Notes on accumulation and utilization of capital: some empirical issues

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October 18, 2019

[Very preliminary draft]

Abstract

The paper makes three contributions. First, following up on Nikiforos (2016), it provides an in-depth examination of the Federal Reserve measure of capacity utilization and shows that it is closer to a cyclical indicator than a measure of long run variations of normal utilization. Second, and related to that, it argues that a relatively stationary measure of utilization is not consistent with any theory of the determination of utilization. Third, based on data on the lifetime of fixed assets it shows that for the issues around the "utilization" controversy the long run is a period after thirty years or more. This makes it a platonic idea for some economic problems.

JEL Classification: B22, O4, D3, D2
Keywords: Accumulation, Growth, Distribution, Utilization

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1 Introduction

As in every debate in economics or elsewhere a significant part is related to the empirics. What is the right data to examine the questions at hand? What is this data telling us? This is also the case with regards to the question whether the normal rate of utilization is endogenous to demand or not (for a review of this "utilization controversy" see Nikiforos [2016]).

An obvious piece of data that can help us answer this question are the measures of industrial production, capacity and the related utilization constructed by the Federal Reserve Board (FRB). Indeed this measure of utilization has been widely used by both sides of this debate.[1]

The FRB measure of utilization fluctuates for long periods of time around the same level, which points towards an exogenous-to-demand utilization rate. Utilization driven by demand may fluctuate around a center of gravity, but this center of gravity itself is exogenous. In a previous paper (Nikiforos 2016) I argued, among other things, that the FRB data are not right for that purpose. Because of the method of its construction the FRB measure of utilization does not capture significant changes that might occur over time. This becomes clear if one reads carefully how these measures are produced. A first contribution of the present paper is to provide a detailed examination of the FRB measure of utilization (section 2). An exhaustive treatment of the issue confirms the ambiguities surrounding the FRB measure, and that it is closer to being a cyclical indicator of economic activity than a measure of long run variations of normal utilization.

At the same time, it is important to note that a part of the recent declines of the FRB measure—the average rate of utilization in the FRB series has been lower since the early 1980s and even more in the last years after the Great Recession—can be attributed to lower demand. To the extent that this is the case, it confirms that utilization is exogenous to demand. However, this does not negate the inappropriateness of the FRB series for the measurement of the evolution of the normal utilization.

If the FRB measure is not appropriate, then what is? As I explain in Nikiforos (2016, 2019b) a better measure for the long run evolution of utilization is the Average Workweek of Capital, which measures how many hours the capital stock is utilized over the course of a week, which by definition is 168 hours long. The properties of the available estimates of the average workweek of capital are birefly summarized is section 2.1

However, there is a more fundamental reason why the FRB measure is inappropriate. A

1. See for example Lavoie, Rodríguez, and Seccareccia (2004) and Skott (2012), or more recently Gahn and González (2019) and Setterfield and Avritzer (2019).

rate of capacity utilization that is relatively stable over time is not consistent with any theory for the determination of capacity utilization. Even if one believes that demand does not play a role and that only technological, cost or other factors enter in its determination, there is no reason to expect that all these other factors will change in such a way to keep utilization constant. This is another—logical—reason why the FRB data, which are stationary over long periods of time, are not the appropriate measure of the long run trajectory of the rate of capacity utilization. This issue has passed completely unnoticed in the literature so far. It is discussed in section 3.

Finally, the paper deals with the question how long is the long run. The literature here is ambiguous. In the context of the "utilization controversy," the long run is the period when all capital is "free" to take any physical form, that is after the useful life of existing capital is over. Based on data on the useful life of capital I show that the average useful life is around thirty years. Hence, for certain economic questions normal utilization is relevant only in logical time, but does not say much about actual historical processes. In this very long run, when the lifetime of all capital stock has expired after a shock, we need to go back to the justification provided above. However, this sort of long run often "floats above historical time as a Platonic Idea" as Joan Robinson (1979, 180) famously pointed.

2 The Federal Reserve's measure of capacity utilization

The FRB data on capacity utilization are presented in figure 1. The picture that emerges from this data is that utilization fluctuates around the same level for very long stretches of time. For the period 1948–1979 (both of them peak cycle years) it fluctuated around 83.07 percent, while for the period 1979–2006 (2006 was also a peak cycle year) average utilization was 80.69 percent.[2] Regressions for these two periods show that there is no trend in the data.[3] From an economic point of view, this constancy of utilization over thirty-year long periods of time provides support to the argument that the rate of utilization is exogenous to demand in the long run. Demand plays a role only in the business cycle frequency and drives the oscillations of the data around the average.

figure 1 around here

2. In Nikiforos (2016, section 4.1), I use the periods 1948–1980 and 1980–2007. The results are similar, but the periodization used in this paper is more consistent because it uses peak cycle years.

