Asymmetric dynamics and local persistency in capacity utilization fluctuations

Guilherme de Oliveira

Department of Economics and International Relations

Federal University of Santa Catarina, Brazil.

E-mail: oliveira.guilherme@ufsc.br

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Abstract

This study analyses the empirical evidence on the existence of asymmetric dynamics and local persistency in capacity utilization fluctuations, a central variable in demand-led growth models. We allow for the possibility that shocks of different sign and magnitude have a different impact on capacity utilization by testing the presence of unit root through a quantile autoregression model. The model shows that, even by using official survey measures of capacity utilization, which may be arguably global stationary, there is a robust empirical evidence in favor of local unit root tendencies. With some differences among countries, shocks at the lower conditional quantiles (the negative ones) have a persistent effect on the level of utilization. It is also shown that the response of capacity utilization to exogenous shocks is asymmetric. In general, while shocks at the lower conditional quantiles are persistent, the shocks located at the median and upper conditional quantiles have transitory effects on capacity utilization.

Keywords: Capacity utilization; Asymetric dynamics; Local persistency;

JEL codes: B50; E12; E22.

Resumo

Este estudo analisa a evidência empírica sobre a existência de dinâmica assimétrica e persistência local nas flutuações da utilização da capacidade, uma variável central nos modelos de crescimento liderado pela demanda. Consideramos a possibilidade de que choques de sinal e magnitude diferente possam ter impacto diferente na utilização da capacidade ao testar a presença de raiz unitária por meio de um modelo de auto-regressão quantílica. O modelo mostra que, mesmo usando medidas oficiais de utilização da capacidade, há uma evidência empírica robusta em favor da presença de tendências local de raiz unitária. Para a maioria dos países da amostra, choques nos quantis condicionais mais baixos têm um efeito persistente sobre o nível de utilização. Mostra-se também que a resposta da utilização da capacidade a choques exógenos é assimétrica. Em geral, enquanto choques nos quantis mais baixos são persistentes, os choques localizados na mediana e nos quantis condicionais mais altos possuem efeitos transitórios sobre a utilização da capacidade.

Palavras-chave: Utilização da capacidade; Dinãmica assimétrica; Persistência local.

Área da Anpec: Crescimento, Desenvolvimento Econômico e Instituições.

1 Introduction

The neo-Kaleckian benchmark model is one of the most influential contributions in the post-Keynesian theory of economic growth and income distribution. Given the elegance and simplicity of its theoretical formulation, the model has been extended in many ways since the contribution made by Rowthorn (1981), Dutt (1984), Taylor (1985), and others. At the same time, however, the model has not been free from severe theoretical and empirical criticism over the years.

A central critique is that in the long run the *actual* rate of capacity utilization does not converge to its *desired* rate. In the model, the rate of capacity utilization is an accomodating variable (Skott, 2010). The argument is that the actual utilization cannot be persistently different from its desired rate. One reason is that the maintance of a capital (under)overutilization during a long period is unprofitable, and thus inconsistent with a best response of firms. The other refers to the Harrodian instability: unless actual and desired rates are equal in the long run, firms will not be in steady state equilibrium (Auerbach and Skott, 1988). As there is nothing in the neo-Kaleckian model to bring the actual rate towards its desired rate, its predictions would apply only to the short and medium run (Nikiforos, 2016). In the long run we either would have to suppose the classical prediction, in which there is no space for demand issues (Duménil and Lévy, 1999), or to seek other theoretical post-Keynesian formulations (Skott, 2012).

A response was articulated by Amadeo (1986), Lavoie (1995, 1996), Dutt (1997), and Lavoie et al. (2004). In essence, the argument conceded the equalization between the actual and desired rate of capacity utilization in the long run. However, it is the desired rate that is endogenous to the actual rate. The response is logically consistent, but at least two critiques remain. The model fails to explain why any deviation of the actual utilization from the desired utilization will induce the firms to revise their desired rate (Skott, 2012); and shocks to demand still have permanent effects on actual utilization. In other words, the model predicts a non-stationary rate of capacity utilization. The empirical evidence appears do not support this prediction (Schoder, 2014).

In the case of the United States, for example, the conventional empirical approach usually uses the Federal Reserve data on capacity utilization. The pattern of these series, as interpreted by the literature, reveals that the rate of capacity utilization fluctuates around a constant mean (the actual long run level), aproximadately 80% (Nikiforos, 2016). This pattern is observed, *mutatis mutandis*, in other countries. The argument is then that despite exhibiting significant short-run variations, the actual utilization does not deviate persistently from the desired rate. Conventional unit root tests usually supports this claim by verifying the stationarity of these series. Gahn and González (2019), for instance, suggest that the direct survey measures of capacity utilization of 24 developed and developing countries from 1996 to 2017 are stationary (not persistent), positively correlated with growth in the short run, but uncorrelated with growth in the long run.

The empirical literature dealing with the presence of unit root in the rate of capacity utilization focuses on constant-coefficient time series models that relies on a single measure of conditional central tendency, the mean. Consequently, shocks to demand are homogeneously treated along the conditional distribution of capacity utilization. The utilization realizations that are high or low relative to utilization realizations in the previous periods are not distinguished. However, it is reasonable to suspect that the capacity utilization response to a large negative shock might be qualitatively differ from a median or a large positive shock. In other words, firms may asymmetrically adjust the utilization rate depending on the intensity and sign of the shock.

If the asymmetric dynamics characterizes the behavior of firms, one may investigate whether the evidence of persistence in capacity utilization fluctuations also varies according to the intensity of the shock. The idea of a qualitative different dynamics along the business cycles dates back at least to Mitchell (1927) and Keynes (1936). In several passages of the General Theory, for instance, Keynes suggests that the length of time between a peak and a recession is much shorter than the length of time from a recession to a recovery. A large empirical literature have taken this possibility into account in the case of GDP fluctuations. Some studies find evidence on permanent effects of recessions and transitory effects of expansions (Hamilton, 1989; Hosseinkouchack and Wolters, 2013), while others suggest the opposite (Beaudry and Koop, 1993). However, there is no empirical literature examining this nonlinear behavior in capacity utilization fluctuations.

The purpose of this study is to analyse the empirical evidence on the existence of asymmetric dynamics and persistence in capacity utilization fluctuations to an availability sample of 15 developed and developing countries. The empirical strategy tests the presence of unit root at the tails of the conditional distribution of capacity utilization by using a quantile autoregression (QAR) model. The QAR model is one way to study asymmetric dynamics and local persistency in time series (Koenker and Xiao, 2004). Even when specific ocurrences of mean reversion are sufficient to insure stationarity, as in the case of the empirical evidence regarding utilization controversy, some particular forms of the model show that time series can exhibit unit root tendencies or even temporary explosive behavior (Koenker and Xiao, 2006).

The main contribution of this study is to consider that the response of the rate of capacity utilization to exogenous shocks is conditional upon the phase of the business cycle. We do so by allowing for the possibility that shocks of different sign and magnitude have a different impact on capacity utilization. With some differences among countries, the results show that the capacity utilization fluctuations are asymmetric. In general, shocks located below the median (the negative ones) are persistent, but shocks located at the median and upper conditional quantiles are transitory. While transitory shocks suggest that the neo-Kaleckian adjustment mechanism seems unlikely, persistent shocks suggest that, in many circunstances, the desired utilization should not be considered a strictly exogenous ahistorical level.

