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Wall of Worries: Reflections on the Secular Stagnation Debate*

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Wall of Worries: Reflections on the Secular Stagnation Debate[1]

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Since the financial crisis and in some sense longer – since the decade of the 1970s, according to the now conventional narrative – growth in the advanced economies has disappointed.[2] The growth of total factor productivity has slowed in the U.S. and elsewhere.[3] The demographic picture has darkened. Real interest rates have fallen to unprecedented levels, and nominal interest rates are perilously low. If this wall of worries didn't have a name, someone would have to give it one. In the event, someone already has, the name in question being "secular stagnation."[4]

But along with the name comes confusion, or at least a plethora of associated definitions, hypotheses and interpretations.[5] In sorting through this confusion I find it useful to start with the real interest rate, which figures in all competing hypotheses and interpretations. The secular decline in real interest rates in the advanced economies is not a new phenomenon; the IMF argues that it has been underway since the 1980s.[6] Nor is it newly noticed, having been the subject of analysis by researchers at the Bank of Canada as long as ten years ago.[7] That ex ante real interest rates (ex ante rates being what matter for economic activity) are not easy to measure may explain why it took so long for this attention to become general.

The equilibrium real interest rate is a matter of considerable uncertainty, as Janet Yellen and Ben Bernanke have recently reminded us.[8] Probably the simplest framework for thinking about it is the Ramsey optimal growth model. In balanced growth equilibrium without uncertainty and with optimal decision making by households, the Ramsey model leads to the following formula:

$$r = MPK = \rho + \sigma g$$

where r is the real interest rate and MPK is the marginal product of capital. Assuming perfect foresight, the steady-state marginal product of capital is a function of the rate of discount of future income (the subjective rate of time preference) ρ, the rate of growth of per capita income g, and the rate at which households are prepared to substitute between current and future growth σ (where $1/\sigma$ is the intertemporal elasticity of substitution).

Intuitively, the interest rate will be higher when individuals are more impatient (ρ is higher), since it will have to rise to discourage borrowing against the future and thus equalize saving and investment. It will be higher when growth g is faster, since individuals will again

[1] Text of the Mayekawa Lecture, delivered to the Bank of Japan-IMES annual conference, Tokyo, June 4-5, 2015. I am grateful to Miguel Moran and Donghyu Yang for helpful comments.
[2] And now there are signs of this same disappointment spreading to emerging markets.
[3] Fernald and Wong (2015) summarize the latest.
[4] And that someone being Lawrence Summers.
[5] Perhaps this is unavoidable, given the temptation to apply a prominent label to a variety of quite different tendencies and concerns. But that confusion is not helpful for either diagnosing the problem or identifying potential solutions.
[6] See IMF (2014).
[7] See Desroches and Francis (2006).
[8] See Yellen (2015) and Bernanke (2015).

want to borrow more against their higher future incomes, and the interest rate will have to rise to limit this tendency. How much it will have to rise will depend on the intertemporal elasticity of substitution, since, with a high elasticity, households will be more inclined to substitute future for current consumption.

This model offers a prediction of how lower labor productivity growth g should affect interest rates. With standard values for ρ and σ of 0.5 and 1.0, reducing the rate of labor productivity growth from 1.8 per cent (the G7 average between 2001 and 2007) to 0.9 per cent (the 2007-12 average for the same set of countries) suggests a decline in real interest rates from 2.3 per cent to 1.4 per cent.[9]

Over the longer run, data on labor productivity growth and these parameters suggest a decline in real interest rates from 3.4 per cent in the 1970s to 2.9 per cent in the 1980s and 2.4 per cent in the 1990s (see Figure 1). This matches rather closely the IMF's estimate of the change in the equilibrium real return on equity over these same periods (IMF 2014).[10] It suggests that some of the decline in ex post real rates observed since the early 1980s, when these reached high levels, most notably in the United States, reflects mean reversion, but not all.[11]

Hamilton, Harris, Hatzius and West (2015) provide a critique of this approach. They find that changes in growth rates have little predictive power for the real interest rate.[12] They then argue on the basis of a narrative approach that business cycle fluctuations, changes in the intensity of financial regulation, inflation rates, and financial bubbles are more important predictors or correlates of observed changes in real rates. My interpretation of their findings is that these other variables dominate over shorter horizons. It takes time for long-term trends in growth rates to be incorporated into household behaviour and translate into secular changes in the real interest rate. But once they are so incorporated such secular trends become evident.

A related argument is that the observed decline in real interest rates on treasury bonds in the G7 countries reflects a shortage of safe assets (Gourinchas and Jeanne 2012), which has driven up the price and depressed the yield on information-insensitive treasury securities. However, Gordon, Lwellen and Metrick (2012) estimate that the percentage of safe assets represented by the sum of U.S. government debt and safe private financial debt has remained constant at close to one third since the early 1950s. It could be that formerly safe assets supplied by governments and corporates in other G7 economies, like those of Europe, have lost their information insensitivity. But this loss of information insensitivity is a recent phenomenon to the extent that it has occurred, while the decline in real rates has been secular.

