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Notes on the accumulation and utilization of capital: Some empirical issues

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Abstract

The paper makes three contributions. First, 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. Other measures, such as the Average Workweek of Capital or the National Emergency Utilization Rate are more appropriate for examining long-run changes in 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.

KEYWORDS

accumulation, distribution, growth, utilization

JEL CLASSIFICATION

B22; O4; D3; D2

1 | INTRODUCTION

As in every debate in economics or elsewhere, a significant part is related to empirics. What is the right data to examine the questions at hand? What is the data telling us? This is also the case with

regards to the question of whether the normal rate of utilization is endogenous to demand or not (for a review of this "utilization controversy," see Nikiforos [2016, 2020b]; a recap is provided in Section 2).

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

The FRB's utilization measure fluctuates for long periods of time around the same level, which points toward 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 this measure is produced. The first contribution of the present paper is to provide a detailed examination of the FRB measure of utilization in Section 3. An exhaustive treatment of the issue confirms the ambiguities surrounding the FRB measure, and that it is closer to a cyclical indicator of economic activity than a measure of long-run variations in normal utilization.

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

However, there is a more fundamental reason why the FRB measure is inappropriate. A rate of capacity utilization that is relatively stable over time is not consistent with any theory on capacity utilization's determination. 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 measure's data, which is 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 4.

If the FRB measure is not appropriate, then what is? As I explain in Nikiforos (2016, 2020a), a better measure for the long-run evolution of utilization is the average workweek of capital (AWW), which measures how many hours the capital stock is utilized over the course of a week (which, by definition, is 168 hr long). The properties of the available estimates of the AWW are summarized in Section 5.

In the next section (Section 6), I discuss the national emergency utilization rate (NEUR) that is published by the U.S. Census Bureau. This rate is calculated based on an engineering definition of productive capacity and also avoids many of the ambiguities related to the FRB rate. At the same time, it can capture variations in utilization due to changes in intensity and speed of production, and not only the time productive capacity is used. Its examination and juxtaposition to the FRB rate confirm that the FRB rate is not appropriate for measuring long-run variations in utilization.

Section 7 discusses a common objection to the endogeneity of the rate of utilization, namely that this rate cannot be unbounded and therefore it has to fluctuate within some narrow limits. It is explained that (almost) every economic variable is bounded and endogeneity means that the degree of adjustment of a variable in response to a shock is economically meaningful. When it comes to the rate of utilization, the empirical evidence of the previous sections points to large and economically significant adjustments.

[1]See, for example, Lavoie et al. (2004) and Skott (2012), or, more recently, Gahn and González (2019) and Setterfield and Avritzer (2020), Gahn (2020), Haluska et al. (2021).

Finally, in Section 8, the paper deals with the question of how long the long run is. 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 the capital, I show that the average useful life is around 30 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 discussions in Kurz (1986) and Nikiforos (2013, 2020b). However, this sort of long run often "floats above historical time as a Platonic Idea," as Joan Robinson (1979, p. 180) famously pointed.

2 | A RECAP OF THE CONTROVERSY[2]

The behavior of the rate of capacity utilization, and more precisely its endogeneity or not to demand, is of central importance for the theory of growth and distribution.Moreover, with regard to growth, the important question is whether demand plays an independent role in the long-run growth performance of the economy. On the other, with regard to distribution, the central question is whether the distribution is determined within the economy (like in the neo-Keynesian or neoclassical traditions) or primarily outside of the economy based on institutions, social norms, and the class struggle (this is the answer of the classical tradition).

The combination of classical distribution with an independent role for aggregate demand necessitates an endogenous-to-demand rate of utilization. This is the basic closure of what is usually referred to as the Kaleckian or Structuralist model. If the rate of utilization is treated as exogenous, we need to drop either the classical theory of distribution or the independent role of aggregate demand. In the first case, we are in a neo-Keynesian system where distribution becomes endogenous to allow for the adjustment of total savings to the level of investment. In the second case, we are in what is usually called a Classical model. An alternative is the neo-Sraffian Super Multiplier model, which by introducing a central role for "autonomous expenditure" squares the circle and allows for classical distribution and an autonomous role of demand (at the cost of making investment rudimentary and passive).

Hence there are two sides to the utilization controversy. Moreover, Kaleckians/Structuralists have argued that utilization is endogenous in the long run, and the normal utilization adjusts toward its actual level. On the other, neo-Keynesian, neo-Sraffian, and classical economists have criticized the Kaleckian model (among other things) on these grounds, that is, that the utilization rate does not change in response to shocks to demand. At the macro level, they argue that deviations of the actual from the normal rate of utilization due to shocks to demand, induce changes in the accumulation rate that allow capacity to adjust and keep the normal rate of utilization constant.