The general results also contribute to a refresh debate on the appropriate measures of capacity utilization for long run analysis (Gahn and González, 2020; Nikiforos, 2020). Even by using survey measures on capacity utilization from Federal Reserves, which may be arguably global stationary by construction Nikiforos (2020), to the contrary of the results reported in the literature (e.g., Gahn and González (2019)), we are able to find local unit root tendencies in the utilization series.

The remainder of the paper is organized as follows. Section 2 presents a Neo-Kaleckian baseline model. Section 3 details the identification strategy. Section 4 discuss the empirical results. The paper closes with a summary of the main conclusions derived along the way.

2 A Neo-Kaleckian model

This section oulines a Neo-Kaleckian benchmark model in order to briefly summarize some of the controversies surronding the adjustment in the long run. It is beyong the scope of this study to present a detailed description of the model and its controversies (see, e.g., Hein et al. (2012)).

A substancial literature discusses the failure of the canonical neo-Kaleckian model to equate the actual rate of capacity utilization with the deriserd rate. Kurz (1986), Committeri (1986), Duménil and Lévy (1999), and Auerbach and Skott (1988) are some of the early critics. The critique is well know and can be summarised as follows. First, the maintance of a capital under(over)utilization in the long run is unprofitable, and thus inconsistent with a best response of firms. Second, the desired rate of capacity utilization is determined within the cost-minimising long run problem of the firm. Finally, in the long run the actual rate fluctuates around an exogenous and structurally determined desired rate of utilization (Nikiforos, 2016).

Some neo-Kaleckian responses to the critique suggests that the adjustment process based on "the distinction between the actual utilization and a given desired utilization rate may be implausible" (Dutt, 1990, p. 59), while others face the problem and develops analytical models. A formal response was articulated in a series of contributions made by Amadeo (1986), Lavoie (1995, 1996), Dutt (1997), and Lavoie et al. (2004). In order to examine some implications of this response, a concise presentation of a neo-Kaleckian model for a closed economy without governmental activities is suffice. The presentation is based in Lavoie (1995) and Dutt (1997).

The short-run structure of the model can be described by the following five equations:

$$g^I \equiv \frac{I}{K} = \eta + \eta_u(u - u^d) + \eta_\pi \pi, \tag{1}$$

$$g^S \equiv \frac{S}{K} = s\pi u\rho, \tag{2}$$

$$\pi = \bar{\pi} \equiv 1 - \sigma, \tag{3}$$

$$g^I = g^S, \tag{4}$$

$$g \equiv \hat{K} = g^I - \delta. \tag{5}$$

The Equations (1) and (2) are the investment, I, and saving, S, functions, both normalized by the capital stock, K. Investment is increasing in the profit share, π, and the deviation of the actual utilization, u, from its desired rate, u^d, under $\eta_u, \eta, \eta_\pi \in \mathbb{R}_+$. In (2), s is the savings rate, while ρ denotes the technical output-capital ratio. In (3), the mark-up rate is fixed and the classical conventional wage share assumption, in which the wage share, $1-\sigma$, is exogenous, is supposed to hold. The equilibrium condition in the product market is defined by (4). Finally, (5) defines the growth rate of K as being equal to the gross accumulation minus the rate of depreciation, $\delta \in \mathbb{R}_+$. All the equations are derevid under the definition of the profit rate, $r = \pi u \rho$.

Using (1) and (2) in (4), the equilibrium rate of capacity utilization, u^*, is equal to:

$$u^* = \frac{\eta + \eta_\pi \pi - \eta_u u^d}{s\pi\rho - \eta_u}, \tag{6}$$

in which the Keynesian stability condition, $s\pi\rho > \eta_u$, is supposed to hold; it is supposed further that $\eta + \eta_\pi \pi > \eta_u u^d$.

In turn, using (6) and (1) in (5), the equilibrium growth rate in the short run is given by:

$$g^* = \frac{s\pi\rho(\eta + \eta_\pi \pi - \eta_u u^d)}{s\pi\rho - \eta_u} - \delta. \tag{7}$$

Equations (6) and (7) define the short-run equilibrium, in which the desired utilization is supposed to be given. It is readily seen that shocks to demand, for example, changes in the autonomus investment, η, will be accomodated by changes in the actual rate of capacity utilization. In turn, changes in the actual utilization will induce the investment rate and increase the equilibrium growth rate. This adjustment is a particular feature of the neo-Kaleckian model, very distinct of Robinsonian models, in which shocks are accommodated by changes in the mark-up rate.

In the long run, the model supposes that the short-run equilibrium values of the variables are always attained. Following Amadeo (1986), which suggests that faced with a gap between actual and desired utilization firms revise their desired rate of capacity utilization, the following dynamic equation can be formalized:

$$\frac{du^d}{dt} = \mu(u - u^d), \tag{8}$$

in which $\mu \in \mathbb{R}_+$. Dutt (1997) and Lavoie (1995) follows a similar formalization. Dutt (1997) justifies the adaptative behavior in (8) in terms of the strategic behavior of the firms. Firms will reduce their desired rate of capacity utilization if they expect that the future rate of entry is higher than the present rate of entry. In a series of contributions Lavoie (1995, 1996) and Lavoie et al. (2004, p. 133), in turn, arguees that the uncertainty surronding the effective demand effects might "hinder firms from achieving the target, unless the normal rate is itself a moving target influenced by its past values". Under this path dependence, the desired rate is thus, for firms, a "convention".

To complement the system, the Amadeo-Lavoie-Dutt argument supposes that the desired utilization changes endogenously with the expected growth rate, $\gamma = \eta + \eta_\pi \pi$. The following dynamic equation is supposed:

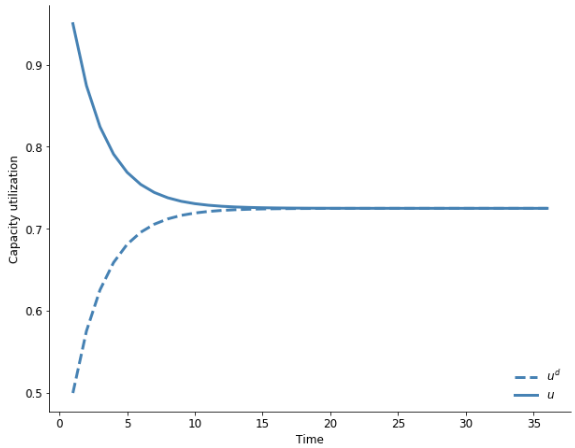
$$\frac{d\gamma}{dt} = \theta(g^I - \gamma), \tag{9}$$

in which $\theta \in \mathbb{R}_+$. Note that when the gross accumulation exceeds the expected rate, firms will rise the expectations about the growth rate. The opposite is true when $g^I < \gamma$. Using (1), (9) can be rewriteen as beig equal to:

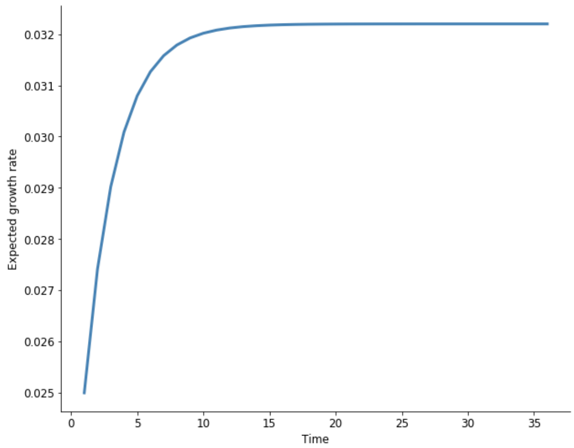
$$\frac{d\gamma}{dt} = \theta\eta_u(u - u^d). \tag{10}$$

Equation (10) and (8) form a two dimension dynamical system, whose the stationary solution is given by: $\gamma = s\pi\rho u^d$. The properties of the dynamical system can be qualitatively analyzed using conventional local stability criteria. In this sense, the determinant of the Jacobian matrix is zero; the two functions coincide. The long run stability condition requeries that: $\mu s\pi\rho > \theta\eta_u$.