3. The averages in the figure come from these regressions. For the first period the coefficient for the trend is 0.000191 with a p-value of 0.9867, while for the second period the coefficient for the trend is -0.008693 with a p-value of 0.4191.

However, as I argued in Nikiforos (2016, section 4.2), the FRB data tend to be stable because of the method they are constructed and the purpose of the related measure, and therefore cannot answer how utilization behaves in the long run. As it is explained in several related papers, the purpose of the FRB measure is to capture the amount of resource *slack* in the economy (e.g., Morin and Stevens 2004). In turn, in the way data are constructed slack is treated as a cyclical variable that can capture possible inflationary pressures and demand for capital goods (Morin and Stevens 2004; Federal Reserve 2019b). Inflationary pressures and demand for capital goods are not a function of normal utilization, but rather of the distance between actual and normal.

Seen from another angle, the first sentence of the methodology section on the Federal Reserve's (2019) website reads as follows (emphasis in the original): "The Federal Reserve Board's capacity indexes attempt to capture the concept of *sustainable maximum output*, the greatest level of output a plant can maintain within the framework of a realistic work schedule after factoring in normal downtime and assuming sufficient availability of inputs to operate the capital in place." The "sustainable maximum output" definition of capacity is an economic definition—as opposed to an engineering definition.[4] It is the level of capacity that minimizes the unit costs or maximizes the profits of production. If demand or any other factor would increase both production and the optimal level of output, the change would not be reflected in the measurement of the utilization rate based on such definition of capacity.

At a practical level, the FRB utilization rate is based on the Survey of Plant Capacity (SPC) conducted by the US Census Bureau. The plant managers are asked to report the "*full production capability* of their plant—the maximum level of production that this establishment could reasonably expect to attain under *normal* and *realistic* operating conditions fully utilizing the machinery and equipment in place." As I discuss in Nikiforos (2016, section 4.2) "normal and realistic conditions" is an ambiguous term. If a firm operates for a long time under a single-shift (40-hour per week) system, then these are its normal and realistic conditions. If for some reason production increases and a second shift is added and is maintained for a long period of time, the two shifts are the new normal. This change will not be reflected in the reported utilization rate.

The possibility that the "definition" of normal in the answers of plant managers might change in such a way was confirmed to me in personal correspondence by Federal Reserve economists who are involved in the creation of the index. In addition, there is other evidence that points toward such an interpretation of the results of the survey and the FRB measure of

4. For references to the various definitions of capacity, see Nikiforos (2016, 438–39).

capacity and its utilization.

Doyle (2000) provides a detailed discussion of the 1989 change in the definition of capacity in the SPC questionnaires. It was in that year that the SPC started asking about the "full production" capacity. Up until then, plant managers were asked to report "preferred" capacity, which refers to a clearly economic definition of capacity as discussed above, and "practical" capacity, which corresponds more closely to the engineering concept of capacity. She compares the surveys using different techniques and concludes that "the results point to a one-to-one mapping between full utilization and preferred utilization" (2).

Richard Raddock, who for many years produced the papers on the annual revisions of the capacity and utilization measures for the FRB's division of research and statistics, writes in one of them: "production indexes, especially at major cyclical peaks provide floors and suggest ceilings in calculating the capacity indexes" (Raddock 1985, 760).

The ambiguous definition of capacity has been repeatedly highlighted. Taubman and Gottschalk (1971, 451), referring to the utilization measure based on the McGraw-Hill survey, which preceded the SPC, write that: "[it] allows each firm to define capacity as it wishes. Thus the measure is vague and ill defined and, while attempts have been made to correct these deficiencies, it is not clear how successful they have been."

The McGraw-Hill Spring Survey of Business Plans for New Plants and Equipment ran from 1955 to 1988, and was the source of the FRB data for the early postwar decades. The Census survey that is used today started in 1974, so there was an overlap of 14 years. It is telling about how we should interpret the FRB data that the estimates of capacity from the Cesnsus surveys were adjusted to levels that maintain consistency with the McGraw-Hill survey. "In general simple level adjustment achieved this broad consistency. In some cases, *both level and trend adjustments* were required because the utilization rates based on the Census survey trend lower over time than those based on the McGraw-Hill/DRI survey" (Raddock 1990, 491, emphasis added).

In a paper titled "Assessing the Federal Reserve's measures of capacity and utilization" Matthew Shapiro (1989, 187–8, emphasis added) concludes that "they [the FRB] estimate capacity so that *production does not exceed capacity* (except in rare instances) and so that *production is not chronically below 'normal' capacity utilization*. The consequence of these adjustments is, *as the Federal Reserve's documentation makes clear, that the published utilization figures should be given no cardinal interpretation*."

