular way in which suburban development occurred in the U.S.

produced a range of negative consequences. These include sprawl, vast housing tracts that are distant from available retail services, and the hollowing out of once vital cities. He insists that many of these consequences could have been avoided with better planning, and he points to the superior land-use patterns that have characterized European cities.

Finally, Gordon's account of the scale of the transformation of the average standard of living in the century from 1870 and 1970 is fundamentally sound. He acknowledges that race and gender discrimination meant that not all of these advances were shared, but he is persuasive in insisting that the combination of electrification, the internal combustion engine, and indoor plumbing represented a huge improvement in the quality of people's everyday life.

The Measurement Problem

Most of the problems with Gordon's book become apparent in the second half of the book, when he focuses on the period since 1970. Here, again, he acknowledges the limitations of GDP as a measure of economic output, but he argues that for the recent period, the distortions are significantly more modest because the national income accountants have made adjustments for quality improvements for such key items as automobiles and computers. He argues, for example, that huge improvements in the quality of lighting and of automobiles between 1910 and 1940, for example, had gone unnoticed and unmeasured in the official data. The consequence is that increases in prices were overstated and, hence, growth in output was understated. However, in recent decades, the statisticians have introduced new methods to capture qualitative improvements in key products, making both price indexes and measures of output change more accurate.

But Gordon completely ignores one of the most important changes in recent decades; the extraordinary proliferation in the variety of consumer goods available in any given category. The change is enormous from the early years of the century when you could order a new Ford car in any color as long as it was black. Moreover, with the search capacity of the internet, consumers are able to find relatively quickly a precise match to what they are looking for. To be sure, not all of this de-standardization of products is truly necessary, but it does raise huge measurement issues. First, the accuracy of price indexes based on a standardized basket of goods becomes problematic when most consumers are no longer buying a quart of whole milk but are divided across skim milk, 1% milk, lactose-free milk, soy milk, almond milk, each of which comes in a proliferation of types with prices that vary in different rhythms. Second, how does one account for the consumer's recently acquired ability to tailor his or her milk purchase to a very specific set of dietary and esthetic needs? Is that not a gain in consumer surplus comparable to the enormous convenience of indoor plumbing? Moreover, while Gordon waxes rhapsodic about the lifestyle gains from electric light bulbs and the mobility facilitated by the automobile, he mostly ignores the convenience gains of ordering products over the internet and avoiding the drive to the mall.

And that is only the tip of the iceberg. Gordon ignores some of the key qualitative changes in economic output that have been realized with billions and sometimes trillions of dollars of investment. The United States has spent vast sums since the early 1970s on environmental projects including reducing air and water pollution, cleaning up toxic waste dumps, and slowing the production of greenhouse gases. While Gordon earlier placed much emphasis on the qualitative gain derived from removing horse manure from city streets when cars replaced horses, he completely fails to recognize the consumer gain from these initiatives.

Perhaps he needs to spend more time in Beijing during one of their air-pollution crises to be reminded of the value of being able to take a deep breath without a feeling of choking.

It is also surprising that Gordon as a fierce critic of U.S.-style suburbanization neglects the work done over the last thirty years to make large cities more like the great cities of Europe with cafés along the waterfront, attractive urban parks, and other amenities that are appealing to both tourists and residents. The investment in these amenities is closely linked to the revitalization of downtown areas, and one only has to spend a little time in New York, or Chicago, or San Francisco, or almost any other large city to see how many people are taking advantage of these amenities. Surely, the benefits that consumers receive are far more than what they pay out in hotel and restaurant bills.

Most critically, Gordon is intellectually inconsistent when he rushes past the gains in life expectancy at sixty that have occurred from 1970 to the present. In the first part of the book, he makes a big deal of the gains in life expectancy at birth that occurred between 1870 and 1970 that resulted largely from dramatic reductions in infant mortality. On page 463, however, he acknowledges that life expectancy at age sixty rose more than 33% from 1950 to 2008, but he does not linger on this fact. Here is the full story: In 1900-1902, the best estimate is that life expectancy at sixty was 14.76 additional years. By 1969-71 that had risen to 18.34 years, but by 2011, it had increased to 23.12 years. In other words, during 70 years of Gordon's heroic period, the average increase was 3.6 years, but in the forty years following 1971, the increase was 4.8 years (U.S. Department of Health and Human Services 2015, Table 21). This is a significant acceleration in the improvement in life expectancy that occurred in Gordon's epoch of allegedly slow growth.