Figure 1 simulates the trajectories of the key variables towards the long-run equilibrium in face of a positive demand shock. The causality runs as follows. The shock is acomodated by a change in the actual rate of capacity utilization in the short run, where the desired rate is supposed to be given. In the long run, it is supposed that the short run values of the actual rate are always attained. Hence, the demand shock creates a gap between the actual and the desired utilization. The firms will revise their desired rate of capacity utilization upwards (panel (a)). The expected growth rate also grows proportionaly to the utilization gap. As the gap is decreasing over time, the expected growth rate increases at a diminishing rate (panel (b)). The adjustement continues towards the steady state in which $u = u^d$.



(a) Actual and desired capacity utilization.



(b) Expected growth rate.

Parameters: $\eta = 0.038$, $\eta_\pi = 0.05$, $\pi = 0.4$, $s = 0.2$, $\rho = 1$, $\eta_u = 0.04$, $\mu = 0.02$, $\theta = 0.01$, $u^d(0) = 0.5$, $\gamma(0) = 0.027$, $t = [0, 100]$.

Figure 1: The behavior of the model in the long run.

The neo-Kaleckian response is logically consistent and supplies a solution to the problem of equating the actual and the desired rate of capacity utilization in the long run. However, the causality runs from the actual rate to the desired rate. Skott (2012) raises several objections to the neo-Kaleckian response, with emphasizes on the lack of coherence of the behavior foundation of (8). Skott (2012, p. 120) analyses that the argument in Lavoie (1995) and Amadeo (1986) “does not go beyond stating the formal possibility of an adjustment”. The author sees the argument in Lavoie et al. (2004) as misguided, once the presence of uncertainty and conventional elements in the demand effects does not justifie that the desired utilization be defined as a conventional variable. Regarding the argument in Dutt (1997), Skott (2012) classifies as reasonable, although the sensitivity of the desired rate to the entry threat is likely to be low.

A characteristic of the Amadeo-Lavoie-Dutt argument is that the actual utilization remains an accomodative variable in the long run. The model still predicts persistent long run variations in u. In the canonical version of the model, this persistency represents a permanent gap between u and u^d. Now, the persistency pattern relies on the endogeneity of the desired utilization. Fluctuations in the actual rate are supposed to be able to change the long run level of the desired rate.

The modification of neo-Kaleckian model does not result in a testable empirical specification. However, the entire dynamics of capacity utilization and its stationarity condition in the long run can be well described through an autoregressive process, which is detailed in next section.

3 Methods and data

The empirical strategy is concerned with the identification of the asymmetric dynamics and local persistency in capacity utilization fluctuations by using a QAR model. A first issue in this regard is related to the measure of capacity utilization. This study uses the official survey measures of capacity utilization, mostly available in the respective Federal Reserves of individual countries. This choice is not free from criticism. Nikiforos (2016), for instance, argues that these series of capacity utilization, as those constructed by the U.S. Federal Reserve, are stationary by construction. Skott (2012), in turn, argues that the data problems are real, but one would need a convincing argument to believe that errors or biases in the measures are sufficient to explain an eventual lack of adherence between the neo-Kaleckian predictions and the empirical evidence. Gahn and González (2020) raise concerns as regards the criticism presented in Nikiforos (2016). Based on conventional unit root analysis, the authors suggest that the use of survey measures of capacity utilization is a reasonable choice. Their conclusion is on the lack of empirical adherence of the neo-Kaleckian model. In this study we choose the survey measures for comparative purposes.

A second issue is related to the time series. Given the nature of the long run analysis, and for reasons that will become clear latter, the empirical strategy demands a relatively large number of observations. The number of countries for which the data is available at a relatively long time horizon is scarce. To overcome this limitation, the identification strategy uses an availability sample of monthly and quarterly data on capacity utilization. The selection criteria defines a minimum number of 150 observations. The montly sample is composed by the following countries: Argentina, Brazil, Mexico, Colombia, Mexico, Peru, Phillipines, Thayland, Turkey, and United States. In turn, the quarterly sample is composed by: France, Germany, Italy, New Zeeland, Spain, Switzerland, and United States. Note that the United States data is used in both samples as a benchmark for robustness check; to exclude the possibility that eventual persistent/transitory shocks occurs in reason of the nature of the data, and not by the characteristics of business cycles.

The quarterly data, and the montly data for Turkey was obtained in the Business Tendency Surveys database from OECD (2020); Argentina in INDEC (2020); Brazil in BCB (2020); Colombia in ANDI (2020); Mexico in BANXICO (2020); Peru in BCRP (2020); Phillipines in NSO (2020); Thayland in BOT (2020); and United States in FED (2020).

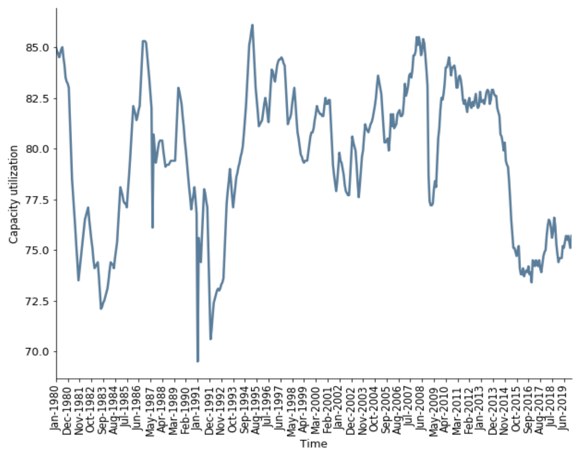
Table 1: Descriptive statistics for the montly and quarterly rate of capacity utilization.

Country	Time	Mean	Std. Dev.	1ºDecil	9ºDecil	Skew.	Kurt.	Shapiro-Wilk
Argentina	Jan2002-Jan2020	69.61	6.92	60.06	77.91	-0.43	0.12	0.9791*
Brazil	Jan1980-Jan2020	79.58	3.60	74.30	84.00	-0.40	-0.86	0.9572*
Colombia	Jan1998-Dec2019	75.98	3.77	71.73	81.19	-0.31	0.23	0.9875**
Mexico	Jan1998-Jan2020	73.07	2.16	70.36	75.77	0.36	1.66	0.9807*
Peru	Jan1994-Nov2019	65.09	18.03	42.27	87.09	0.00	-1.52	0.9087*
Philippines	Jan2002-Dez2019	81.70	2.44	78.50	84.19	-1.14	0.73	0.8595*
Thayland	Jan2000-Feb2020	63.34	4.26	58.24	68.08	-1.02	2.36	0.9448*
Turkey	Jan1987-Jan2020	75.91	3.34	71.88	79.68	-0.91	1.99	0.9521*
United States	Jan1967-Dez2019	80.10	4.24	74.98	85.54	-0.18	-0.18	0.9815*
France	Q11976-Q12020	83.60	6.25	81.10	86.40	-1.25	4.55	0.9096*
Germany	Q11960-Q12020	83.98	3.93	78.60	88.30	-0.89	0.97	0.9524*
Italy	Q41968-Q12020	75.22	3.11	71.00	78.60	-0.60	1.32	0.9728*
New Zeeland	Q21961-Q42019	89.40	2.33	85.99	92.21	-0.49	-0.49	0.9665*
Spain	Q21965-Q12020	79.31	3.59	74.58	83.23	-0.36	1.71	0.951*
Switzerland	Q21967-Q12020	83.52	3.21	79.64	87.70	-0.12	-0.41	0.9885***
United States	Q11967-Q42019	80.10	4.23	75.03	85.51	-0.18	-0.17	0.988***