[9] These are OECD-assembled data on the rate of change in GDP per hour worked.

[10] Note however that the average level of the latter is higher, presumably reflecting the equity risk premium. The picture would admittedly look different, making the story more complex, were the data partitioned mid-decade to mid-decade, highlighting the relatively rapid growth of the 1995-2005 decade, in the United States in particular.

[11] This is similarly the conclusion of the Laubach-Williams (2003) approach, as updated by Williams (2015), where the nominal rate is adjusted for changes in the trend rate of GDP growth, estimated via a Kalman Filter. As Williams (2015) shows, the real rate dips from its high early-1980s level before stabilizing (relatively speaking), declining modestly in the 1990s and then falling persistently after 2001. The model's estimate of a natural rate of 3 per cent in 1990 is remarkably similar to the estimates here using the Ramsey model.

[12] At the same time, their preferred estimates of the U.S. real interest rate, based on the nominal (central bank discount) rate minus a measure of expected inflation based on inflation persistence over the most recent 30 years, behaves quite similarly to the real rate as estimated on the basis of the Ramsey model and the calibration above.

In addition, recent years have seen a rise in the price of (decline in yields on) riskier assets something which is unlikely to be affected by this so-called safe-asset shortage.

It seems hard to argue that fluctuations in business cycles, inflation, the supply of safe assets and financial bubbles can explain a secular decline in real interest rates that has been ongoing for the better part of 35 years (although trends in financial regulation are plausibly a better candidate for explaining these secular trends). Hamilton et al. dismiss the secular stagnation hypothesis on these grounds and predict that the real interest rate will rise to conventional levels once recovery is given more room to run. In the spirit of Zhou Enlai I am more inclined toward the view that it's too early to tell.

* * * * *

What then might lie behind these longer-term changes, assuming that they're real? (Pun intended.) That the downward trend in real interest rates is relatively long lived suggests that more than just the financial crisis is at work. That the trend is evident across the advanced economies suggests looking at global rather than country-specific factors.[13] Since the real interest rate can be thought of as equilibrating desired levels of saving and investment, factors influencing saving and investment globally, or at least in countries constituting a significant share of the global economy, should be the focus of attention.

Precedence here goes to the hypothesis of a global savings glut, since the point was flagged earlier on by Bernanke (2005) and Greenspan (2010). The idea is lent plausibility by the rapid growth of high-saving emerging markets. It is supported by the existence of a discernible, albeit slight, upward trend in global saving as a share of global GDP from 23-24 per cent in the 1990s to 25 per cent in 2002-2007.[14]

But if this was the only, or even the main, thing going on, investment should have risen across countries, all of which would have been affected similarly by the fall in real interest rates.[15] In fact, investment rates fell in the advanced countries, from some 24 per cent of GDP in the 1980s to 22 per cent in the 1990s and then 20 per cent in the 2000s. Evidently, something else important was occurring at the same time in the advanced-country world.

Some observers point to growing income and wealth inequality as contributing to the savings glut, on the grounds that the rich save while the poor don't, or at least that the rich have higher savings rates (Mian and Sufi 2014). Theories of underconsumption rooted in inequality go back at least to Hobson (1910) if not Malthus (1836), and there is some modern evidence lending them credence. Lawrence (1991) used micro-data from the U.S. Panel Study of Income Dynamics to estimate Euler equations suggesting that rates of time preference are 3 to 5 percentage points higher for households with low permanent incomes than for those with higher ones. Dynan, Skinner and Zeldes (2004) similarly found higher marginal propensities to save among richer households. More recently, Haushofer, Schunk and Fehr (2013) found in an experimental setting that relatively poor subjects with

[13] The earlier literature on trends and fluctuations in real interest rates, dating from the earlier 1990s, while not yet aware of the secular downward trend similarly highlighted the role of global factors (see Barro and Sala-i-Martin 1990, Barro 1992, G10 1995 and Smith 1996).

[14] For purposes of this comparison I leave out the 1990-1, 2000-1 and 2008-9 periods when investment was depressed by recession and financial crisis. Note that the elasticity of the global real interest rate with respect to global savings would have to be quite high for this relatively limited rise in the latter to explain the substantial observed fall in the latter. That said, the structural estimates of Barro and Sala-i-Martin (1990) do not rule out responses of this magnitude.

[15] A point usefully emphasized by Fatas (2013).

unfavourable wealth endowments exhibit higher discount rates (higher rates of time preference) than the rich.[16] Why this should be the case is not entirely clear. Some economists suggest that attitudes toward saving are culturally conditioned and, as F. Scott Fitzgerald put it, the rich "are different from you and me."