It is important to note here before moving on, that exogeneity does not necessarily mean that there is a fixed exogenous level of utilization, but rather a small exogenous-to-demand range of values of utilization. Since the range is small, the part of the adjustment of the system that takes place through changes in utilization is not economically meaningful and adjustment takes place along other margins (such as distribution in neo-Keynesian models, or investment in classical models).[3]

[2]A detailed exposition of the discussion of these issues is provided in a companion paper (Nikiforos, 2020b, Section 2). The reader can refer to that discussion for extensive references to the related literature.

[3]At the same time, it is usually not clarified what is this small range. In a recent conference, I asked Peter Skott and he suggested a range of ±3%. As it will be demonstrated below the actual variation of utilization is much higher than this.

At the theoretical level, the crucial question is why a firm would change its desired or normal level of utilization (the level of utilization that maximizes its profits or minimizes its costs) in the face of changes in demand. In other words, assume that when a firm built its new plant it decided that its optimal utilization is two shifts per day. Demand shocks can lead to changes in this level of utilization. But would these changes persist in the long run? Or seen from another point of view, if the firm had expected a different level of demand at the time of building its plant would it choose a different level of utilization.

In a contribution that is usually evoked in these debates by those who argue in favor of an exogenous-to-demand utilization, Kurz (1986) gives a negative answer. His model shows that demand can play a role in the short run, but its long-run normal level is affected only by technological and cost factors (such as capital intensity, the relative prices of capital and labor, and shift differentials).

In a paper that extends Kurz model (Nikiforos, 2013), I show that if economies of scale are taken into account it can be shown that an increase in demand will lead to changes in the normal rate of utilization. More precisely, this will happen as long as the rate of returns to scale decreases as the scale of production increases. This condition is justified by the theory of production and is mainly related to the existence of indivisibilities. The basic intuition is that if the capital stock is not fully divisible, a large range of variations in demand will be covered through its utilization. In the hypothetical example above, assuming that capital is not divisible, the firm would choose the same stock of capital irrespective of the level of demand—at least within some limits—and adjust its utilization. The model of Kurz or other models that abstract from this, essentially assume that a firm can find machines of any size. So, if demand decreases to half, the firm will use a machine of half the size, but at the same rate of utilization.[4]

Finally, another question is how we can establish a connection between the micro and the macro levels. If, indeed, the level of demand plays a role for the utilization of the firm at the microlevel, how is this compatible with an endogenous adjustment of normal utilization—to deviations of the actual from the normal utilization—at the macro level. In Nikiforos (2016, Section 6) I suggested that a possible mechanism is through the entry behavior of the firm: when the economy grows at its warranted rate (with a normal utilization) the growth in demand is covered through the entry of firms so that the level of demand for the average firm does not change. If, however, the economy grows faster (slower) than the warranted rate—hence with a higher (lower) than normal utilization rate—demand for the average firm increases (decreases), and hence normal utilization adjusts.

In a more recent paper (Nikiforos, 2020b) I suggest another more straightforward mechanism that can be established on less restrictive assumptions. The idea is that when firms invest and decide the level of utilization of their plant, they do not take into account the level of demand for their product, but rather the expected stream of demand flows over a period of time. If the economy grows at the warranted rate, firms will base their decision on it. If the economy grows faster (slower) firms will adjust accordingly their flows of expected demand and thus normal utilization rate.[5]

[4]In earlier contributions, Lavoie (1995, 1996), Lavoie et al. (2004), and Hein et al. (2012) argue that the normal rate of utilization is just a convention, and hence deviations of the actual rate from this conventional normal rate will cause the normal rate to move toward the endogenous (as conventions shift as well). At the microlevel this rationale is not convincing because the choice of utilization rate is similar to the choice of the production technique and there is nothing conventional about it.

[5]Other possible adjustment mechanisms have been recently discussed by Petach and Tavani (2019), Franke (2020), and Setterfield and Avritzer (2020). The first two papers suggest that at the microlevel, the endogenous adjustment of utilization is based on adjustment costs. This can be thought as a complementary justification to the one suggested here. However, at a practical level adjustment costs should explain only limited variations of utilization. As we will see below empirical data points to significant variations of normal utilization over time. Setterfield and Avritzer argue that lower levels of demand are usually associated with higher demand volatility, and hence, since higher volatility tends to decrease normal utilization, lower demand has the same effect as well.