Moreover, as Gordon knows, we now have measures of Quality Adjusted Life Years that assess the degree to which additional years of life are burdened by illness and disabilities (Stewart et al. 2013). These indicators show continuing improvements in this measure in the period from 1987 to 2008. This means that much of that almost five-year improvement in life span over the last forty years has not been marred by an earlier onset of dementia or other illnesses that destroy the quality of life. Is it not a monumental improvement in the standard of living that the average person now enjoys 4.8 additional years once they reach sixty? Given the low rates of labor-force participation for those sixty-five and older, this means that a lot of people are, in fact, enjoying “golden years” that were previously available only to a small slice of the human population.

To be sure, there is the distressing recent data reported by Case and Deaton (2015) about higher rates of mortality among prime-age white males, and we also know that some portion of the elderly are struggling to survive on Social Security checks that are pathetically small. So the demographic data are not all upbeat. Nevertheless, Gordon’s insistence that there is a difference between the standard of living and GDP measures rings hollow when he simply ignores the extraordinary achievement of extending the life span of people at age 60. While he is right that our health-care system is extraordinarily wasteful, one has to recognize that the trillions that we have spent have resulted in big improvement in quality-adjusted life years.

But the single biggest problem with Gordon’s study is his reliance on trends in Total Factor Productivity (TFP) in the period from 1970 to the present. TFP is a measure that tries to assess the size of annual increases in real GDP that occur independently of growth in quality-adjusted inputs of labor and capital. TFP is a residual; it is an estimate of the portion of output growth that can be explained by technological progress or growing sophistication in our

knowledge of how to use resources efficiently to produce outputs. Much of Gordon's argument hinges on his Figure 17-2 (575) that shows TFP rising at 1.89% per year from 1920 to 1970 and then increasing at only 0.57% per year between 1970 and 1994, at 1.03 per year from 1994 to 2004, and then back down to 0.4 from 2004 to 2014.

Reliance on TFP assumes that GDP is an accurate measure of the growth in economic output, that the GDP deflator is accurately adjusting for changes in prices, and that the statisticians have developed appropriate measures of annual quality-adjusted changes in both labor and capital inputs. But these are heroic assumptions given how dramatically economic output has changed over the past century. Gordon cites a consumer study from 1917 to 1919 in which households were spending 41.1% of their income on food and 17.6% on clothing as compared to 5.4% and 3.1% in 2014. In 2016, goods of any kind – durable and nondurable – represent only about a third of consumer purchases. But the problem is that the output of the service sector – education, health care, public services, retail services, and financial services – are difficult to measure, and it is even more difficult to measure accurately the labor and capital inputs into the production process.

For example, national income accountants include the net interest earned by banks as one element of the value added of the banking sector (Christophers 2013). The theory is that one of the key services that banks provide to the economy is intermediation, that is, connecting savers to borrowers, and the net interest earned by banks is a reasonable proxy for the value of those intermediation services that do not have an actual price tag. This represents a large exception to the way that interest flows are generally treated in the national income accounts; in the case of nonfinancial corporations, the interest they earn is not included as part of their contribution to GDP on the assumption that it is a transfer of income from somewhere else. Moreover, making

this exception for banks is problematic because many economists believe that banks are not fundamentally intermediaries; they are institutions that are authorized to create credit. It follows that net interest is a problematic measure for the value to the economy of banks' credit-creating role. But these measurement problems are not trivial because the U.S. GDP data shows that the value added provided by banking and insurance in U.S. GDP almost doubled between 1970 and 2008 from 4% to 8%.

Comparable problems emerge for another sector that also grew very rapidly across that same period – the health-care industry. On the one side, most output of the health-care sector is measured in GDP in terms of the dollar value of the services that were paid for. But as anyone who has had an overnight stay in a hospital knows, the resulting hospital bills are a work of imaginative fiction, and usually both private insurers and Medicare pay only a small fraction of the amount requested. But this also suggests that anything that shifts the relative bargaining power of insurers and hospitals can produce not insignificant shifts in the dollar value of the services that hospitals provide. And then national income statisticians face the daunting task of trying to differentiate between inflation and quality improvements. If the cost of a coronary bypass increases 15% from year one to year two, but patient-recovery time is cut in half, what portion of the price change should be attributed to quality improvement? Notwithstanding Gordon's claim that national income accountants have gotten better at measuring quality improvements, the U.S. statisticians are only beginning to tackle this problem (Hall 2015).

And here we get back to the improvements in life expectancy at sixty and the upward trend line in Quality Adjusted Life Years. A more accurate measurement of GDP would attempt to adjust the dollars spent on health-care services to reflect the real gains in quality of health-care delivery. But the current data do not do that. Since health care is now reported to be 17.5% of

GDP, the problem is considerable. Together, health and finance represent about a quarter of GDP, but other poorly measured sectors, such as education, government, and retail services, mean that our measurement scheme works badly for more than half the economy.