But for distribution to explain the decline in real interest rates since 1980 it is necessary to focus not on the level of inequality but the change. This brings us to the observation that the working class has been experiencing lower rates of growth of real earnings and permanent income than the wealthy. This is true across a range of advanced economies but first and foremost the U.S. and UK, as emphasized by the literature inspired by Piketty (2014). If there has been a shift in income toward the wealthy, and if the wealthy spend less as a share of income, then there could be a dearth of spending overall, translating into lower real interest rates.

Cutting against this is the fact that there has been no trend toward higher household saving since the decline in real interest rates became evident in the early 1980s. Meanwhile, savings rates outside the ranks of top earners in fact declined as households with stagnant incomes borrowed even more heavily in the effort to maintain their customary rates of income growth.[17] It could be that deleveraging by such households, their having been impressed by the dangers of excessive indebtedness as a result of the crisis, is now contributing to the dearth of spending. But again it important to recall that the observed decline in real interest rates long precedes the financial crisis and also, for that matter, the consumption and borrowing boom of the early 2000s.

Past BOJ-IMES conferences have focused on possible links between demography and real interest rates.[18] Invoking population aging in the advanced economies and now emerging markets to explain the fall in real interest rates takes some doing, to be sure. Standard life cycle models lead in the other direction. Insofar as elderly retirees have lower savings rates than active labor-force participants, populations with higher old-age dependency ratios should have lower savings rates. One can point to the possibility that the elderly, owing to bequest motives and uncertain lifetimes, are reluctant to reduce their savings rates, much less to actively dissave, and there is some support for the proposition (Weil 1994). Or one can hypothesize that that population aging has an even larger negative impact on investment (Goodhart and Erfuth 2014), perhaps because rates of capital/labor substitution are extremely low. But there is little systematic empirical evidence for the hypothesis. Higgins' (1998) careful study of country-level panel data suggests that savings rates decline faster than investment rates at the national level as the population ages (beyond 70 years, in particular).

Any conclusion based on such mixed evidence is bound to be controversial. My conclusion for what it is worth is that factors operating on the saving side of the saving-investment balance – the so-called global savings glut, changes in demographics, and the level or rate of change of income inequality – do not by themselves provide a compelling explanation for the observed decline in real interest rates in and of themselves.

* * * * *

[16] On the other hand, looking across countries Schmid-Hebbel and Serven (2000) find no evidence of a significant link between measures of income inequality and aggregate savings rates.

[17] Kumhof , Ranciere and Winant (2015) develop a model linking the growing income and wealth shares of the top 5 per cent to their greater willingness to lend, to the greater willingness of low income individuals to borrow given prevailing interest rates, and to subsequent crises and default, but I regard their evidence for the model, such as it is, as only suggestive.

[18] See Shirikawa (2012).

If not due to an increase in savings supply, then the decline in real interest rates must reflect a decline in investment demand. The observed decline has been centered in the advanced countries, as noted above, although there was also a reduction in investment rates in East Asia ex China and Japan after the Asian financial crisis, as noted by Rajan (2006). Although investment rates in China have not yet shown much tendency to fall, they have a least stopped rising and will now decline as growth slows and the country continues the process of economic rebalancing.[19] And while a trend that has been underway since the early 1980s almost certainly has a secular component, there is no doubt that the even more pronounced weakness of investment relative to saving in recent years (reflected in a further decline in real interest rates) also has a cyclical component attributable to disruptions to the financial system, policy uncertainty and other after-effects of the financial crisis.[20]

This secular decline in investment relative to saving could reflect the declining relative prices of investment goods, as a result of which the same investment projects can be pursued by committing a smaller share of GDP.[21] In his work on the prices of capital goods, Gordon (1990) has shown that this change in relative prices is not limited to information-technology products; it is more general. But it is most pronounced in the IT subsector. As Larry Summers has described the implications:

> "[T]he leading technological companies of this age…find themselves swimming in cash and facing the challenge of what to do with a very large cash hoard. Ponder the fact that WhatsApp has a greater market value than Sony with next to no capital investment required to achieve it. Ponder the fact that it used to require tens of millions of dollars to start a significant new venture. Significant new ventures today are seeded with hundreds of thousands of dollars in the information technology era. All of this means reduced demand for investment with consequences for….equilibrium levels of interest rates."[22]

But it is far from clear that what is true of high-profile IT companies like Google, Apple and WhatsApp employing frontier IT technologies is true of companies employing new technologies generally. Consider high-tech batteries: the cost of Tesla's "Gigafactory" for producing batteries for electric cars and other purposes, for example, will run not in the hundreds of thousands or tens of millions of dollars but upwards of $5 billion.