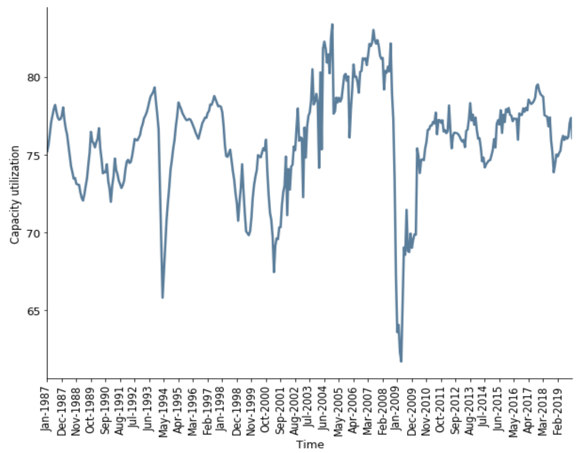
Source: Multiple sources; See Section 3 p. 8. Significant at: (*) 1%, (**) 5%, (***) 10%.

Table 1 details some descriptive statistics for each time series of the dataset. The time horizon in each country varies from seventeen years in Philippines to fifty years in Germany. The standard deviation of the capacity utilization in Peru is relatively high, at 18%. In all the other countries the standard deviation is within normal ranges with de mean relatively close to the median. Recessions are viewed as data realizations in the lower conditional deciles, while expansions are viewed as data realizations in upper conditional deciles. For most countries, the difference between the 1st to the 9th decile is at least two times the standard deviation. There is considerable variations in all the series. In addition, most country data presents negative skewness indicating that most of the time the rate of capacity utilization stood below the average over the period. The kurtosis and the Shapiro-Wilk test for normality indicate that the data does not fit a normal distribution.

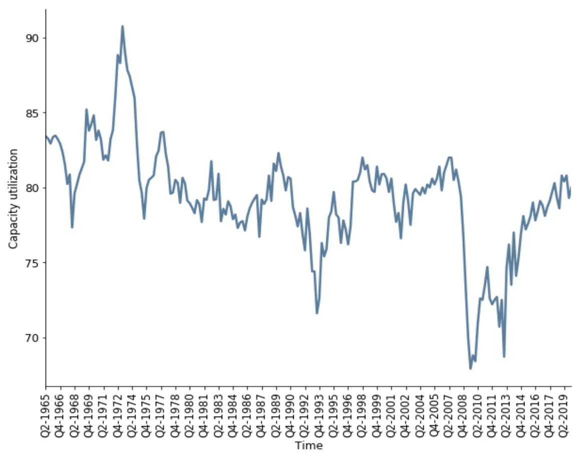
Figure 1 presents the path of the rate of capacity utilization to four selected countries, Brazil, Turkey, Spain and United States. It is readily seen the large negative effect of the great recession of 2009 followed by a slowly recovery. In Brazil, the recession started in 2015 has dropped the level of capacity utilization to the level of the lower decile. The fall was relatively more intense than that of the great recession of 2009. After 2009, the spanish rate of capacity utilization tooked more then ten year to achieve the prior crise levels. The series of the United States is the only one that presents a small negative tendency from 1967 to 2019. The monthly data confirms this behavior. All the remaining series of the dataset present a time path without trend.



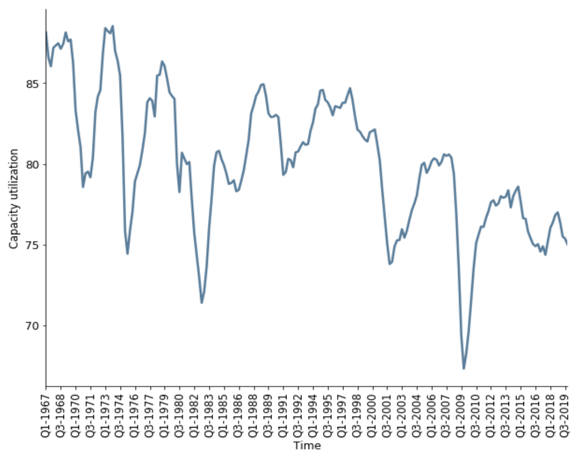
(a) Brazil Jan-1980:Jan-2020



(b) Turkey Jan-1987:Jan-2020



(c) Spain Q2-1965:Q1-2020



(d) United States Q1-1967:Q4-2019

Figure 2: Capacity utilization in Brazil, Turkey, Spain and United States.
Source: Multiple sources; See Section 3 p. 8.

The possible structural breaks, the negative skewness and the departure from the normality pattern highlight the benefits of using a QAR modelling based approach, which is robust in the presence of most of these characteristics of the data. Next section details the identification strategy.

3.1 Identification strategy

The empirical literature dealing with the presence of unit root in the rate of capacity utilization focuses on constant-coefficient time series models (Gahn and González, 2019, 2020). The actual long run value of utilization is treated as a good approximation of the desired utilization. It makes sense if one supposes the assumption that the actual utilization cannot deviates persistently from the desired rate. Hence, the presence of unit root in the series indicates that shocks are persistent and that desired utilization may be endogenous to the actual utilization; If the series is stationary, shocks in utilization are transitory. The mean reversion indicates that u converges towards u^d.

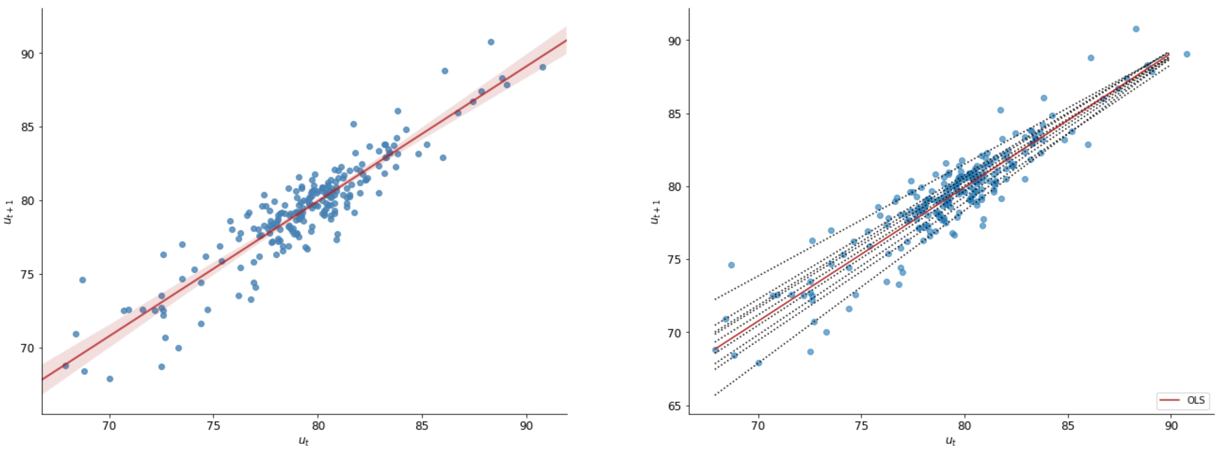
The entire dynamics of the rate of capacity utilization is then captured by an autoregressive, AR, process. An AR(q) process for the rate of capacity utilization can be written as:

$$u_t = \omega + \sum_{i=1}^{q} \beta_i u_{t-i} + \epsilon_t, \tag{11}$$

in which ω is a drift term, ϵ_t is the error term, and q is the lag order. The persistence in capacity utilization fluctuations is measured by $\sum_{i=1}^{q} \beta_i u_{t-i} = \alpha$. This measure is the focus of the empirical approaches about the utilization controversy. Conventionally, (11) can be rewritten as:

$$u_t = \omega + \alpha u_{t-1} + \sum_{i=1}^{q-1} \phi_i \Delta u_{t-i} + \epsilon_t. \tag{12}$$