A few years later he adds that "the Federal Reserve Board's capacity utilization rate provides a convenient, *detrended* source of data on production. Capacity utilization is the ratio of production to a smooth measure of capacity output. [fn 22]: *Hence the Federal Reserve*

Board's capacity utilization rate is not a direct measure of capital utilization" Shapiro (1996, 91, emphasis added).

All of the above show that the FRB measure of capacity utilization is not the right measure for long-run variations in utilization. This is not because of any kind of measurement error and it does not mean that it is a wrong measure. Instead, its method of construction and its purpose are different.

One final point needs to be discussed before moving on. Despite its method of construction, the FRB measure has had a slightly negative trend over the last four decades. As we can see in figure 1, the average for the period 1979–2007 is 2.4 percent below its average during the 1948–1979 period. Also, over the last two recoveries the level of the rate of utilization has not recovered to its post-1980 peaks. Why is this happening? There has not been a definite answer yet. A recent note by Pierce and Wisniewski (2018) is conclusive only in *ruling out* some potential explanations (such as shifts in industry weighting, differences between continuing and entering/exiting establishments). Bansak, Morin, and Starr (2007) attribute the decline to technical change, which makes it easier to increase or decrease production and encourage firms to install a broader margin of excess capacity. This is enhanced by high-tech-capital price declines, which make excess capacity cheaper.

Another potential explanation, as I mention in Nikiforos (2016, 445), is that despite the various adjustments by the FRB some of the decline is due to changes in the sources of the data and the way the series are constructed. This might have to do with the switch from the McGraw-Hill to the SPC survey, or changes to the SPC survey over time. Bauer and Deily (1988) write that "even though the Federal Reserve strives to construct capacity utilization series that are consistent over time, such consistency is difficult to achieve. Major institutional and technological changes have occurred in the past and are certain to continue in the future, possibly affecting the degree of tightness a given capacity utilization rate represents." Morin and Stevens (2004, 8–9) add that "before 1982, the SPC undercounted idle plants, and, consequently, reported industry-level utilization rates that were higher in downturns than would otherwise have been the case (although this has been difficult to detect statistically)."

Finally, the decline might also be related to lower demand. In a related query, FRB researchers replied to me that the decline in utilization is most notable for some industries that have experienced increases in import competition, such as apparel. In the previous hypothetical example, imagine a plant that can only run in eight-hour shifts, using a certain number of workers for each shift (meaning that the shifts need to be fully staffed).[5] Permanent drops in

5. This type of technology is usally called "pure assembly" technology (Mattey and Strongin 1997).

demand that induce changes in the number of shifts will lead to a change in the definition of full production capacity. However, imagine that there is a drop in demand that is not enough to induce a switch from two to one shift, so that the plant runs two shifts below full capacity. Or, if the plant runs one shift, and there is a drop in demand, but it is still profitable to produce. It is possible that these sorts of demand effects are captured in the FRB measure.

Notice that to the extent that this is the case, the FRB measure points toward an endogenous-to-demand utilization rate. Be that as it may, and for the reasons outlined above in this section, the FRB is not able to capture the bulk of the variation in utilization over time. This becomes obvious when we compare it with the measure of the average workweek of capital.

2.1 The Average Workweek of Capital

The average workweek of capital (AWW) is a more appropriate measure of the variations of the utilization of capital in the long run. It avoids a lot of the ambiguities of the FRB measure because the maximum time a plant can run during a week is 168 hours, which serves as a fixed and unambiguous basis. In turn the rate of utilization is the number of hours a plant runs divided by 168. The ambiguities of the definition of "normal" conditions do not appear here.

The AWW measure is not without problems. The most important problem of this measure is that it does not take into account changes in the speed of operation of a plant. Utilization can change either through changes in the time that it is utilized or through changes in the speed of its operation. In principle, every plant can adjust its utilization through both time and speed. However, depending on the specific technology of production the startup and shutdown costs of a plant may vary. Industries where these costs are high are usually called "continuous industries," and tend to adjust utilization through changes in the speed of operation. The most common examples of this type of industries are chemical plants or plants with blast furnaces. On the other hand, variations in time of operation are the margin of adjustment in industries with low startup and shutdown costs (e.g., Mattey and Strongin 1997).

figure 2 around here

With these qualifications, the AWW is better suited as a measure of long run utilization. Figure 2 presents six different estimates of the AWW by Foss (1984, 1995); ii) Orr (1989), who follows closely the methodology of Taubman and Gottschalk (1971); iii) Shapiro (1986); iv) Beaulieu and Mattey (1998); v) Shapiro (1996); and vi) Gorodnichenko and Shapiro (2011). The details and the statistical properties of these series has been extensively discussed

in Nikiforos (2016, 2019b), so I will not get into them here. It suffices here to point out that the AWW presents a markedly different picture compared to the Federal Reserve measure of utilization.