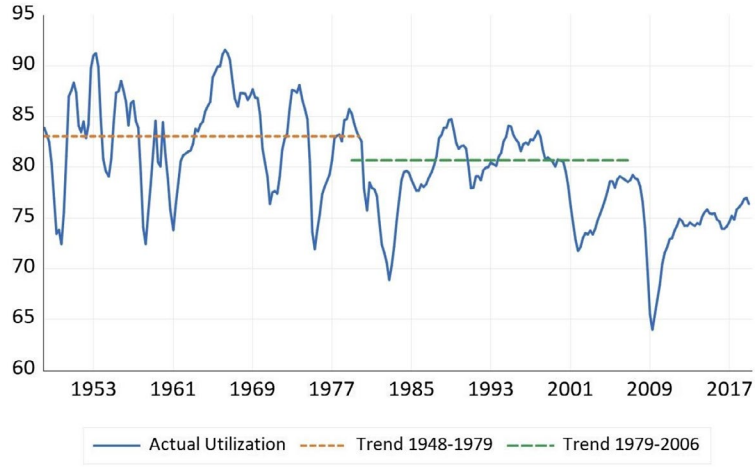

FIGURE 1 The FRB measure of capacity utilization [Colour figure can be viewed at wileyonlinelibrary.com]

3 | 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%, while for the period 1979–2006 (2006 was also a peak cycle year) average utilization was 80.69%.[6] Regressions for these two periods show that there is no trend in the data.[7] From an economic point of view, this constancy of utilization over 30-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 business cycle frequency and drives the oscillations of the data around the average.

However, as I argued in Nikiforos (2016, sect. 4.2), the FRB data tend to be stable because of their method of construction 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 & Stevens, 2004). In turn, in the way the underlying data are constructed, slack is treated as a cyclical variable that can capture possible inflationary pressures and demand for capital goods (Federal Reserve, 2019b; Morin & Stevens, 2004). Inflationary pressures and demand for capital goods are not a function of normal utilization, but rather of the distance between actual and normal utilization.

Seen from another angle, the first sentence of the methodology section on the Federal Reserve's (2019a) 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

[6]In Nikiforos (2016, sect 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.

[7]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 .9867, while for the second period the coefficient for the trend is −0.008693 with a p value of .4191.

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.[8] 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 U.S. Census Bureau. 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, sect. 4.2), "normal and realistic conditions" is an ambiguous term. If a firm operates for a long time under a single-shift (40-hr 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 plant managers' answers might change in this 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 survey's results and the FRB measure of 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 clear 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" (Doyle, 2000, p. 2). 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, p. 760).

The ambiguous definition of capacity has been repeatedly highlighted. Taubman and Gottschalk (1971, p. 451), referring to the utilization measure based on the McGraw-Hill Spring Survey of Business Plans for New Plants and Equipment, 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 survey ran from 1955 to 1988 and was the source of the FRB data for the early postwar decades. The U.S. Census Bureau survey that is used today started in 1974, so there was an overlap of 14 years. The estimates of capacity from the U.S. Census Bureau's surveys were adjusted to levels that maintained 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, p. 491, emphasis added). It is important to take these adjustments into account when we try to interpret the FRB data.

In a paper titled "Assessing the Federal Reserve's measures of capacity and utilization," Shapiro (1989, pp. 187–188, emphasis added) concludes that "[the FRB] estimate capacity so that *production*

[8]For references to the various definitions of capacity, see Nikiforos (2016, pp. 438–439).

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, p. 91, emphasis added).

All of the above shows 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% 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, or differences between continuing and entering/exiting establishments). Bansak et al. (2007) attribute the decline to technical change, which makes it easier to increase or decrease production and encourages firms to install a broader margin of excess capacity. This is enhanced by high-tech-capital price declines that make excess capacity cheaper.

Another potential explanation, as I mention in Nikiforos (2016, p. 445), is that despite the FRB's various adjustments, some of the declines are due to changes in the data sources and the way the series is constructed. This might have to do with the switch from the McGraw-Hill to the SPC, or changes in the SPC 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, pp. 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 associated with 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 8-hr shifts, using a certain number of workers for each shift (meaning that the shifts need to be fully staffed).[9] Permanent drops in 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 shifts to one, so that the plant runs two shifts below full capacity or a situation where the plant runs one shift and there is a drop in demand, but it is still profitable to produce. These sorts of demand effects may be 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 in this section, the FRB measure is not able to capture the bulk of utilization's variation over time.