Furthermore, there is the huge issue of the mismeasurement of the public sector and the nonprofit sector. Essentially, the national income accountants assume the output of this part of the economy to be equal to the main input – the cost of labor. This means that productivity gains are impossible because output is just defined as being equal to the labor input. But since the weight of government and the nonprofit sector is much larger today than in 1940, this procedure pretty much assures that there will be a downward bias in economy-wide measures of productivity. But here again, there are strong reasons to believe that the society's investment in government has produced returns that are completely unmeasured in GDP (Daly 2014).

The TPM is a measurement of a residual – the portion of economic growth that cannot be explained by changes in capital and labor inputs. However, our basic measure – GDP in real terms – of how much the economy has grown between 1970 and the present is flawed because we do not have good ways to measure the output of the service economy. It follows that the elaborate calculations involved in figuring out the TPM are a highly unreliable foundation for reaching the kind of conclusions that Gordon reaches.

The standard defense that Gordon suggests and that has been widely used by economists is that even if there is some bias in the official data because of poor measurement of the service sector, this is only a problem if the bias is increasing significantly over time. This defense is plausible when one compares output over shorter periods of time, such as five or ten years. Over such intervals, it seems implausible that quality improvements in health care, for example, would be so dramatic as to offset a finding that real GDP growth had slowed to 1.7% per year from an

earlier growth of 3%. But the focus of Gordon's study is on comparing changes in consumption over much longer time periods, such as the four decades from 1970 to 2010. Over that period, for example, the purchase of services increased from half to two-thirds of personal consumption expenditures. Should one rely on that same data, when service output is poorly measured in GDP? Gordon's dependence on these dubious numbers represents a disappointing departure from the strong commitment to empiricism that has characterized much of his scholarly research.

Gordon's Inadequate Understanding of Contemporary Innovation

The most surprising weakness of Gordon's project comes towards the end of the book when he discusses solutions to the problem of slower growth. He states:

The potential effects of pro-growth policies are inherently limited by the nature of the underlying problems. The fostering of innovation is not a promising avenue for government policy intervention, as the American innovation machine *operates healthily* on its own (emphasis added, 643).

One could write a whole book explicating everything that is wrong with this single sentence. First, the word "healthily" is particularly jarring in a book devoted to the argument that a century of rapid technological advance ended in 1970. Gordon appears to be suggesting that even though the U.S. innovation system is performing optimally, it is impossible to come up with any breakthroughs that compare to those of the late 19th century. But this suggested "impossibility theorem" has nothing to do with history or economics; it is simply a metaphysical claim that is unconnected to data. It is like saying that human progress reached its peak with the discovery of fire and nothing can ever match that.

However, Gordon's own account provides evidence to challenge the claim that U.S. business firms are making the optimal effort to push the innovation frontier. In his discussion of growing inequality, he points to the dramatic expansion of stock options in the compensation

plans of corporate executives. This change is closely linked to the focus on maximizing shareholder value, which has contributed to a pervasive short-term orientation among corporate executives. The focus on improving the share price next quarter means cutting back on investments that might contribute to corporate profits in five or ten years (Lazonick 2009). This has led many firms to cut back on their research and development expenditures. In fact, quite a few large firms have eliminated their corporate laboratories and now treat innovation as simply another input that they can purchase on the market.

There is also strong reason to believe that the offshoring of large segments of U.S. manufacturing has undermined the innovative capacity of the U.S. economy. The important MIT study (Berger 2013) provides powerful evidence that across the global economy, the firms that are most innovative are the ones where research and development efforts are located close to production facilities. Figuring out how to mass produce an innovative product is now the final stage in the R&D process; it requires research engineers and production engineers to work closely together, and this works best with physical proximity. It follows that the many U.S. firms that have moved production facilities overseas have impaired their ability to produce new innovation products.

But the truly astonishing aspect of Gordon's sentence is the assertion that "the American innovation machine operates ... on its own." Gordon appears to be ignorant of the overwhelming empirical evidence that almost all of the key technological innovations in the U.S. since the end of the Second World War have relied heavily on government funding, government procurement, government support for research initiatives in universities and federal laboratories, and, particularly since the 1980s, on a vast array of government programs designed to help firms

move innovations from the research laboratory into the commercial space (Block 2008, Block and Keller 2011, Mazzucato 2013, Weiss 2014).

In fact, there is good reason to believe that this sentence is not just a lapse but an indication of an appalling gap in Gordon's knowledge of recent history. Gordon begins his chapter on computers and the internet in 1960, so that he leaves out any mention of the government investments in computation in the U.S. and the U.K. during World War II. He does not mention the Defense Advanced Projects Research Agency's huge role in pushing the computer field forward from the late 1950s onward, nor does he mention that almost all of the early procurements of mainframe computers were either for the Pentagon or the space program (National Research Council 1999). He seems not to know that most of the key innovations of the personal computer were first developed at the Xerox-Parc laboratory paid for by government money (Fong 2001). And, of course, he does not mention Mariana Mazzucato's (2013) work showing how many of the innovations built into the iPhone had been developed in research efforts funded by the federal government.