3 Should utilization be stationary?

The FRB measure's stability has been often used as evidence that utilization is exogenous to demand. There is a long series of contributions that in one way or another write that the stationarity of the FRB measure of utilization stands against neo-Kaleckian models that predict a endogenous-to-demand rate of capacity utilization.

However, even if utilization is exogenous to demand, should we expect it to be stationary? The theory of utilization points to a series of factors other than demand that determine utilization. The most common are related to technology, costs, and market structure (see Kurz [1986], and Nikiforos [2013, and references therein]). More precisely, the related literature has identified the following determinants of utilization:

i Capital intensity.

ii Relative prices of labor and capital.

iii The rhythmic variation of input prices. A special case of this is the so-called the utilization differential (a wage premium that is paid to workers who work over the "normal" working hours).

iv Rhythmic variations in demand.

v Economies of scale.

vi The degree of monopoly in the market.

All other things equal higher utilization is the result of higher capital intensity, higher relative price of capital, lower rhythmic variation of input prices, lower level of economies of scale and lower degree of monopoly.

A stationary rate of utilization over the long run would imply that all these factors evolve in such a way that utilization remains stationary. However, it is not clear why that would happen, unless by a fluke.

If one is ready to accept that such a strange coincidence of all these factors is likely, then demand could be one of these factors as well. In this case, the stationarity of utilization is not

evidence of an exogenous-to-demand utilization rate. If we do not think this coincidence is likely—and I do not see why it should be—we should not expect that utilization should be stationary in the long run.

That has a series of implications. First, it is a theoretical reason why the FRB measure is inappropriate for measuring long-run variations in utilization and justifies the analysis of section 2 of this paper from a different perspective. Second, it makes clear that the use of the long-run stability of the FRB measure as evidence for an exogenous-to-demand utilization is inconsistent with the theory of utilization. For example, in the context of the utilization controversy, the FRB measure—with the qualifications discussed in section 2—is not consistent with a firm like the one described Nikiforos (2013), where demand plays a role, but it is also not consistent with the firm described by Kurz (1986), where demand plays no role.

Finally, this also implies that non stationary equilibrium is a necessary but not sufficient condition for the endogeneity of utilization to demand in the long run. The investigation of this question—does demand contribute to the non stationarity of utilization?—is I think more interesting for future research. I provided a first answer in my econometric analysis in Nikiforos (2016, section 7), but more can and should be done.

4 How long is the "long run"?

The debate around the endogeneity or not of utilization refers to the long run. However, it is not clear what is the precise duration of this long run in historical time. For example, the system in Duménil and Lévy (1999) is brought to its classical long run through countercyclical monetary policy, which implies a long run equal to the duration of the business cycle. The same is true for those who use the FRB data as an evidence of an exogenous rate of utilization because the FRB data gravitate around a certain mean at the business cycle frequency. To put this in context, according to the Business Cycle Dating Committee of the US National Bureau of Economic Research the average duration (trough to trough) of the 33 cycles of the period 1854-2009 was 56.2 months—slightly below five years.[6] This has increased to 69.5 months—or roughly seven years—in the eleven cycles of the postwar period 1945-2009.[7] Others have have suggested a slightly higher number. For example, Vianello (1985, 71) gives a hypothetical example where an economy finds itself in a fully adjusted position, and returns

6. The business cycle reference dates as estimated by the Business Cycle Dating Committee of the National Bureau of Economic Research can be found at https://www.nber.org/cycles.html.

7. This number will further increase when the current cycle is counted, since the current recovery recently became the longest in the US history.

to a fully adjusted position "after a period of, say, ten years." Finally, others do not specify a number. For example, Kurz (1986, 40) writes that "it cannot be precluded that deviations of the actual situation from the 'normal' one, may become large, and remain so for a long period of time".

Thus the question remains: how long? To approach this issue we can start from the firm level. At every period of time, a firm that maximizes its profits (or minimizes its costs) makes two decisions related to accumulation and utilization:

1. If it will invest or not. This investment decision is affected by various factors like profitability, internal and external finance, the state of the balance sheets of firm etc. Importantly, the investment decision will depend on current utilization of capital but also the useful life of the capital stock. Higher utilization will ceteris paribus increase the chances that a firm will invest. At the same time, the higher the remaining useful life of the capital stock is, the lower the chances that the firm will invest are.

2. If the answer to the first decision is positive, then the second decision has to do with how much it will invest and how much this new capital stock will be utilized. As we explained above these two decisions—size of investment and utilization of the new capital stock—are intertwined.