[9]This type of technology is usually called "pure assembly" technology (Mattey & Strongin, 1997).

4 | SHOULD UTILIZATION BE STATIONARY?

As it was discussed in the previous section, 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 an 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:

1. Capital intensity.
2. Relative prices of labor and capital.
3. The rhythmic variation of input prices. A special case of this is the so-called "utilization differential" (a wage premium that is paid to workers who work over the "normal" working hours).
4. Rhythmic variations in demand.
5. Economies of scale.
6. The degree of monopoly in the market.

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

This has a series of implications. First, it is a theoretical and logical reason why the FRB measure is inappropriate for measuring long-run variations in utilization and justifies the analysis of Section 3 of this paper from a different perspective. Second, it makes clear that the use of the FRB measure's long-run stability 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 nonstationary equilibrium is a necessary but not sufficient condition for the endogeneity of utilization to demand in the long run. The investigation of the question of whether demand contributes to the nonstationarity of utilization is more interesting for future research.

5 | THE AVERAGE WORKWEEK OF CAPITAL (AWW)

The AWW is a more appropriate measure of the long-run variations of the utilization of capital. It avoids a lot of the ambiguities of the FRB measure because the maximum time a plant can run during

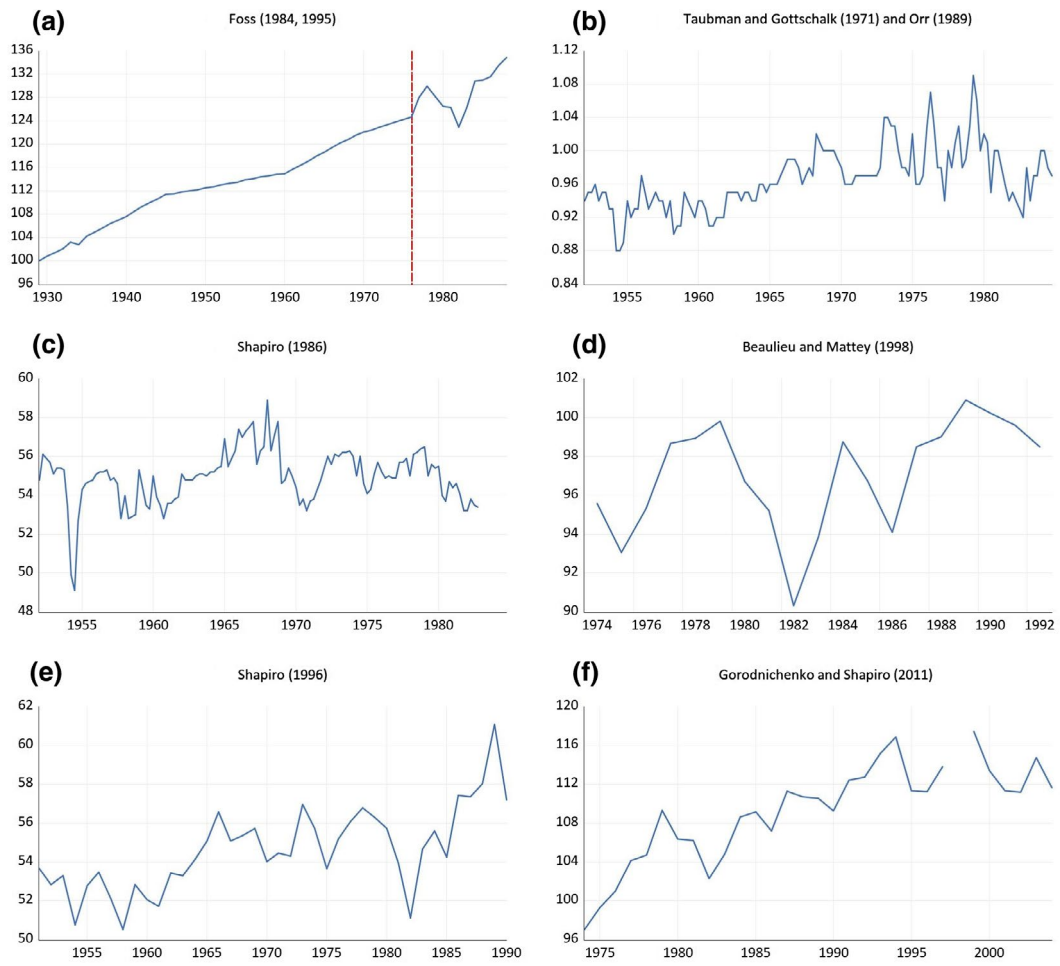

FIGURE 2 Estimates of the AWW [Colour figure can be viewed at wileyonlinelibrary.com]

a week is 168 hr, which provides a fixed and unambiguous basis. In turn, the rate of utilization is the number of hours a plant runs per week divided by 168. The ambiguities of the definition of "normal" conditions do not appear here.