Conventional methods can be used in (12) to test the unit root hypothesis. If $\alpha = 1$, then capacity utilization has a unit root; if $\alpha < 1$, capacity utilization is stationary. The usual procedure for estimation of (12) relies on a single measure of conditional central tendency, the mean. For illustrative purposes on the procedure, Figure 3 panel (a) plots the AR(1) estimates for the rate of capacity utilization in Spain. It is readily seen that the OLS regression line does not fit consistently all the scatter of points. The line regression at the median points is giving a good estimate of u_{t+1}, but the realizations in the lower conditional quantiles have a relatively higher variance. The utilization realizations that are high or low relative to utilization realizations in the previous periods are homogeneously treated along the estimation procedure.



(a) Spain - OLS AR(1).

(b) Spain - QAR(1).

Figure 3: OLS AR(1) and QAR(1) of the rate of capacity utilization in Spain.

In Figure 3 panel (b) the OLS regression line is compared with a quantile regression estimation (Koenker and Bassett, 1978). Fitting the data using this somewhat more inclusive model by introducing nine deciles minimizes the problem of heteroscedasticity. In addition, quantile regression is relatively more robust against outliers and when the data does not fit a normal distribution. Here, the use of different measures of central tendency and dispersion can be useful to perform a more comprehensive analysis on how exogenous shocks can affect capacity utilization. This is the main idea of the QAR model which bases the identification strategy.

Hence, (12) is estimated by using a QAR procedure. The τ-th conditional quantile is defined as the value $Q_\tau(u_t|u_{t-1},...,u_{t-q})$ such that the probability that the utilization rate conditional on its lagged values will be less than $Q_\tau(u_t|u_{t-1},...,u_{t-q})$ is τ. If capacity utilization value is low (high) relative to its lagged realizations, it means that a relatively large negative (positive) shock has occurred adn that u_t is located below (above) the mean conditional on lag observations, $u_{t-1},...,u_{t-q}$, somwhere in the lower (upper) conditional quantiles (Koenker and Xiao, 2004). The QAR(q) process at the quantil τ of capacity utilization can be written as:

$$Q_\tau(u_t|u_{t-1},...,u_{t-q}) = \omega(\tau) + \alpha(\tau)u_{t-1} + \sum_{i=1}^{q-1}\phi_i(\tau)\Delta u_{t-i} + \epsilon_t. \tag{13}$$

Koenker and Xiao (2004) show that (13) can be estimated by using the Koenker and Bassett (1978) quantile regression estimator, which is based on the minimization of the quantile loss function. The estimation of (13) at different quantiles, $\tau \in (0,1)$, result in a set of estimates of the persistent measure, $\alpha(\tau)$. Intuitively, it is possible to test the null hypothesis of $\alpha = 1$ at different quantiles. This identification strategy also follows Galvao (2009), which extended the test to include deterministic components. The procedure is individually applied to all countries. The United States data is a special case. As Figure 2 suggests, the data shows a small negative tendency. An expanded version of (12) with trend cannot be rejected at the usual significance levels. Hence, for the United States time series, the following particular version of (13) was estimated:

$$Q_\tau(u_t|u_{t-1},...,u_{t-q}) = \omega(\tau) + \alpha(\tau)u_{t-1} + bt + \sum_{i=1}^{q-1}\phi_i(\tau)\Delta u_{t-i} + \epsilon_t. \tag{14}$$

Regarding inference, the null hypothesis is tested using the t-statistic for the quantile regression estimator, $\hat{\alpha}(\tau)$, expressed as:

$$t_n(\tau) = \frac{\widehat{f(F^{-1}(\tau))}}{\sqrt{\tau(1-\tau)}}(U_{-1}'M_Z U_{-1})^{1/2}(\hat{\alpha}(\tau) - 1), \tag{15}$$

in which $f(.)$ and $F(.)$ are the probability and cumulative density functions of the error term, U_{-1} is the vector of lagged utilization rate, and M_Z is the projection matrix onto the space orthogonal to $Z = (1, t, \Delta u_{t-1}, ..., \Delta u_{t-q+1})$. The details of the estimation procedure to obtain $\widehat{f(F^{-1}(\tau))}$ can be checked in Koenker and Xiao (2004). Based on Koenker and Xiao (2004) and Galvao (2009), the critical values of $t_n(\tau)$ for different quantiles are simulated by a bootstrap of $R = 1000$ replications.

Following the conventional approach of Andrews (1993), it is possible to estimate the lenght of time of a shock in the utilization rate. The estimation is based on the half life of a unit shock, $HL[\hat{\alpha}(\tau)] := log(1/2)/log[\hat{\alpha}(\tau)]$. This number characterizes the likely duration of an exogenous shock in the utilization rate in each specified quantile. All the time series were seasonally adjusted.

4 Results and discussion

Table 2 presents a benchmark based on the Augmented Dickey-Fuller, ADF, and the $KPSS$ unit root tests in order to verify whether capacity utilization may be considered a global stationary process. From the ADF test, the null hypothesis of unit root is rejected for 13 countries. In Argentina, Peru and Philippines the null hypothesis cannot be rejected at the conventional levels of significance. Both developing countries series present large variations in the period. In general, ADF results replicates the evidence based on the traditional unit root tests suggesting that capacity utilization is globally stationary, as in Gahn and González (2019).

The results of the KPSS stationarity test, in turn, suggest that the evidence of stationarity for some countries is unstable. This point was recently raised by Nikiforos (2020), which argues that some econometric results, as used in Gahn and González (2020), are not robust to more suitable specifications of the unit root tests. The unstable results are reported for Colombia, Mexico, New Zeeland and Spain. As will become clear later, this instability may be arising, *inter alia*, from capacity utilization realizations that are locally persistent, highlighting the use of the QAR model.