Similarly in his discussion of medical advances, he appears not to recognize that most of the successful new large molecule pharmaceuticals that have been developed in the last thirty years either came out of government laboratories or were the result of government-funded research (Vallas et al. 2011). Moreover, almost all of the key advances in medical instruments and in imaging technologies have involved significant government involvement. Nor does he seem to know that the federal government is heavily involved in funding research on robotics and artificial intelligence and that government procurement has been a driver of advances in these fields.

Most critically, Gordon does not seem to know that the key locus of innovation in the U.S. economy has shifted over the last generation to public-private collaborations organized through a wide variety of government programs. One of the most important is the Small Business Innovation Research Program that provides roughly \$2 billion a year to early-stage technology companies (Keller and Block 2013). This program has nurtured far more successful firms than has the widely celebrated venture capital industry that is generally reluctant to provide funds to firms that are years away from having a commercial product.

Collaborations between the federal laboratories, especially the Department of Energy laboratories that include Argonne, Lawrence Berkeley, and the National Renewable Energy Laboratory also loom very large. In any given year, there are thousands of Cooperative Research and Development Agreements between big firms and the laboratories to do joint research to overcome key technological barriers. Sometimes, these collaborations are organized under the Work for Others program where private firms pay the laboratories to do targeted research. Giant firms such as Intel, Exxon-Mobil, and the pharmaceutical industry routinely make use of these services.

Finally, there has been a proliferation of government-funded research institutes that are organized to facilitate these public-private collaborations. On university campuses, there are dozens of NSF-funded Industry University Collaborative Research Centers and Engineering Research Centers (Currall et al. 2014) devoted to solving technological problems faced by particular industries. The Department of Energy has also created many similar centers to address challenges such as developing advanced batteries and biofuels. More recently, the Obama Administration has created fourteen advanced manufacturing institutes to address the challenges of mobilizing new manufacturing technologies, such as 3-D printing and the production of

flexible and wearable electronics. As of late 2016, these institutes had 1300 corporate partners and had initiated 240 separate research and development projects.¹⁰

The critical point here is that business firms both large and small are now enthusiastic participants in these collaborations. These firms are aware that they cannot effectively innovate on their own; it does not make sense for them to try to assemble in-house all of the scientific and engineering specialties that are required to develop new products or new processes. So their strategy is to assemble smaller teams who then work with publicly funded scientists and engineers in efforts to overcome technological hurdles. Moreover, we see that firms are spending money on this strategy; thousands of firms, for example, pay dues to the NSF collaborative research centers to keep them going. We also see that major corporations are continuously lobbying on Capitol Hill in support of the government's science and technology spending.

It follows that Gordon is simply wrong that changes in government policy cannot influence the rate of innovation.¹¹ He should know that countries around the world have copied U.S. efforts such as the SBIR program precisely with the aim of accelerating their rates of innovation. It is also the case that this system of public-private collaborations in the U.S. could be made significantly more productive with certain critical reforms. One still urgent problem, for example, is that many early-stage technology companies have great difficulty surviving in the years between receiving SBIR funds and developing a commercial product.

An Empirical Question

In fact, it is possible to assemble data showing that Gordon's pessimism about current technologies is off the mark. Here it is relevant to compare recent data to the heroic period from 1910 to 1929, when there were huge gains in manufacturing productivity as a result of

electrification and improvements in factory organization (Sklar 1992, David and Wright 1999, Field 2011). However, even in that period, there were only a handful of industries where productivity advances were so dramatic that quality-adjusted prices actually fell. Gordon shows that between 1910 and 1923, the quality-adjusted price of the Model T dropped from \$722 to \$19 – a 73% drop or an average price decline of 5.6% per year. After that, quality-adjusted prices actually rose slightly even though cars continued to be cheaper relative to disposable income. He also reports that the real price of a kilowatt-hour of electricity dropped by 6% a year between 1902 and 1929. He also cites William Nordhaus' (1997) research that shows that the quality-adjusted cost of a unit of lighting fell at 3.2% per year from 1910 to 1930 with the transition from carbon filaments to tungsten. The cost of long-distance phone calls also dropped about 66% between 1915 and 1930 or an annual decline of 4.4% (Gordon, 185).