The distinction is important. Since the capital stock is durable, after the firm has invested in a particular type of capital, the cost of this capital is sunk and this has obvious implications for the choice of the optimal system of production. In other words, after investment has been realized even if the firm can change its capital stock by investing or disinvesting (so that we are not in short-run where the capital stock is constant) it will tend to adjust its productive capacity to demand by adjusting its utilization much more compared to a situation where it needs to invest. It is in the latter case that there is the usual trade-off between a single a double shift, between a lower average cost of capital and a higher cost of labor or other factors of production.

Hence, the debate about normal utilization and fully adjusted positions, and the related discussion about how the firm specifies its normal utilization (e.g. Kurz 1986; Nikiforos 2013, 2019a)) refers only to the second decision. It refers to a very long period, where all capital is "free" to take any physical form.[8] In other words, it refers to a situation in logical time, where the system is in a fully adjusted position, there is a shock, and then enough time passes so that all firms exhaust the useful life of their capital, and they need to invest again. An obvious way to measure the duration of this process in actual historical time is with the use of data on

8. The terms "free" is used by (Garegnani 1992, 56) who borrows the term from (Wicksell 1934).

the useful life of capital stock.

figure 3 around here

The literature on the useful life of capital stock (e.g. Blades et al. 1983; Rincon-Aznar, Riley, and Young 2017) estimates that the life of tangible assets begins from 7-10 years for "Office equipment and hardware" and "Motor Vehicles", to more than 15-20 years for machinery and then more than forty years for various kinds of infrastructure. Figure 3 summarizes the estimates by Rincon-Aznar, Riley, and Young (2017) for 87 industries of the United Kingdom for the period 2000-13. According to this data, the industry with the shortest average asset life is Air Transport with 10 years. However, only 20 percent of industries have an average asset life below 19. The median and the mean are 25 and 31 years respectively. And forty percent of industries have an average asset life above forty years. What these data show is that, in relation to capacity utilization, in actual historical time the long run refers to a period longer than two and a half to three decades.

This has some important implications. A short run of twenty to twenty five years is a pretty long short run. Given, that in actual historical time the economy is constantly subject to shocks of different types, for many economic problems such a long run becomes irrelevant. It is probably this kind of considerations that led Joan Robinson to oscillate between looking for a theory of the long run and then repudiating Garegnani's (1978) conception of the long period as floating "above historical time as a Platonic Idea."

5 Conclusion

The present paper discussed some empirical issues related to the long run evolution of normal utilization. It made three points. First, following Nikiforos (2016), it provided a detailed examination of the Federal Reserve measure of capacity utilization and showed that it should be regarded as a cyclical indicator rather than a measure of long run variations of normal utilization. A more appropriate measure is the Average Workweek of Capital. Second, it explained that a relatively stationary measure of utilization is not consistent with any theory of the determination of utilization. Finally, it was argued that when we talk about the long run in the context of fully adjusted positions we refer to a time horizon of close to thirty years or more. This puts some of the related debates into perspective. For many economic problems in actual historical time such a long run becomes a platonic idea.

References

Bansak, Cynthia, Norman Morin, and Martha Starr. 2007. "Technology, capital spending, and capacity utilization." *Economic Inquiry* 45 (3): 631–45.

Bauer, Paul W., and Mary E. Deily. 1988. "A user's guide to capacity-utilization measures." Economic Commentary. Federal Reserve Bank of Cleveland.

Beaulieu, J. Joseph, and Joe Mattey. 1998. "The Workweek of Capital and Capital Utilization in Manufacturing." *Journal of Productivity Analysis* 10 (2): 199–223.

Blades, Derek, et al. 1983. *Service lives of fixed assets.* Technical report. OECD techical report. Paris: OECD.

Doyle, Maura P. 2000. "The 1989 Change in the Definition of Capacity: A Plant-Level Perspective." Working Paper 00-09, Center for Economic Studies, U.S. Census Bureau.

Duménil, Gérard, and Dominique Lévy. 1999. "Being Keynesian in the Short Term and Classical in the Long Term: The Traverse to Classical Long-Term Equilibrium." *The Manchester School* 67 (6): 684–716.

Federal Reserve. 2019a. "Capacity and Capacity Utilization Methodology." Federal Reserve System. Https://www.federalreserve.gov/releases/g17/Meth/MethCap.htm.

———. 2019b. "History of the Capacity and Capacity Utilization Index." Federal Reserve System. Https://www.federalreserve.gov/releases/g17/Hist/HistCap.htm.

Foss, Murray F. 1984. *Changing Utilization of Fixed Capital: An Element in Long-Term Growth.* Washington, D.C.: American Enterprise Institute for Public Policy Research.