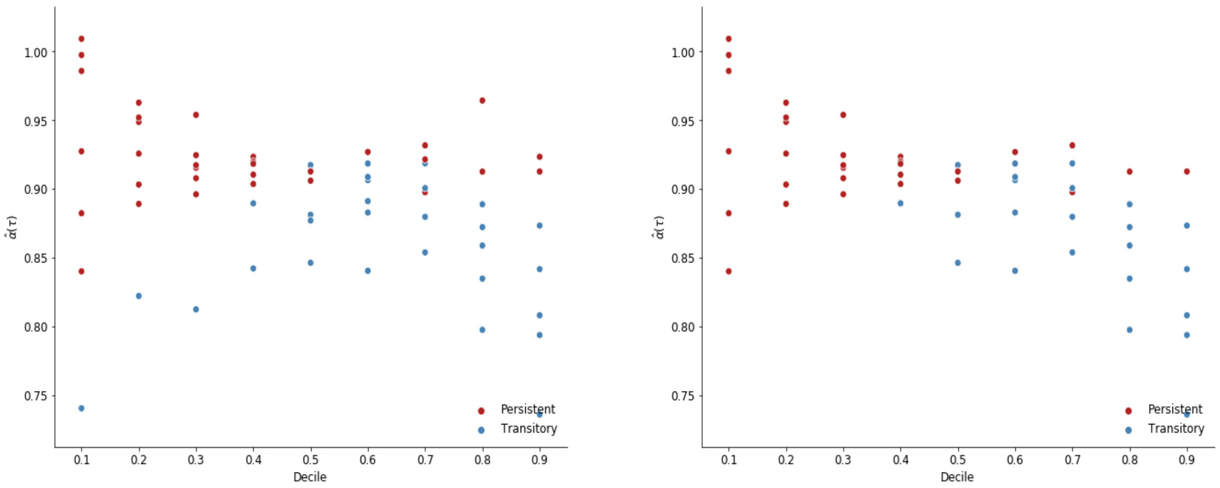
Table 2: Augmented Dickey-Fuller unit root test for the rate of capacity utilization.

Country	Data	q	ADF-Statistic	KPSS-Statistic
Argentina (ARG)	Monthly	10	-1.40	0.37***
Brazil (BRA)	Monthly	6	-3.18**	0.22
Colombia (COL)	Monthly	6	-3.74*	0.45***
Mexico (MEX)	Monthly	8	-2.94**	0.71**
Peru (PER)	Monthly	10	-0.53	1.86**
Philippines (PHL)	Monthly	10	-2.44	1.32**
Thayland (THA)	Monthly	8	-4.41*	0.12
Turkey (TUR)	Monthly	10	-4.42*	0.16
United States (USA)	Monthly	9	-3.48*	0.15
France (FRA)	Quarterly	4	-4.01*	0.09
Germany (DEU)	Quarterly	5	-5.99*	0.14
Italy (ITA)	Quarterly	4	-4.22*	0.08
New Zeeland (NZL)	Quarterly	4	-3.26**	0.58**
Spain (ESP)	Quarterly	4	-3.12**	0.68**
Switzerland (CHE)	Quarterly	5	-4.73*	0.17
United States (USA)	Quarterly	4	-3.84*	0.13

Note: Lags are selected using the MAIC criterion. Significant at: (*) 1%, (**) 5%, (***) 10%.
KPSS null hypothesis: The capacity utilization is stationary.

These series are now reconsidered using the proposed QAR model and the results are reported in Tables 3-4. The Tables 3-4 present the estimates of the largest autoregressive root for nine deciles. The lags are selected by using the MAIC criterion. The t-statistic and the critical values are reported for 95% of confidence. The null hypothesis of unit root is rejected when the t-statistic is numerically smaller than the critical values, as usual. Table 3 reports the results for the quarterly sample, while Table 4 for the monthly sample. The parameters are not strictly comparable.

In order to facilitate visualization, Figure 4 plots the largest autoregressive root at each decile for the quarterly sample. The transitory shocks (the null hypothesis is rejected) are shown in blue color; the persistent shocks (the null hypothesis cannot be rejected) are shown in red color. There is considerable variations among countries. The evidence on asymmetric dynamics is mixed, with some countries presenting a negative asymmetry, even if relatively small (Table 3). The evidence on persistence, in turn, is relatively more clear. We cannot reject the hypothesis that shocks below the median are persistent. A more rigorous criteria on confidence, 99%, for instance, would indicate that this result is valid for the shocks located below the 4th decile.



(a) All countries. (b) All countries excluding Switzerland.

Figure 4: Estimates of the largest AR root at each decile of capacity utilization (quarterly).

The transitory shocks are located from the median, as shown by the concentration of blue dots in Figure 4. As expected the parameters associated with a transitory shock are numerically smaller than those associated with a persistent shock. There are some exceptions to this pattern. In Switzerland the positive shocks from the 7th decile are persistent. The exclusion of Switzerland in panel (b) highlights the average negative asymmetry in the selected developed countries.

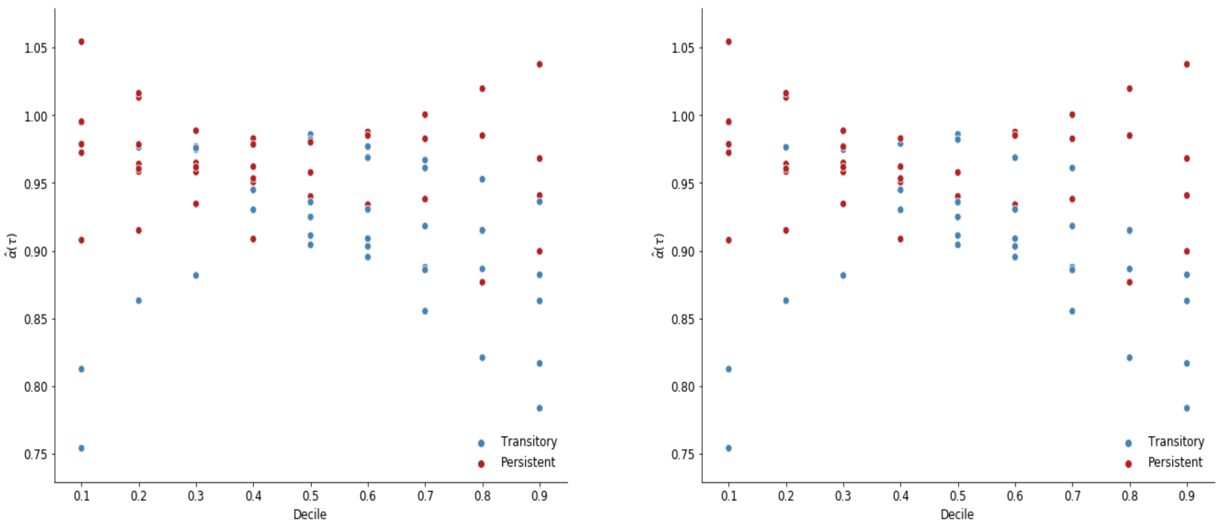
Table 3: Estimates of the largest AR root at each decile of capacity utilization (quarterly).