Since cars (and trucks), electricity, lighting, and telephones were all general-purpose technologies that were widely diffused across the entire economy, these dramatic quality-adjusted price declines fueled rapid adoption and broader gains in both productivity and living standards. But when one looks at the current period, one finds even more dramatic price declines for an even broader set of general-purpose technologies. Gordon (444-446) compares the computing power of a Cray-1 supercomputer in 1976 to a \$449 Lenovo laptop in 2014 and calculates that the price decline over the period was at the rate of 41% per year.¹² He also cites work by Nordhaus (2007) suggesting that after 1980, the annual price decline was more like 64% per year. Gordon is moved to say that: “The sharp contrast between the Cray-1 and today’s most ordinary laptops represent progress so rapid that it is hard to grasp” (444).

But the reality is that price declines that are almost as dramatic have been occurring in the recent period in a range of different technologies. Byrne and Corrado (2015) estimate that for the

last twenty years, prices of communications equipment have been falling at 11% per year. It appears that nobody has yet attacked the Herculean problem of measuring quality-adjusted prices of cellphone services over the last two decades, but given the competition among both handset providers and wireless service providers, it seems probable that consumer prices have been falling more rapidly than the 11% per year rate of decline for communications equipment.

Another recent study (Graetz and Michaels 2016) found that quality-adjusted prices of industrial robots declined by 80% between 1990 and 2005 or an annual rate of 5% per year. Between 1998 and 2013, the cost of installing solar-energy systems in the U.S. fell by 6-8% per year, while the fall in prices of solar panels was even larger (Feldman et al. 2014). Nykvist and Nilsson (2015) report that the cost of Lithium-ion battery packs for electric cars fell at an annual rate of 14% between 2007 and 2014, and there are reports that the declines have accelerated more recently. A study of LED light bulbs that represent a major advance over both incandescent and compact fluorescent bulbs shows that between 2011 and 2014, prices were declining at between 28 and 44% per year, and here also, there is every reason to believe that these declines are continuing (Gerke et al. 2014). Finally, just between 2009 and 2015, the cost of wind power fell at close to 12% per year (US DOE 2016).

It is obvious that these price declines have not translated into the kind of dramatic measured productivity gains elsewhere in the economy that were visible in the 1920s. This is predictable since manufacturing has become a much smaller share of the whole economy. But two fundamental points follow from this evidence of a range of different products with significant quality-adjusted price declines. First, it calls into question the claim that there is somehow a slowdown in technological progress. On the contrary, since the computer is a general-purpose technology that influences every sector of the economy, it seems clear that the

rate of technological advance is now more rapid than it was in the 1920s. Second, if we had in place in the United States the government policies required for a rapid transition to clean energy such as those employed in Germany and China, the falling prices of advanced batteries, LED bulbs, solar power, and wind turbines could well start having more visible consequences for the larger economy.

4. BRINGING SCHUMPETER BACK IN

Gordon's account would be much richer, had he drawn more heavily on the Schumpeterian tradition. He does employ several concepts that have links to Schumpeter and other scholars who have thought systematically about the rhythms of innovation over many decades. Gordon refers to three distinct Industrial Revolutions to characterize different periods of technological advance. The first, which happened in England in the early 19th century, does not figure in his story, but he talks about the cluster of innovations at the end of the 19th century that included automobiles and electrification as the Second Industrial Revolution. He then labels the advances in computers and communication that began with the first sales of mainframe computers in the late 1950s and have continued with the personal computer, the internet, and mobile phones as the Third Industrial Revolution.

He also emphasizes the closely related point that periods of innovation tend to occur in clusters. He notes that the key breakthroughs of developing the light bulb and a workable automobile occurred within months of each other in 1879. He also recognizes that the 1920s and 1930s represented a key period of technological advance, as multiple breakthroughs occurred simultaneously. He employs the same idea when talking about advances in computerization and communication in the last several decades.

But surprisingly, he only mentions Schumpeter once, and he never references the analysis of long waves of innovation that Schumpeter borrowed from Kondratief. He also focuses almost entirely on changes in consumer goods, even though he has to acknowledge that much of the rapid economic advance of the 1920s through the 1940s was driven by the sharp improvements in the productivity of capital. As a result of these omissions, Gordon lacks a theoretical framework to help him to make connections among technological breakthroughs, the diffusion of new consumer and capital goods, and changes or lack of changes in the policy environment in which the economy operates.

This absence is particularly glaring in the final part of his argument. He uses the rather vague metaphor of headwinds to describe four distinct factors that make it unlikely that the U.S. economy will soon again experience rates of economic growth comparable to those of the golden century from 1870 to 1970. The factors he identifies are certainly important, but giving them this label is confusing because for the pilot of an aircraft, headwinds are a given that cannot be altered. However, most of the items on Gordon's list are factors that could be changed with a transformation of the government policies that have been in place since the early 1980s. Moreover, in a brief postscript to the book, he argues for such a shift in policy.