In addition, any additional projects that may be rendered attractive by this lower cost of capital must not be enough to offset this decline in the investment share if lower investment-good prices are to mean lower real interest rates. Some international evidence implies the opposite: Hsieh and Klenow (2007) show that countries with the lowest relative price of investment goods in practice have the highest investment rates.[23]

* * * * *

The alternative is to hypothesize that investment has grown less attractive irrespective of price. This was one of the original conjectures of Hansen (1938), who coined the phrase

[19] That investment is the principal component of GDP to decline during growth slowdowns is a key finding of Eichengreen, Park and Shin (2012).
[20] As emphasized by Hamilton et al. (2015) and noted above.
[21] As I note in Eichengreen (2015), for this change to deliver the necessary effect (a decline in the share of investment in GDP) the number of new additional investment projects undertaken as a result must be limited; in particular, the elasticity of substitution between capital and labor must be less than one
[22] Quoted in Weisenthal (2014).
[23] What is true in the cross section may not also be true of changes over time, but this is the best evidence we have.

secular stagnation.[24] In its current form, due to Gordon (2012), the argument is that innovation is translating into slower total factor productivity growth than in the past, and slower TFP growth in turn means fewer attractive investment opportunities.

To be clear, the argument is not that innovation has slowed (an idea that is hard to square with impressionistic evidence) but that rather it has become less profitable. Gordon's variant associates periods of high commercial applicability and profitability with three specific clusters (or "waves") of innovation: steam and rail in the 19th century; electricity, the internal combustion engine and (more prosaically) indoor plumbing from the late 19th through the mid-20th centuries, and now information technology, including computers, cell phones and the web since the 1960s. That these technologies come in clusters suggests that they are interrelated and may have an important network dimension. The core argument is that the contribution to TFP growth of the third cluster is less than that of its two predecessors.

It may help, in order to get purchase on this hypothesis, to divide it into its three component parts.

- First, the dynamic efficiency advantages of the third wave of innovations, as captured by TFP growth, are likely to be less than those of its predecessors.
- Second, the time profile of those efficiency effects will be shaped by the recession and financial crisis through which the advanced countries have just passed.
- Third, the time profile of those efficiency advantages will be further shaped – specifically, their materialization may be further delayed – by the network-based nature of this third wave of innovations.

Consider these sub-hypotheses in turn, starting with the first. Whether smart machines, the Internet of Things, and materials like graphene have the potential to raise TFP growth as dramatically as the great inventions of the past is necessarily a matter of speculation. I will therefore pass over it quickly, although my study of the relevant economic history biases me against the conclusion that "all the (commercially) great inventions have been made."

A less speculative and more tractable question is whether the advanced economies lack the capacity to effectively commercialize and apply these technologies in ways capable of boosting TFP.[25] This is a hard case to make. Commercialization requires finance. But venture capital and other forms of early-stage finance (crowdsourcing) have become if anything easier to obtain, not harder, though it can be argued that they remain easier to obtain in some places like the United States than others. Commercialization requires patience from those providing finance. Here the fact that many venture capital firms are private partnerships and that companies attempting to commercialize projects with long time horizons are closely held (think Google) helps to accommodate the need.

Commercialization requires entrepreneurship. But again there would seem to be no shortage of relevant skills in the advanced countries, which source entrepreneurs globally.[26]

[24] Proven false by subsequent – and, indeed, as we will see, contemporaneous – experience.
[25] Relatedly, Pagano and Sbracia (2014) conclude that previous studies predicting secular stagnation were wrong not because they failed to anticipate new technologies but because they underestimated the potential of technologies that already existed.
[26] In principle in the case of the advanced countries, in practice mainly in the case of the United States.

Commercialization also requires coordination between basic and applied research. Here the close connections between universities, where government-funded basic research takes place, and business, where applications are developed, paint a broadly positive picture by the standards of the past.

Then there is the question of how efforts at translating new technology into increases in total factor productivity are affected by financial crises and deep recessions like those recently experienced in the advanced economies. On the one hand there is the Reinhart and Rogoff (2014) view that recoveries from deep recessions marked by financial crises are characterized by slow growth of output, employment and productivity (where the current "productivity-less" recovery in the UK is often thought to epitomize the phenomenon). Because the financial system is impaired, banks hesitate to lend. Because firms are deleveraging, they are reluctant to invest. Because households are seeking to work down debts, they are reluctant to spend, and the demand for goods and services is weak. All this makes for weak investment in TFP-boosting activities including those related to the commercialization of new technologies.

On the other hand there is the view, associated with Hall (1991) and Caballero and Hammour (1994), that recessions are good times for productivity enhancing reorganization. In recessions, a firm's resources are not fully utilized in current production; some can instead be redeployed for figuring out how to enhance the efficiency of future production. And what is true for the individual firm or sector is true by analogy for the economy as a whole. We should therefore see productivity growth accelerate in the wake of deep recessions marked by financial crises.

Support for the recessions-as-reorganizations view is lent by the 1930s, when total factor productivity grew quickly in both the United States and United Kingdom.[27] TFP in manufacturing in the United States in 1935 was fully 30 per cent above its 1929 level, while the comparable change in UK manufacturing was 25 per cent (Table 2).[28] 1929-41 saw the fastest growth of TFP in the United States of any period of comparable length in the 20th century.