Country	**q**	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
		$\hat{\alpha}(\tau)$	0.986	0.889	0.896	0.890	0.913	0.927	0.880	0.835	0.736
FRA	4	t-stat.	-0.106	-1.754	-2.049	-2.807**	-1.924	-1.638	-2.44	-2.903**	-5.025**
		C.V.	-2.618	-2.571	-2.627	-2.603	-2.668	-2.675	-2.556	-2.375	-2.281
		HL($\hat{\alpha}$)	∞	∞	∞	5.919	∞	∞	∞	3.836	2.259
		$\hat{\alpha}(\tau)$	0.998	0.949	0.908	0.923	0.917	0.919	0.919	0.872	0.842
DEU	5	t-stat.	-0.031	-1.276	-2.519	-2.609	-2.939**	-2.959**	-2.811**	-3.932**	-4.172**
		C.V.	-2.383	-2.601	-2.853	-2.784	-2.747	-2.675	-2.552	-2.422	-2.214
		HL($\hat{\alpha}$)	∞	∞	∞	∞	8.040	8.153	8.164	5.069	4.019
		$\hat{\alpha}(\tau)$	0.840	0.926	0.925	0.904	0.846	0.840	0.854	0.797	0.794
ITA	4	t-stat.	-1.225	-1.062	-1.696	-2.458	-4.152**	-3.635**	-3.602**	-3.394**	-2.420**
		C.V.	-2.424	-2.587	-2.561	-2.542	-2.571	-2.535	-2.517	-2.492	-2.295
		HL($\hat{\alpha}$)	∞	∞	∞	∞	4.151	3.986	4.385	3.062	2.998
		$\hat{\alpha}(\tau)$	0.882	0.952	0.954	0.920	0.881	0.883	0.898	0.859	0.913
NZL	4	t-stat.	-1.393	-0.744	-0.837	-2.278	-3.512**	-3.553**	-2.591**	-3.019**	-1.224
		C.V.	-2.513	-2.559	-2.625	-2.511	-2.637	-2.608	-2.596	-2.574	-2.513
		HL($\hat{\alpha}$)	∞	∞	∞	∞	5.481	5.560	6.416	4.554	∞
		$\hat{\alpha}(\tau)$	1.009	0.963	0.915	0.910	0.913	0.906	0.901	0.913	0.808
ESP	4	t-stat.	0.139	-0.752	-1.957	-2.146	-2.426	-2.833**	-3.336**	-1.936	-2.543**
		C.V.	-2.419	-2.598	-2.572	-2.646	-2.649	-2.555	-2.548	-2.493	-2.367
		HL($\hat{\alpha}$)	∞	∞	∞	∞	∞	7.053	6.621	∞	3.251
		$\hat{\alpha}(\tau)$	0.740	0.822	0.812	0.842	0.877	0.891	0.922	0.964	0.923
CHE	5	t-stat.	-2.4407**	-2.3532**	-3.9291**	-3.812**	-2.805**	-2.779**	-2.204	-0.619	-0.629
		C.V.	-2.196	-2.226	-2.652	-2.732	-2.684	-2.690	-2.705	-2.535	-2.464
		HL($\hat{\alpha}$)	2.305	3.538	3.334	4.033	5.281	6.012	∞	∞	∞
		$\hat{\alpha}(\tau)$	0.927	0.903	0.917	0.918	0.906	0.909	0.932	0.889	0.873
USA	4	t-stat.	-1.430	-2.188	-2.272	-2.467	-3.262**	-3.095**	-2.760**	-3.159**	-2.895**
		C.V.	-2.378	-2.945	-3.280	-3.293	-3.140	-2.941	-2.732	-2.749	-2.754
		HL($\hat{\alpha}$)	∞	∞	∞	∞	7.022	7.240	9.798	5.880	5.116

Note: Lags (q) are selected using the MAIC criterion. t-statistic and critical values (C.V.) for the 5% (**) significance level. Bootstrap: R = 1.000. HLs are calculated when $\hat{\alpha}(\tau)$ is smaller than unity; otherwise, HLs are set as infinity.

The duration of a transitory shock in capacity utilization, as approximated by the half-life, varies across countries. The average duration of a relatively large expansionary shock, at 9th decile, is of 3.5 quarters. The expansionary shock dissipates more quickly than a median shock, in which the average duration is estimated in 7 quarters. This result is consistent with the view that the capacity utilization does not present persistent long run variations Skott (2012). The evidence, however, is located at median and upper deciles, not reflecting the entire conditional distribution of quarterly data on capacity utilization of this selected developed countries.

Figure 5 plots the largest autoregressive root at each decile for the monthly sample. Panel (a) plots the results for all countries, while panel (b) focuses on developing countries, with the exclusion of the United States data. The evidence reported in Figure 4 is reinforced by the monthly sample. We cannot reject the hypothesis that shocks located below the median are, in general, persistent. This evidence is independent of the exclusion of the U.S. data. Note that the results for the United States, which are used in both samples as a benchmark, are relatively similar in both samples, as we cannot reject the null hypothesis that shocks below the median are persistent (Table 4).



(a) All countries.

(b) Developing countries.

Figure 5: Estimates of the largest AR root at each decile of capacity utilization (monthly).

The average asymmetry in this monthly sample is not so general and remarkable as that of presented in Figure 4 panel (b). The presence of relatively more persistent shocks located at the upper deciles is concentrated in Argentina, Brazil, and Mexico (Table 4). In Brazil, the shocks are symmetrically distributed along the conditional quantiles. Below the median, only the 1st decile is persistent. Above the median all shocks are persistent. In turn, shocks in Argentina and Mexico presents a positive asymmetry. This characteristic is clear in Argentina, in which the hypothesis of global stationarity is rejected (Table 2). In Mexico, few realizations above the median are sufficient to ensure global stationarity, but the shocks located from the 6th decile are persistent. Eventually, the presence of relatively more persistent shocks at the upper deciles in these countries may be related to economic and political instabilities.

The duration of a transitory shock at the median in the monthly sample is of approximately 19.5 months. The estimate is relatively close to those obtained with the quarterly data. In turn, the duration of a relatively large expansionary shock, at the 9th decile, is of approximately 6 months.

The average duration of a transitory expansionary shock at 9th is relatively greater in the selected developed countries (Table 3) than in the developing countries (Table 4).

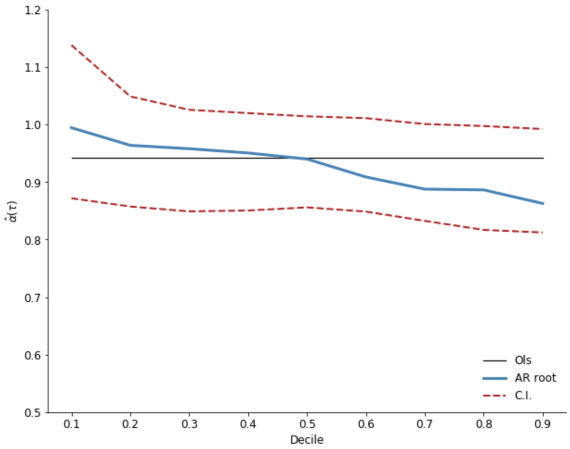
Figures 4-5 show that the evidence of asymmetry varies among countries. However, there are some countries in which the evidence is more remarkable. As Tables 3-4 suggest, at least in 12 countries the evidence of asymmetric dynamics (positive or negative) is non negligible. Figure 6 plots the largest AR root together with 95% confidence bands at each decile of the rate of capacity utilization for Colombia, France, Spain, and Thailand. For comparative purposes, the estimates at the conditional mean (OLS) are show in the blackline.

Table 4: Estimates of the largest AR root at each decile of capacity utilization (monthly).