Gordon's first headwind is the most important; it is the rising inequality of income and wealth in the U.S. that has been well documented by Thomas Piketty (2014) and others. Since his focus is on the actual standard of living, he recognizes that figures on the growth of average income per capita are insufficient at a time when almost all of the growth in income has gone to the top 1%. It is necessary to focus on the much slower rate of income growth for income recipients at the median. His second headwind is the far slower growth of average educational attainment that has occurred in the U.S. since 1970. He draws on Goldin and Katz's (2008)

finding that educational attainment increased by 0.8 years per decade from 1890 to 1970, but improvement since then has been negligible as dropout rates from high school remain high and the percentage of graduates going to college has been stagnant. His third headwind is a somewhat confusing demographic variable – the decline in work hours per person. The final headwind is the consequences of rising debt to GDP ratios in the two decades after 2020 that are projected because of the costs of health care and retirement benefits for the elderly.

As Gordon acknowledges, these headwinds could be overcome by a shift in public policies. Gordon argues for reducing inequality, investing more in public education, and changing the tax system to raise more revenue. (The demographic problem would presumably be solved if these other measures worked to accelerate the rate of growth.) But his brief postscript makes these proposals seem like an afterthought rather than real advocacy. He seems to understand that his own diagnosis of the problem as secular stagnation has already doomed the progressive policy solutions that he favors.

The problem is that in U.S. politics, the belief that the economy is going to grow slowly over the next two decades works to strengthen right-wing interests that insist that we need more austerity, not less. This has, in fact, been the story ever since the mid-1970s because of the rhetorical resonance of the right-wing economic diagnosis (Block 1996). A poorly performing economy has been used ever since as the justification for abandoning the more egalitarian policies of the New Deal era and passing tax cuts and other measures that have allowed the rich to get much richer. The same rhetorical move lies behind the disinvestment in public education that has produced stagnant levels of educational attainment.

So regardless of Gordon's own political preferences, the evidence he has mobilized for slower growth will be used to argue that the nation cannot possibly afford to provide the funding

for Social Security and Medicare that has been promised in current law. They will also insist that raising the minimum wage or placing a higher tax burden on the wealthy will prove counter-productive in a slow-growth context because such actions will discourage new hiring and new entrepreneurial initiatives.

Towards a More Structural Account

All of this is particularly unfortunate because if Gordon had made greater use of Schumpeterian and Neo-Schumpeterian insights, he could have constructed an alternative narrative to secular stagnation that would actually provide support for the policy proposals that he has tacked on at the end of his book. This Neo-Schumpeterian interpretation would have also helped him avoid the nostalgic argument in which a lost golden age is contrasted to the current period, where we are doomed to slow growth. This problematic frame forces Gordon to treat the extraordinary advances in computers and communication technologies as a minor sideshow. In a richer analysis, these advances can be recognized and seen as laying the foundation for a new period of dynamic growth.

A more dialectical approach would also better illuminate Gordon's core question of the changes in the standard of living in the period from 1970 to 2016. Gordon's account is that there has been slow growth for almost everybody, save the most affluent households. But when we factor in all of the qualitative elements that are poorly measured in GDP, we end up with a substantially more complex and nuanced picture. For one thing, sorting out the relative weight of qualitative gains versus qualitative losses is extremely difficult. On the one side, there are increases in quality-adjusted life years, environmental improvements, the huge benefits of computer-based connectivity, and the enhanced amenities of urban areas. On the other, there is

diminished social mobility, greatly increased insecurity of employment and income, and the disappearance of millions of stable jobs that provided decent incomes.

Moreover, the benefits and losses have been distributed very unevenly regarding both geography and income groups. So, the benefits have been heavily concentrated in the largest metropolitan areas, and the negatives have been highest in rural areas and small towns. And generally, those in the top half of the income distribution have been winners, while the losers have been concentrated in the bottom half. But it is precisely this unevenness in the distribution of economic gains and economic losses that has fueled the populist outrage that has dominated recent political debates in the U.S.

The irony is that much of Gordon's account of what happened between 1900 and 1970 fits the Schumpeterian model precisely. His description of the disruptive technologies of electrification and the automobile starting in the 1890s, but accelerating in the 1920s, is consistent with the Neo-Schumpeterian story that mass production outran mass consumption. He also shows how New Deal reforms that increased worker purchasing power laid the basis for the three decades of expansion after World War II based on the automobile and suburbanization.