U.S. railroads in the 1930s are a striking case in point, as shown by Field (2012). Experiencing a sharp reduction in current demand for their services but finding it hard to dispose of a large fixed capital stock, the railroad fundamentally reorganized how they scheduled their rolling stock and employees, integrated maintenance and managed overhead. This history is more obviously consistent with the relatively optimistic Hall-Caballero-Hammour interpretation than the pessimistic Reinhart-Rogoff view.

While U.S. TFP grew especially quickly, UK TFP grew somewhat more slowly (see Figure 3).[29] This differential performance was not limited to manufacturing, although the data are best for that sector.[30] In particular, TFP growth was faster in the U.S. than the UK despite

[27] The 1930s were also a period of unusually rapid TFP growth in Japan, led by the manufacturing sector, not by the standards of the post-World War II period, to be sure, but by the standards of the 1920s and earlier years (Ohkawa 1966). Analyzing the Japanese case is however beyond the scope of this paper.

[28] Note that this comparison is roughly (business cycle) peak to peak, so it doesn't reflect the recovery of TFP from any Depression-induced decline.

[29] Another case in point, relevant for this lecture, is Japan, where TFP growth in the 1930s was also relatively slow. Interestingly, the post-1929 downturn in Japan was also relatively mild, consistent with my interpretation in the preceding text.

[30] There is also the fact that the U.S. far outperformed the UK in terms of TFP growth during and after World War II, as described in Broadberry and Crafts (2003).

the fact that America's financial system was more deeply impaired by the crisis of the 1930s. Where the U.S. suffered literally thousands of bank failures in the 1930s and was forced in early 1933 to declare a full-fledged bank holiday, nothing remotely similar happened in the UK.[31] This suggests that damage to the financial system may be overrated as an impediment to post-crisis TFP growth, especially when TFP growth relies not on new investment but on reorganizing and rationalizing earlier investment.[32]

For firm to proceed with reorganization and rationalization in the 1930s, notwithstanding its costs, they had to be confident that the Depression would not recur. With departure from the gold standard and the transition to "cheap money" in Britain and with depreciation of the dollar and advent of the New Deal in the United States, they become convinced that there had been a change in the policy regime. They became convinced, in other words, that the future would be different, macroeconomically, from the (recent) past. Aghion and St. Paul (1998) warn that recessions creating expectations of future recessions may blunt rather than sharpen incentives for productivity-growth-enhancing activities. Thus, for TFP growth to accelerate or even to be maintained after a crisis, it is important to convincingly demonstrate that the future will be different from the past, as the British and American governments did in the 1930s.

Finally, it may be that waiting for returns to innovation in the form of TFP growth requires patience and that we simply have not been sufficiently patient to date.[33] In particular, there can be a lag between innovation and TFP growth when new products and processes have network characteristics, requiring rearrangement of a wide range of distinct activities before efficiency effects begin to materialize. The 1930s, the decade of most rapid U.S. productivity growth (and ironically Hansen's decade), illustrates the point. The key innovations exploited in this period, electricity and the internal combustion engine, in fact dated from the late 19th century.[34] Thomas Edison's breakthroughs affecting the generation and distribution of electric power took place in his Menlo Park, New Jersey laboratory already in the 1870s and 1880s, and Niagara Falls was harnessed to generate large amounts of electric power for use in New York and elsewhere on the Eastern Seaboard already in the 1890s.

But only in the 1920s and 1930s did urban and rural electrification, respectively, become prevalent. There had to be prior agreement on standards for distribution (alternating current) and coordination between equipment suppliers and central power-generating stations. The distribution network had to be built out with government help. Again there was a role of government, this time in the form of, inter alia, the Tennessee Valley Authority.

End-users then had to adapt. In the household sector this was done through the purchase, often on instalment contracts, of new electric-powered, productivity enhancing appliances. Within manufacturing, the factory floor had to be reorganized to capitalize on the availability of the new power source.[35] Factories had previously utilized steam power distributed through a network of overhead drive shafts and brackets. Electrification allowed

[31] As described and analysed by Grossman (1994).
[32] As in the case of the railways in the 1930s. Field (2012) shows that new investment had been more important for TFP growth in the book years of the 1920s, which rationalization of existing investment was more important in the depressed 1930s. Abiad, Dell-Ariccia and Li (2011) show that so-called creditless recoveries are not rare and that they tend to be led by sectors not heavily dependent on external finance for new investment.
[33] An early influential statement of the point is David (1990).
[34] A third network technology relevant in this period, railways, had a rather different productivity history, reflecting the fact that the network had already been built out earlier, in the 19th century (see below).
[35] An important source of detail on this process is Devine (1983).

removal of this steam-related apparatus, making it possible to install overhead cranes to move subassemblies. Electricity also allowed workers to use portable power tools and move freely along the line. This increased their productivity relative to their predecessors who, much like the steam-powered machinery with which they worked, were figuratively bolted to the shop floor. In this way electrification facilitated the adoption of scientific management practices designed to optimize the efficiency of labor input, notably through the time and motion studies pioneered by the management consultant Frederick Winslow Taylor.[36]

A similar story can be told about the internal combustion engine, the other notable network technology of the period. Key innovations occurred already in the 1870s and 1880s (Karl Benz's patent for a reliable two-stroke engine in 1879, for example, and Gottlieb Daimler's patent for a supercharger in 1885). But there had to be standardization of design to make large-scale production economical (Henry Ford's focus on not simply one set of designs but, literally, one model, the Model T, took this to an extreme) and to facilitate maintenance and after-sales service through the development of vocational schools, apprenticeship programs and on-the-job training conferring a standard set of skills.