The AWW measure is not without problems. Utilization can change either through changes in the time that capital is utilized or through changes in the speed of its operation. However, the AWW cannot capture the latter . 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 industry are chemical plants or plants with blast furnaces. Moreover, variations in time of operation are the margin of adjustment in industries with low startup and shutdown costs (e.g., Mattey & Strongin, 1997).

Even 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: (a) Foss (1984, 1995), (b) Orr (1989), who follows closely the methodology of Taubman and Gottschalk (1971), (c) Shapiro (1986), (d) Beaulieu and Mattey (1998), (e) Shapiro (1996), and (f) Gorodnichenko and Shapiro (2011).

The details and the statistical properties of these series have been extensively discussed in Nikiforos (2016, 2020a), so I will not discuss them in detail here. For the purposes of this paper, a few comments are important. First, the AWW presents a markedly different picture compared to the FRB measure of utilization. Second, the various estimates of the AWW are not directly comparable, as they are based on different sources of data and they make different choices of aggregation and weighting when they construct the series. Many of the aforementioned contributions acknowledge that their results are sensitive to these choices (e.g., Beaulieu & Mattey, 1998; Gorodnichenko & Shapiro, 2011).

Third, and related to that, the three series that follow the same method of construction are those of Taubman and Gottschalk (1971), Orr (1989), and Shapiro (1986).[10] These series were taken together with Foss (1984, 1995) point to an increase of the AWW of capital in the first decades of the postwar period which slowed down or came to a halt after the mid-1970s.

Finally, as mentioned at the end of the previous section, for the same reasons that a stationary measure of utilization is implausible, a non-stationary measure (such as the AWW) does not mean that utilization is endogenous to demand. This is an interesting question for future research. Given the increases in the cost of labor in the early post-war period—which should have decreased utilization—there is strong prima facie evidence that the high growth rates of the period should have played a role. A preliminary econometric analysis in Nikiforos (2016, sect. 7) confirms this.

The role of demand is also confirmed in an earlier—and cruder—study by Foss (1963) that calculates the AWW based on data on power equipment and on electricity consumption and finds significant increases in the AWW between 1929 and 1955. The methodology of that study has several drawbacks, but an interesting advantage is that it is able to examine industries with negligible technical change over the period under examination (such as the cotton industry). Hence, Foss concluded that despite the increase in the cost of labor (and no-technical change) utilization had increased.

6 | THE NATIONAL EMERGENCY UTILIZATION RATE (NEUR)

Another measure of utilization that is useful for evaluating the long-run behavior of the normal utilization rate is the so-called National Emergency Rate of Utilization (NEUR), which is published by the U.S. Census Bureau. This measure is only available for the period after 1989, which probably explains why it has been ignored in the related literature. It was recently unearthed in a paper by Gahn (2020).

The NEUR is also based on the Census's SPC. After asking plant managers to report their plant's "full production capability," the survey also asks them to estimate their *national emergency*

[10]Shapiro (1986) estimates the AWW for the period 1952–1982. Up until 1968, he follows Taubman and Gottschalk 's (1971) estimates, based on data from the U.S. Bureau of Labor Statistics Area Wage Survey program in standard metropolitan statistical areas (SMSA) in order to produce estimates at the SMSA level and then aggregate them to the national level. Orr (1989) follows this methodology to produce his estimates that extend Taubman and Gottschalk 's estimates until 1984. After 1969 Shapiro uses national-level data on shiftwork, which he interpolates to the quarterly frequency. If we account for a structural break in the series of Shapiro at the first quarter of 1969, his estimates are similar to those of Orr (for a detailed discussion see Nikiforos [2020a, Section 3.3]).