What Gordon fails to see is that the period starting around 1970 shows the typical symptoms of a growth wave that has reached exhaustion. Growth based on suburban development had reached its limits as evidenced by ever longer commutes, wasteful use of energy, and hollowed out center cities. At the same time, slower growth and fiscal crisis in the 1970s empowered the political right and produced the nation's extended experiment with "free market" economics. According to the doctrine of Milton Friedman and his associates, measures such as tax cuts for the rich, reductions in antitrust actions, and slowdowns in the growth of government spending on nonmilitary programs were supposed to reinvigorate the economy, but

they had the opposite effect. Continuing fiscal crisis meant that levels of educational attainment in the U.S. failed to rise. In fact, some of the slowdown in the growth in the standard of living after 1970 that Gordon documents was a direct consequence of misguided policies proposed by the right that were supposed to accelerate growth.

However, the Schumpeterian innovation process started up again in the 1980's and 1990s with the disruptive advances in computerization, the internet, and parallel advances in communications technology. All of these technologies could be traced back to earlier decades, but it was in the 1990s that they attained the scale needed to reshape perceptions across the whole economy. The result, once again, of this technological disruption was the predictable speculative boom of the late 1990s driven by exaggerated expectations about internet-based firms.

The problem, however, is that there are significant institutional barriers to a new period of expansion that could take full advantage of these technologies. So what happened instead was an extremely anemic economic recovery after the stock market bubble burst in the early 2000s. And that anemic recovery was heavily dependent upon a completely unsustainable boom in the building of single family homes that was facilitated by a rapid increase in mortgage lending, including the notorious expansion in subprime lending. When that mortgage bubble burst in 2007 and 2008, the result was the Global Financial Crisis, which has been followed by another extended period of anemic growth.

It is possible, however to anticipate what a new period of economic expansion based on these new technologies and a coordinated consumption economy might look like. The expected improvements in the standard of living could easily be substantial enough over twenty or thirty years that even Gordon would have to admit that they compared well with earlier heroic decades.

Among the possible changes would be a shift to an environmentally sustainable model of economic growth that ended our dependence on fossil fuels. This would involve concentrating most of the population in urban areas, which would allow dramatic rewilding of a significant part of the continental land mass. There would be a dramatic expansion in desired leisure time, with the average workweek falling to 20 or 25 hours. The quality of jobs would also improve significantly, with the vast bulk of the labor force doing work that was intellectually challenging and provided intrinsic satisfactions. Finally, a rich urban lifestyle would be available to both urban dwellers and visitors. This would be facilitated by software apps that facilitate coordination, so that people could enjoy nearby parks, restaurants, cultural opportunities, and ease of transportation from one part of the city to another. Finally, the combination of computers, improved communication, and more leisure time would open up vast opportunities for lifelong learning for everyone.

There are, however, a series of very significant institutional barriers that block this type of economic expansion:

1. As in the 1930s, the maldistribution of income limits the ability of much of the population to participate in a new economy. There is still a yawning digital divide that excludes many people, and residential broadband services are far inferior and more expensive than those in other developed nations. Moreover, maldistribution of income blocks the educational upgrading required for high-tech employment.
2. Public spending on infrastructure has been falling for a generation, so the resources to fund critically needed investments are lacking. This is particularly an issue for the pending transformation to renewable energy. The electrical grid needs to be modernized and charging stations must be built to support the electrification of cars and trucks.

3. There are no public policies to facilitate the upgrading of urban neighborhoods except through a process of gentrification that expels many long-term residents. This means that many of the benefits of dense, high-service urban life are confined to the upper middle class while others are pushed towards the urban periphery, where there are few services and employees face long commutes.

4. Another key improvement in the standard of living would be expanded leisure time, which did not come at the price of increased economic insecurity. However, this option is currently not available; employees who opt for reduced hours risk losing their jobs.

The point is that it is not secular stagnation or a slowdown in technological change that prevents us from realizing these possibilities; it is rather institutional and political obstacles. While Gordon does propose reducing economic inequality, raising more funds through the tax system, and spending more on infrastructure, he fails to recognize that a new reform effort, comparable in scale to the New Deal, could unlock the ability of current technologies to drive a major improvement in the standard of living (Block 2011). Had he engaged with Schumpeter and other theorists of long waves, he would have been able to recognize Schumpeter's central point that economic problems can ultimately be traced to particular institutions that require significant restructuring.

5. Conclusion

The core weakness of Gordon's book is its asymmetry. When he analyzes the period from 1870 to 1970, his work is rooted in years of painstaking research, knowledge of the history of technology, and great sensitivity to the qualitative changes experienced by much of the U.S.

population across that time period. But when he comes to the period from 1970 to the present, all of these strengths are lost. He substitutes aggregate statistics that are of dubious value for the careful analysis of different technological trajectories. His ignorance about the role of the U.S. government in our current innovation system is a symptom of how little he has read about these more recent technological breakthroughs. And most importantly, he systematically ignores the substantial evidence of important qualitative improvements in the standard of living that have occurred since 1970, particularly the improvements in quality adjusted years of life after age sixty.