In addition, it was necessary to build out the highway network before the full efficiency advantages of the new form of locomotion could be reaped. Roads and driving practices had to be standardized. The location of homes and jobs had to be adapted to the existence of this new form of transportation, culminating with the advent of suburbanization in the 1920s and, especially, the 1930s – again with government support, this time from the Federal Housing Authority. Ambitious entrepreneurs like the Florida land mogul George Merrick sought to coordinate of new suburban developments like Coral Gables with construction of the Dixie Highway linking Florida to the Upper Midwest.

More generally, America's head start in the development of the multi-divisional "Chandlerian" corporation facilitated the coordinated reorganization of production and distribution so as to capitalize on the availability of trucking.[37] Broadberry (2006) documents the rapid rise in TFP in transportation, distribution and communications services in the U.S. in this period.[38] That rise was evident, relative both to the preceding era (reflecting the existence of this long gestation period) and to other countries (reflecting favourable initial conditions, namely America's aforementioned head start in the development of the large corporation and multidivisional form, something that preceded the internal combustion engine).[39]

Thus, it is at least conceivable that what we are experiencing at the moment is not secular stagnation but a fit of impatience. It is not unprecedented for three decades of incremental innovation, standardization and adaptation to have to pass before the efficiency advantages of radical new network technologies begin to show up in TFP statistics. Thus, that

[36] The full potential of the assembly line, symbolized by Henry Ford's massive River Rouge Complex constructed starting in 1917, could finally be realized in the 1920s and 1930s (Nelson and Wright 1992). And it was in industries like motor vehicles that differential in productivity growth between the United States and other countries was most pronounced.

[37] After Alfred Chandler (1990). Not that the trucking services were necessarily provided in house; in practice they were typically subcontracted to small, non-hierarchically organized firms (Field 2012). Trucking records one of the highest rates of TFP growth between 1929 and 1941 according to the calculations of Field (2006).

[38] Significant advances in efficiency consumer-product and services industries were similarly evident in this period in tobacco, food products, plastic products, and chemicals, according to Bernstein.(1987).

[39] The rise of the large multidivisional form having been associated instead with the railways, the first true multidivisional corporations, according to Chandler.

the IT revolution, as captured by TFP growth, took a decade-long pause between 2005 and 2015 may be less a portent of secular stagnation than a harbinger of better times to come.[40]

[40] The fact that productivity growth accelerated between 1995 and 2005 before then decelerating again requires more analysis, which I leave to elsewhere. One interpretation is that the first wave of IT-related micro-technologies that came along in the 1970s and 1980s and found expression, after a delay of some years, in the acceleration of productivity growth in 1995-2005 was fundamentally different (it constituted a "different generation" of new technologies) than the second wave that developed subsequently and has yet to find expression in a renewed acceleration in productivity growth.