———. 1995. "Operating Hours of the US Manufacturing Plants, 1976-1988, and their Significance for Productivity Change." In *Work Patterns and Capital Utilisation: An International Comparative Study,* edited by Dominique Anxo, Gerhard Bosch, Gilbert Cette, Thomas Sterner, and Dominique Taddei. London: Kluwer Academic Publishers.

Gahn, Santiago J., and Alejandro González. 2019. "On the 'utilisation controversy': a comment." Forthcoming, *Cambridge Journal of Economics.*

Garegnani, Pierangelo. 1978. "Notes on consumption, investment and effective demand: I." *Cambridge Journal of Economics* 2 (4): 335–53.

———. 1992. "Some Notes for an Analysis of Accumulation." In *Beyond the steady state: a revival of growth theory,* edited by Joseph Halevi, David Laibman, and Edward J. Nell, 47–71. New York, NY: St. Martin's Press.

Gorodnichenko, Yuriy, and Matthew D Shapiro. 2011. "Using the survey of plant capacity to measure capital utilization." US Census Bureau Center for Economic Studies Paper No. CES-WP-11-19.

Kurz, Heinz. 1986. “Normal positions and capital utilisation.” *Political Economy* 2 (1): 37–54.

Lavoie, Marc, Gabriel Rodríguez, and Mario Seccareccia. 2004. “Similitudes and Discrepancies in Post-Keynesian and Marxist Theories of Investment: A Theoretical and Empirical Investigation.” *International Review of Applied Economics* 18 (2): 127–49.

Mattey, Joe, and Steven Strongin. 1997. “Factor utilization and margins for adjusting output: evidence from manufacturing plants.” *Economic Review:* 3–17.

Morin, Norman, and John Stevens. 2004. “Estimating capacity utilization from survey data.” Working Paper 2004-49. Finance and Economics Discussion Series. Divisions of Research & Statistics and Monetary Affairs. Federal Reserve Board.

Nikiforos, Michalis. 2013. “The (Normal) Rate of Capacity Utilization at the Firm Level.” *Metroeconomica* 64 (3): 513–38.

———. 2016. “On the ‘utilisation controversy’: a theoretical and empirical discussion of the Kaleckian model of growth and distribution.” *Cambridge Journal of Economics* 40 (2): 437–67.

———. 2019a. “Notes on accumulation and utilization of capital: some theoretical issues.” Levy Economics Institute Working Paper.

———. 2019b. “On the ‘utilization controversy’: a rejoinder and some comments.” Forthcoming, *Cambridge Journal of Economics.*

Orr, James A. 1989. “The Average Workweek of Capital in Manufacturing, 1952-1984.” *Journal of the American Statistical Association* 84 (405): 88–94.

Pierce, Justin R, and Emily Wisniewski. 2018. “Some Characteristics of the Decline in Manufacturing Capacity Utilization.” *FED Notes.*

Raddock, Richard D. 1985. “Revised Federal Reserve Rates of Capacity Utilization.” *Federal Reserve Bulletin* 82:411–35.

———. 1990. “Recent developments in industrial capacity and utilization.” *Federal Reserve Bulletin* 82:754–66.

Rincon-Aznar, Ana, Rebecca Riley, and Garry Young. 2017. “Academic review of asset lives in the UK.” NIESR Discussion Paper No. 474, London: National Institute of Economic and Social Research.

Robinson, Joan. 1979. “Garegnani on effective demand.” *Cambridge Journal of Economics* 3 (2): 179–80.

Setterfield, Mark, and Joana David Avritzer. 2019. "Hysteresis in the normal rate of capacity utilization: a behavioural explanation." The New School for Social Research, Department of Economics, Working Paper 07/2019.

Shapiro, Matthew D. 1986. "Capital utilization and capital accumulation: Theory and evidence." *Journal of Applied Econometrics* 1 (3): 211–34.

———. 1989. "Assessing the Federal Reserve's measures of capacity and utilization." *Brookings Papers on Economic Activity* 1989 (1): 181–225.

———. 1996. "Macroeconomic implications of variation in the workweek of capital." *Brookings Papers on Economic Activity* 1996 (2): 79–133.

Skott, Peter. 2012. "Theoretical and Empirical Shortcomings of the Kaleckian Investment Function." Special Issue on Kaleckian Growth Theory, *Metroeconomica* 63 (1): 109–38.

Taubman, Paul, and Peter Gottschalk. 1971. "The Average Workweek of Capital in Manufacturing." *Journal of the American Statistical Association* 66 (335): 448–55.

Vianello, Fernando. 1985. "The pace of accumulation." *Political Economy: Studies in the Surplus Approach* 1 (1): 69–87.

Wicksell, Knut. 1934. *Lectures on Political Economy.* Vol. I. London: Routledge.