These weaknesses suggest that Gordon's core claim that current technological progress cannot compare to that of the first half of the 20th century is an *idée fixe* rather than a hypothesis that he is willing to test against the data. We have shown, in fact, that there are a wider range of products today where quality adjusted prices are falling on a year-to-year basis than in the 1910s and 1920s, and we have actually only scratched the surface with that argument. The dramatic cheapening of computer power makes it possible for a wide range of products to undergo quality-adjusted price declines. One can think of hearing aids, a wide variety of medical instruments, and machine tools as well as new applications that were previously unaffordable. In cities around the world, for example, bus and subway stops are now being equipped with displays that indicate when the next train or bus is expected to arrive.

However, it is a mistake to focus only on current technological advances that are closely linked to the computer. We are also living in a period of major advances in materials science that result from breakthroughs in nanotechnology. New composite materials make it possible to produce planes and automobiles that are lighter and yet stronger in resisting impact. There have already been new fabrics produced that are light-weight, protect from water and extreme cold,

and allow perspiration to escape. New composite building materials are also being developed that are strong, flexible, and sustainable because they reduce energy use and do not require using scarce inputs. While these products are in the early stages of diffusion, as output expands, we can expect significant price declines.

But the fundamental critique of Gordon that has been advanced here is that he fails to build on the work of Schumpeter and others who stress the predictable discontinuities in the process of technological change. New technologies are disruptive, and they tend to break apart established institutionalized patterns. So, we have numerous examples in the history of technology where a cluster of innovations are introduced in a partial and halting fashion, while also sometimes generating excessive optimism and speculation. So it is to be expected that there will be periods of economic downturn when the old sources of growth no longer work and the new ones cannot get sufficient traction.

These periods, however, should not be viewed as examples of secular stagnation. They are rather symptoms of an institutional mismatch that keeps the society from realizing the potential of those new technologies. This is our current situation. Computerization, automation, clean energy technologies, and dozens of other breakthroughs make possible both a qualitative and quantitative improvement in the standard of living for people in the U.S. and around the world. But achieving those gains requires a reform initiative on the scale of FDR's New Deal to reduce economic inequality, to raise new tax revenue, to make massive investments in infrastructure, to enact new social policies, to expand public input into urban and regional development, to create new economic institutions, and to reform regulatory arrangements for many industries. If we are able to understand the economics of our current situation, we will be able to grasp the urgency of these political reforms.

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¹ To be sure, the Pax Americana has seen its share of wars, but up until recently, they were either brief, like the first Iraq War or Kosovo or far away as with Vietnam and Korea.

² Much of my own work has focused on another theorist of discontinuity, Karl Polanyi. Polanyi was Schumpeter’s contemporary and was also born in Austria (Block and Somers 2014).

³ The problems in Schumpeter’s theory of cycles are addressed in Burlamaqui’s piece that is chapter one of this volume. But as he notes, one can reject Schumpeter’s effort to integrate three distinct cycles of different durations and still retain the idea that there are long waves organized around major technological innovations.

⁴ Schumpeter and the entrepreneurial state are addressed at length in Burlamaqui’s essay that is chapter ____ of the current volume.

⁵ David Gordon, who died in 1996, was the brother of Robert Gordon. The parents, Robert Aaron Gordon and Margaret S. Gordon were also economists.

⁶ For a related argument, see Atkinson 2004. Another scholar who has drawn on the Kondratiev framework is Immanuel Wallerstein, but he has been less focused on the role of the state in facilitating new periods of expansion.

⁷ Given that economic cycles operate differently in different parts of the world, there has been remarkable consistency among scholars using the long-wave framework in terms of dating the first four Kondratiev cycles (Goldstein 1988, Freeman and Louçã 2001). However, there is predictable disagreement about how to think of the last twenty or thirty years. Some analysts argue that a neoliberal expansion began around 1980 while others reject that view. McDonough (2010) reviews some of the disagreements within the social structure of accumulation perspective.

⁹ For useful critiques of secular stagnation and Gordon's broader argument, see Mokyr 2014, 2017. See also Sichel 2016.

¹⁰ On the advanced manufacturing institutes, see Bonvillian and Singer (2018).

¹¹ For a careful analysis of the different rates of success of government innovation policies around the world, see Taylor (2016). See also Burlamaqui's chapter ___ in this volume.

¹² Gordon (444) acknowledges that the hedonic price index used in the official government statistics significantly understates the price decline for computer power. The same point is made in an analysis of semiconductor prices in Byrne et al. (2015).