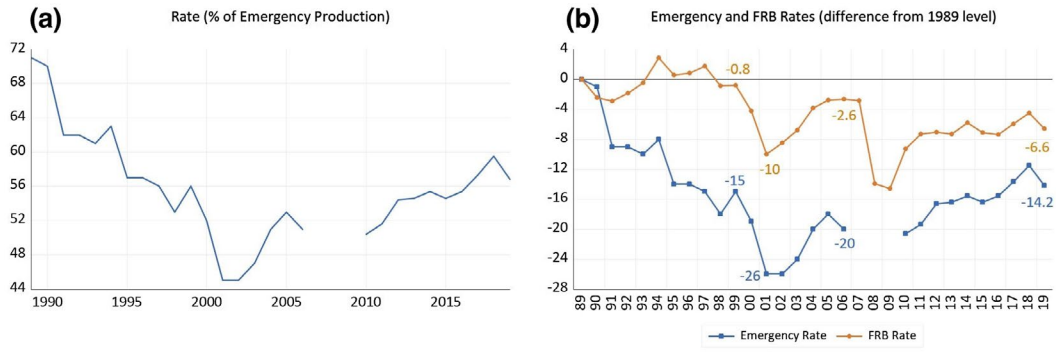

FIGURE 3 The U.S. Census national emergency utilization rate [Colour figure can be viewed at wileyonlinelibrary.com]

production, which is much closer to an engineering measure of production.[11] The NEUR is calculated as the ratio between actual and national emergency production. Compared to the AWW, the advantage of this utilization measure is that it can also capture variations in the *intensity* of the use of productive resources and not only in the *time* they are being used.

The Census reports this estimate of utilization for the period 1989–2019, with the break in the years of the crisis (2007–2009). These estimates are presented in Figure 3. The left panel of the figure presents the NEUR in levels. As one would expect, NEUR is lower than the FRB rate since national emergency production is, by definition, higher than (or equal to) full production capability. At the same time, it is far less stationary compared to the FRB measure. For example, in the 1990s, the NEUR decreased by 26 percentage points, while in 2019 it was more than 14 points below its level in 1989.

The difference between the two measures becomes clearer in the right panel of Figure 3, which plots the change in the NEUR and FRB utilization compared to their levels in 1989. As we can see, in 1998, the NEUR was 15 percentage points below its 1989 level; the FRB rate was only 0.8 percentage points lower. In 2001, at the trough of the cycle, the NEUR had lost 26 points, while the FRB rate only lost 10 points. In 2006, the year before the 2007–2009 crisis, the NEUR rate was 20 points below its 1989 level, while the FRB rate only 2.8 points below. Finally, in 2019 the NEUR had lost 14.2 points, while the FRB rate only lost 6.6 points.[12]

Because national emergency production is definitionally higher than full production capability (and thus the denominator in the NEUR is higher than the FRB rate), all other things equal, a certain change in actual output would lead to a bigger change in the FRB rate compared to the NEUR. For example, assume that the full production capability of a plant is 200 units, and its national emergency

[11]More precisely, per the U.S. Census Bureau (2018, p. 5), in estimating this, national emergency production managers are specifically instructed to: "(a) Assume full use of all machinery and equipment in place (including machinery and equipment that would require extensive reconditioning before they could be made operable); (b) Assume minimal downtime and multi-work shift operations; (c) Assume plant production as close to 168 hr per week as possible, including extra shifts (e.g., operating 7 days per week, 24 hr per day less minimal downtime); (d) Assume overtime pay, availability of labor, materials, utilities, etc., are fully available to you and your suppliers; (e) Assume you can sell all your output; (f) Assume your product mix can change; (g) Assume increased use of productive facilities outside the plant for services (such as contracting out subassembly work) in excess of the proportion that would be normal during the quarter".

[12]The Census also publishes a "full production" utilization rate, which, despite some short-run differences, is close to the FRB rate. For example, in 2019, the full production rate was 6.6 percentage points below its 1989 level—the exact same change as the FRB rate.

production is 400. If the actual output is 100, the full production utilization rate is 50%, while the NEUR is 25%. If actual output falls to 50, the full production utilization rate decreases to 25% (it loses 25 percentage points), while NEUR decreases to 12.5% (it loses "only" 12.5 percentage points). Thus, if the changes in the utilization rates were only due to changes in actual output, while the ratio of full production capability to national emergency production remained constant, we would expect the exact opposite of what we see in Figure 3b.[13]

This is another piece of evidence that confirms Section 2's conclusions, namely that full production capability adjusts toward actual production, therefore, by construction, the FRB rate tends to be stationary because it is based on this measure of productive capacity. Given this, the FRB rate is not an appropriate measure for the long-run trajectory of the normal rate of utilization.