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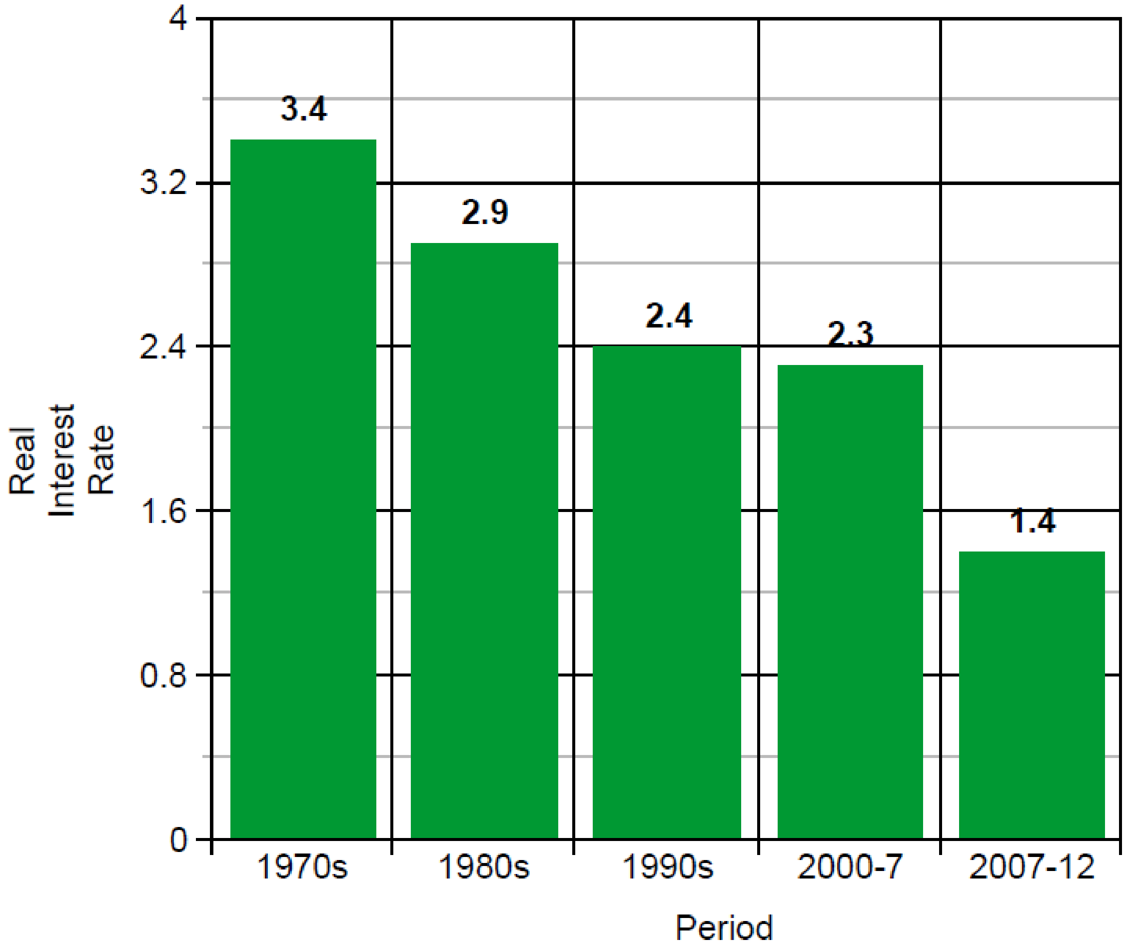
Figure 1. Ramsey Model Predicted Real Interest Rates