Figure 1: The Federal Reserve Board's Measure of Capacity Utilization.

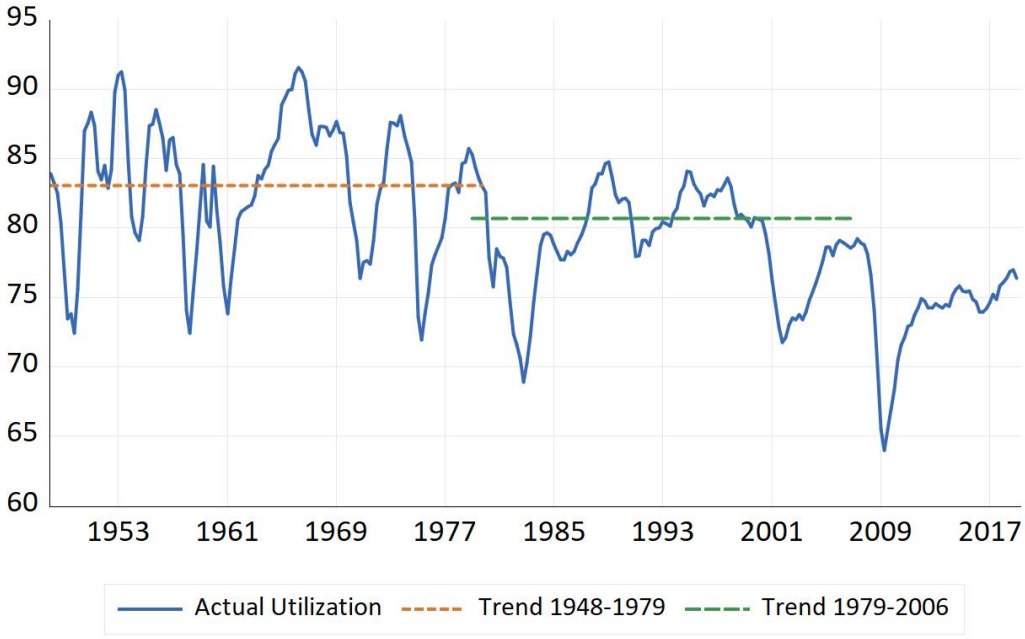
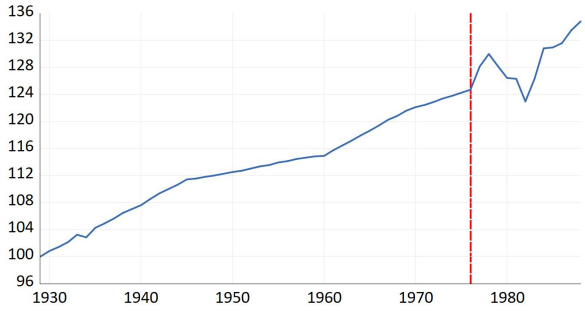
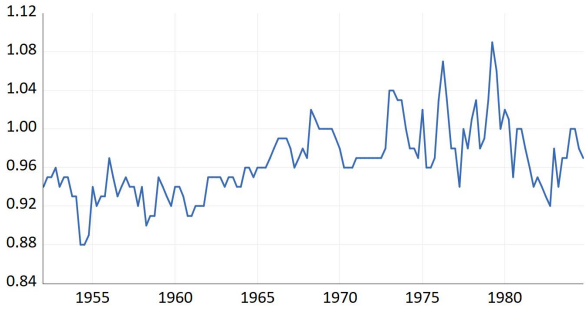


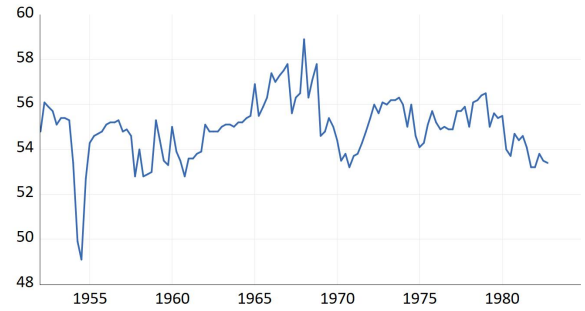
Figure 2: Estimates of the Average Workweek of Capital



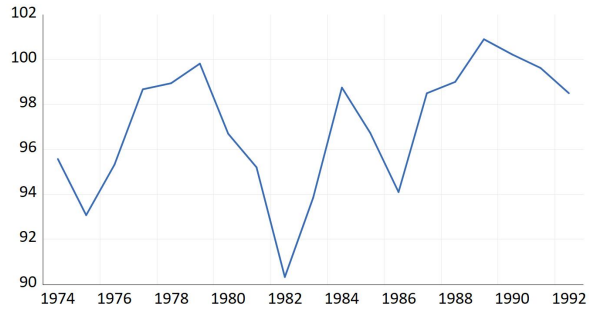
(a) Foss (1984, 1995)