Finally, in a more recent paper (Nikiforos, 2021) I examine the trajectory of potential determinants of capacity utilization—mentioned in Section 4—over the period 1989–2019 and show that most of them have moved in a direction that would have led to an increase in utilization. The main factor that can explain the decrease in the NEUR is aggregate demand, while also the increase in industry concentration might have played a small role.

7 | IS UTILIZATION UNBOUNDED?

One question that usually appears in this debate, is whether the utilization rate is unbounded. Those who argue in favor of an exogenous normal rate of utilization—or a rate of utilization that is bounded within some narrow limits—point that the rate of utilization is bounded and therefore demand might affect utilization within some narrow range but it is not that "anything goes."

Two points can be made in response to this comment. First, while it is obviously true that the rate of utilization is not unbounded, the same is true for almost any economic variable. Most economic variables cannot become negative or move toward infinity. The idea that a variable is endogenous to "something," means that a change in the "something" causes economically meaningful changes to this variable. It does not mean that the variable is unbounded; and it also does not mean that the whole burden of the adjustment will take place through this variable.

Thus, arguing that the normal rate of utilization is endogenous to demand means that changes in demand cause economically meaningful changes in the long-run rate of utilization. It does not mean that the utilization rate is unbounded or that it is the only adjusting variable in the long run (distribution and of course the rate of productivity are two obvious other candidates).

This is where the importance of the empirical examination of the issue at hand becomes important. Looking at the estimates of Murray Foss (1984, 1995) in Figure 2a we can see that the Average Workweek of Capital increased by 25% between 1929 and 1976. If we exclude certain industries, which, because of some of their particular characteristics, usually either work only one shift (such as apparel) or three shifts (such as petroleum) this increase in average weekly plant hours surpasses 32%. Similarly, the National Emergency Rate of Utilization that was discussed in the previous section has decreased by 14.2% between 1989 and 2019—after three cycles, including the two longest economic recoveries in the history of the United States. These adjustments are obviously economically significant.

[13]Interestingly, Gahn (2020) looks at these data and concludes that the NEUR and the FRB rate are similar!

In comparison, the employment to population ratio between its peak in 2000 and 2019 decreased by "only" three percent. Should we subscribe to a (general) theory of employment with an exogenous employment rate (or one fluctuating within a narrow range)?[14]

8 | HOW LONG IS THE "LONG RUN"?

The debate around whether utilization is endogenous or not refers to the long run. However, it is not clear what the precise duration of this long run is in historical time. For example, the system in Duménil and Lévy (1999) is brought to its classical long-run state 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 evidence of an exogenous rate of utilization because the FRB data gravitate around a certain mean over the business cycle. To put this in context, according to the U.S. National Bureau of Economic Research's (NBER) Business Cycle Dating Committee, the average duration (trough to trough) of the 33 cycles of the period 1854–2009 was 56.2 months—slightly below five years.[15] This has increased to 69.5 months—or roughly seven years—in the 11 cycles of the postwar period (1945–2009).[16] Others have suggested a slightly higher number. For example, Vianello (1985, p. 71) gives a hypothetical example where an economy finds itself in a fully adjusted position and returns to a fully adjusted position "after a period of, say, ten years." Still others do not specify a number. For example, Kurz (1986, p. 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, one 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, namely:

1. If it will invest or not. This investment decision is affected by various factors, such as profitability, internal and external finance, the state of the firm's balance sheets, etc. Importantly, the investment decision will depend on the 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 capital stock's remaining useful life is, the lower the chances that the firm will invest.
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 was explained above, these two decisions—size of investment in and utilization of the new capital stock—are intertwined.

The distinction between the two decisions 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, with obvious implications for the choice of the optimal system of production. In other words, even if the firm can change

[14]One could counterargue here that unless we adopt a Malthusian perspective, population is not determined based on economic factors such as the employment rate, while investment and therefore capacity react to changes in the rate of utilization. This is true, but it is also true that the range of adjustment of utilization responding to changes in demand seems to be way bigger.

[15]The business cycle reference dates as estimated by NBER's Business Cycle Dating Committee can be found at https://www.nber.org/cycles.html.

[16]This number will further increase when the current cycle is included, since this recovery recently became the longest in U.S. history.

its capital stock by investing or disinvesting (so that we are not in the 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 and a double shift, and therefore between a lower average cost of capital and a higher cost of labor or other factors of production.