Author's Calculations

Figure 2. Output, Employment and Productivity in US & UK Manufacturing, 1935

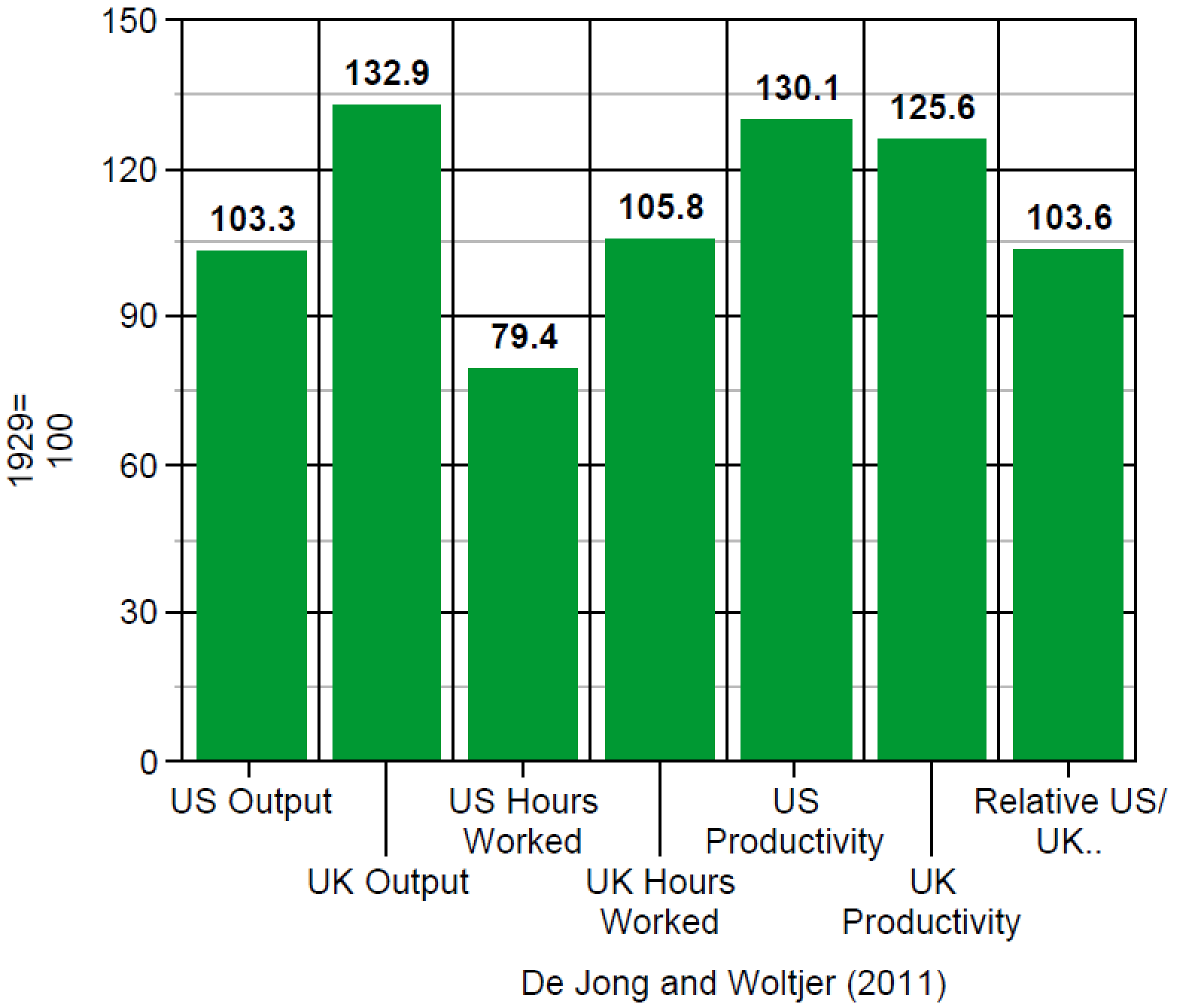
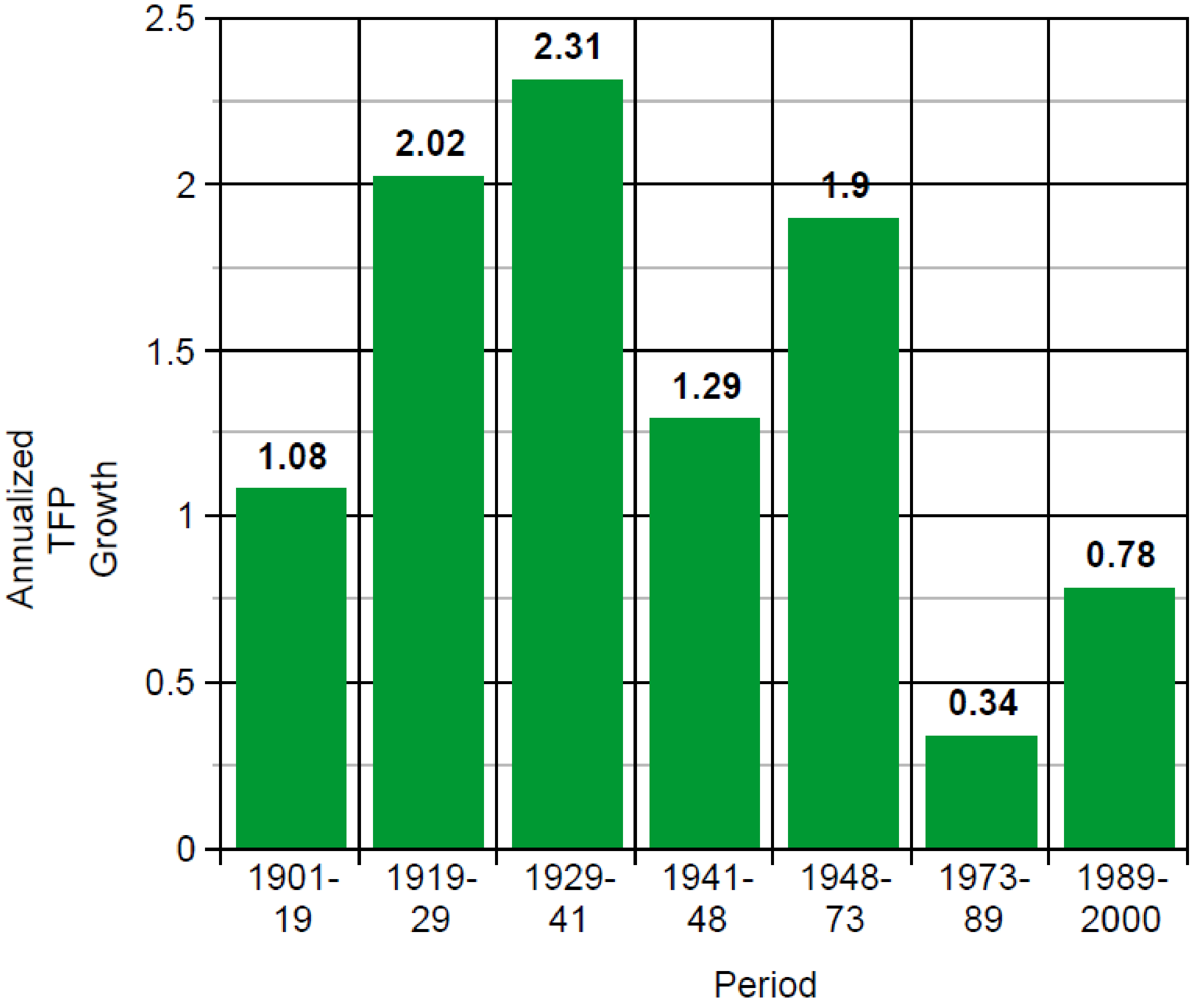


Figure 3. TFP Growth, United States



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