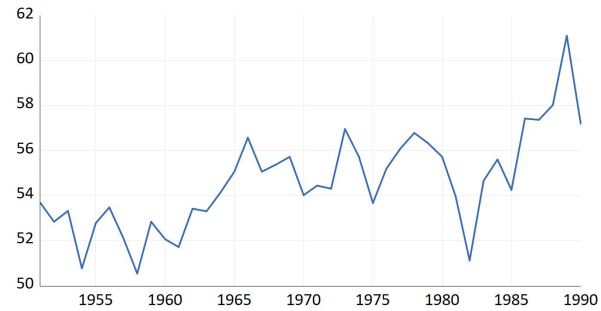
(b) Taubman and Gottschalk (1971) and Orr (1989)



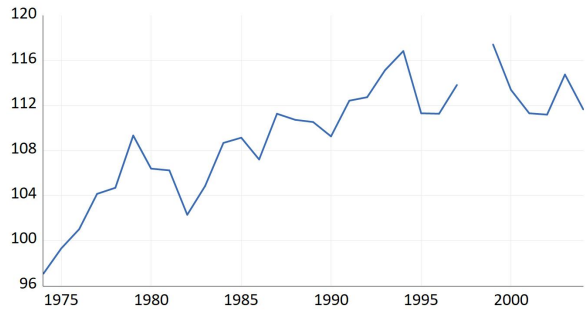
(c) Shapiro (1986)



(d) Beaulieu and Mattey (1998)



(e) Shapiro (1996)



(f) Gorodnichenko and Shapiro (2011)

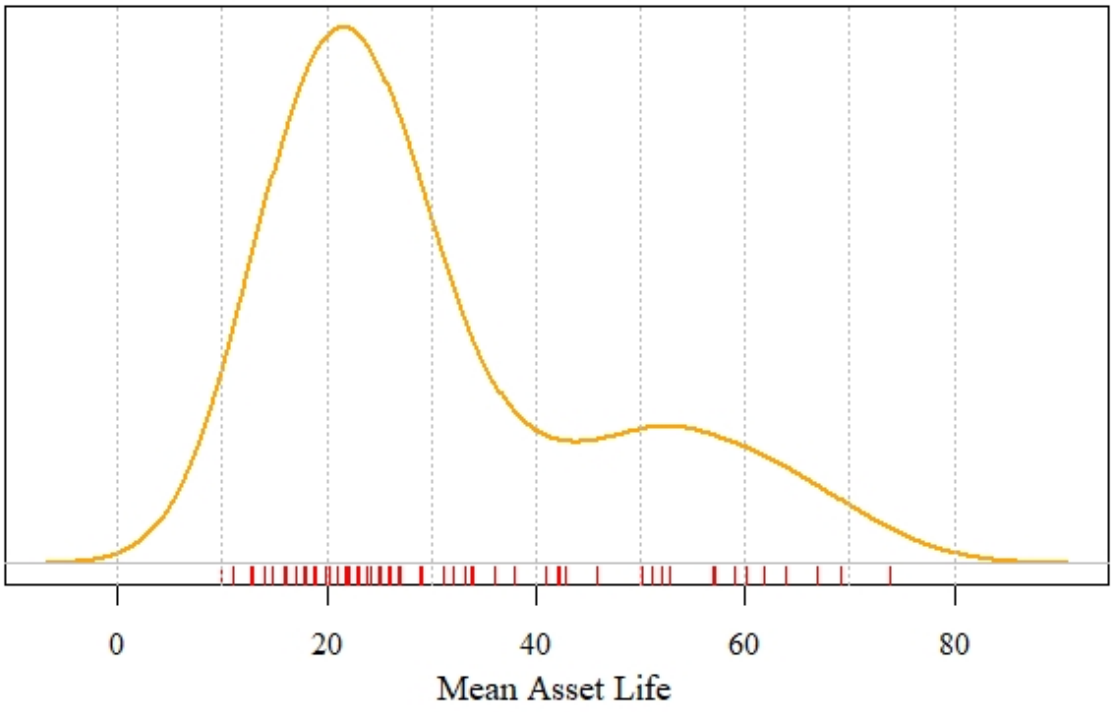


Figure 3: Kernel Density Estimation of the Mean Asset Lives by Industry (weighted by investment) for the United Kingdom (2000-2013)
Source: Rincon-Aznar, Riley, and Young (2017, table A.6)
Summary statistics: Min: 10; 1st Quintile: 19; Median 25; Mean: 30.57; 3rd Quintile: 39.50; Max: 74.00.