For example, think of a newly founded manufacturing firm that builds a plant. This implies that the answer to decision 1 above is positive, and the firm moves to decision 2, how big the plant will be and how much it will be utilized. The firm has certain expectations for the demand for its output. It will compare the cost of a plant of size "x" that will be utilized for two shifts and a plant of size "2x" that will be utilized for one shift. The first choice will tend to be cheaper the higher is capital intensity, the less expensive is relative labor to capital, and the lower is the utilization differential. After solving this cost-minimization problem the firm decides that it is optimal to go for the first choice and builds a plant of a certain size "x," which is utilized for two shifts per day.

It is likely that if *before building the plant* the firm expected half the level of demand, it would have built a plant half the size ("x/2") and utilize for the same rate of two shifts. However, if there is such a decrease in demand *after the plant is built* the firm will tend to keep using the existing plant for the remaining of its useful life and utilize it less. The reason is simple. After a plant is built and has useful life in it, the cost minimization decision of the firm has one more dimension, associated with decision 1. The firm will compare the cost of not investing and utilizing its existing plant for less (thus saying no to decision 1), or investing in a new plant and choosing the cost-minimizing utilization rate of utilization (thus saying yes to decision 1, and then answering decision 2). Because capital expenditure is by now sunk the first option will tend to be cheaper, as the firm will not have to buy any new equipment or build new structures.

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, 2020b), refers only to the second decision. It refers to a very long period, where all capital is free to take any physical form. In other words, it refers to a situation in logical time where the system is in a fully adjusted position and there is a shock that is followed by a period where time passes so that all (or most) 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 data on the useful life of the capital stock. The literature on the useful life of capital stock (e.g., Blades, 1983; Rincon-Aznar et al., 2017) estimates that the life of tangible assets varies from the low end of 7–10 years for "office equipment and hardware" and "motor vehicles," to more than 15–20 years for machinery, and more than 40 years for various kinds of infrastructure. Figure 4 summarizes the estimates by Rincon-Aznar et al. (2017) for 87 industries in the United Kingdom for the period 2000–2013. According to this data, the industry with the shortest average asset life is air transport (10 years). However, only 20% of industries have an average asset life below 19 years. The median and the mean are 25 years and 31 years, respectively. And 40% of all industries have an average asset life above 40 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 20 to 25 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. For example, saying that engaging in the fiscal expansion will have positive effects for 20–25 years, but these effects will vanish after the period—this is the "Keynesian in the short run but classical in the long run" argument—is not in practice terribly relevant if we want to think about the effectiveness or ineffectiveness of fiscal policy. It is probably this kind of considerations that led Joan Robinson to oscillate between looking for a theory

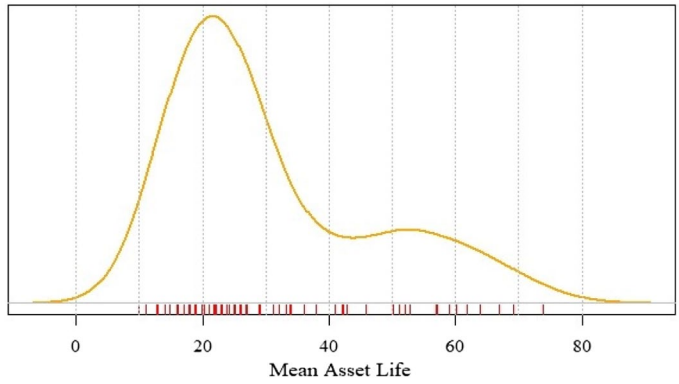

FIGURE 4 Kernel density estimation of the mean asset lives in years by industry (weighted by investment) for the United Kingdom (2000–2013). *Source:* Rincon-Aznar et al. (2017: table A.6). *Summary statistics:* Min: 10; 1st Quintile: 19; Median: 25; Mean: 30.57; 3rd Quintile: 39.50; Max: 74.00 [Colour figure can be viewed at wileyonlinelibrary.com]

of the long run and then repudiating Garegnani's (1978) conception of the long period as floating "above historical time as a Platonic Idea."

Finally, it should be noted that these conclusions obviously depend on the structure of the economy (as different sectors have a capital stock of varying useful lifetime) and also on the distribution of useful lifetime of capital. The "younger" the capital stock of an economy is, the more important these considerations become. Moreover, in an economy with aged or destroyed capital the cost benefits of not investing and utilizing the existing capital will tend to be smaller.

9 | 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 FRB 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. Two more appropriate measures are the AWW and the NEUR. 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 30 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.

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