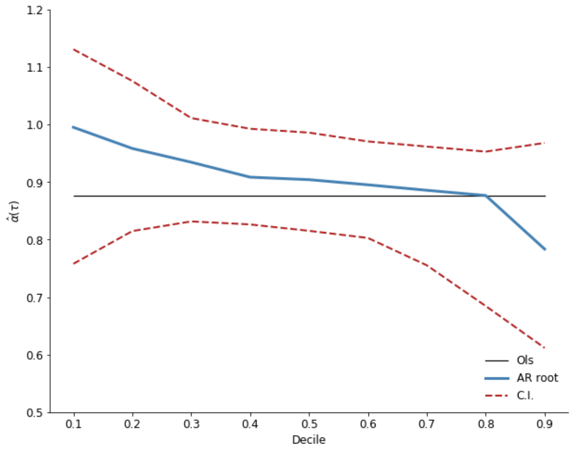
Country	**q**	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
		$\hat{\alpha}(\tau)$	0.754	0.915	0.965	0.962	0.958	0.988	1.000	1.020	1.038
ARG	10	t-stat.	-3.145**	-0.918	-0.52	-0.762	-1.163	-0.364	0.011	0.482	1.239
		C.V.	-2.711	-2.746	-2.599	-2.571	-2.541	-2.580	-2.453	-2.323	-2.324
		HL($\hat{\alpha}$)	2.455	∞	∞	∞	∞	∞	∞	∞	∞
		$\hat{\alpha}(\tau)$	0.979	0.976	0.975	0.979	0.986	0.985	0.983	0.985	0.968
BRA	6	t-stat.	-1.361	-2.6718**	-2.777**	-2.682**	-2.976**	-2.020	-1.964	-1.368	-1.740
		C.V.	-2.584	-2.595	-2.600	-2.668	-2.681	-2.586	-2.562	-2.626	-2.411
		HL($\hat{\alpha}$)	∞	28.899	26.941	32.659	48.466	∞	∞	∞	∞
	6	$\hat{\alpha}(\tau)$	0.995	0.964	0.958	0.951	0.940	0.909	0.888	0.886	0.863
COL		t-stat.	-0.068	-0.733	-1.065	-1.159	-1.482	-2.504**	-2.593**	-2.659**	-3.089**
		C.V.	-2.457	-2.647	-2.567	-2.633	-2.533	-2.487	-2.504	-2.395	-2.235
		HL($\hat{\alpha}$)	∞	∞	∞	∞	∞	7.248	5.819	5.748	4.697
		$\hat{\alpha}(\tau)$	0.812	0.863	0.882	0.930	0.925	0.934	0.938	0.915	0.941
MEX	8	t-stat.	-2.6012**	-3.1461**	-4.112**	-2.633**	-2.725**	-2.295	-1.888	-2.230	-0.690
		C.V.	-2.415	-2.467	-2.578	-2.499	-2.485	-2.540	-2.630	-2.576	-2.514
		HL($\hat{\alpha}$)	3.336	4.704	5.500	9.566	8.866	∞	∞	∞	∞
		$\hat{\alpha}(\tau)$	0.972	1.013	0.977	0.953	0.911	0.903	0.855	0.821	0.817
PER	10	t-stat.	-0.448	0.215	-0.393	-0.839	-3.180**	-3.285**	-2.977**	-2.926**	-2.976**
		C.V.	-2.775	-3.061	-3.077	-3.017	-3.080	-3.128	-2.952	-2.883	-2.927
		HL($\hat{\alpha}$)	∞	∞	∞	∞	7.445	6.801	4.431	3.512	3.421
		$\hat{\alpha}(\tau)$	1.054	1.016	0.989	0.983	0.982	0.969	0.961	0.914	0.882
PHL	10	t-stat.	1.359	0.818	-0.967	-1.729	-2.446**	-3.386**	-3.425**	-4.945**	-3.149**
		C.V.	-2.120	-2.133	-2.353	-2.335	-2.339	-2.444	-2.519	-2.563	-2.609
		HL($\hat{\alpha}$)	∞	∞	∞	∞	38.161	21.726	17.424	7.736	5.525
		$\hat{\alpha}(\tau)$	0.995	0.958	0.935	0.909	0.904	0.895	0.886	0.877	0.784
THA	8	t-stat.	-0.061	-0.658	-1.341	-2.257	-2.777**	-2.886**	-2.707**	-2.289**	-3.341**
		C.V.	-2.361	-2.487	-2.638	-2.556	-2.715	-2.649	-2.601	-2.493	-2.315
		HL($\hat{\alpha}$)	∞	∞	∞	∞	6.883	6.261	5.711	5.263	2.841
		$\hat{\alpha}(\tau)$	0.908	0.960	0.962	0.945	0.936	0.930	0.918	0.915	0.899
TUR	10	t-stat.	-1.211	-1.164	-1.639	-3.001**	-4.199**	-4.022**	-4.473**	-3.426**	-1.785
		C.V.	-2.568	-2.675	-2.721	-2.637	-2.534	-2.451	-2.417	-2.367	-2.317
		HL($\hat{\alpha}$)	∞	∞	∞	12.207	10.446	9.608	8.112	7.803	∞
		$\hat{\alpha}(\tau)$	0.979	0.978	0.976	0.978	0.980	0.977	0.967	0.953	0.936
USA	9	t-stat.	-1.424	-2.350	-3.131**	-2.969	-3.1192**	-3.281**	-4.035**	-4.996**	-5.784**
		C.V.	-2.757	-2.745	-2.818	-2.990	-3.044	-2.970	-2.990	-2.800	-2.666
		HL($\hat{\alpha}$)	∞	∞	28.177	∞	34.310	29.529	20.529	14.305	10.497

Note: Lags (q) are selected using the MAIC criterion. t-statistic and critical values (C.V.) for the 5% (**) significance level. Bootstrap: R = 1.000. HLs are calculated when $\hat{\alpha}(\tau)$ is smaller than unity; otherwise, HLs are set as infinity.

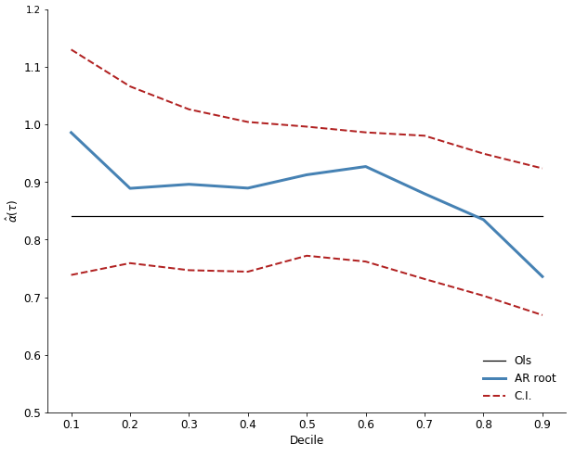
The four selected countries exhibit a negative asymmetry. In both, relatively large negative shocks returns AR roots right close to one. In Colombia and Thailand, estimated AR roots are monotonically decreasing as we move from lower to higher deciles. In France, the AR roots estimated by the QAR model are above the AR root estimated at the conditional mean until the 8th decil. Despite transitory, the predicted duration of a relatively large expansionary shock, at the 9th decile, is relatively faster than the predicted by the mean. The shocks on capacity utilization in Spain are well described by the Ols estimation from the 3nd to the 8th decile, but not at the tails of the conditional distribution, which are clearly asymmetric.



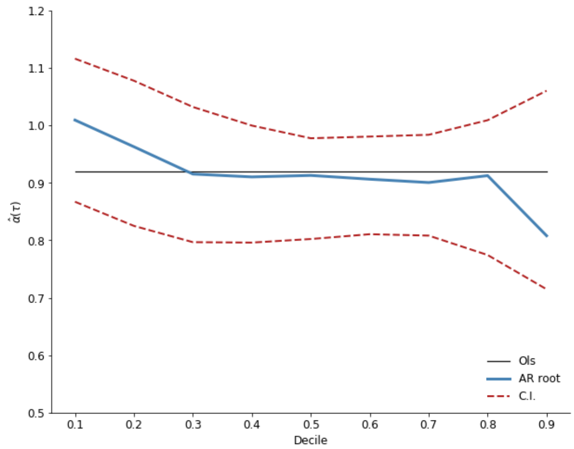
(a) Colombia.



(b) Thayland.



(c) France.



(d) Spain.

Figure 6: AR(1) coefficients with 95% bootstrap confidence interval.

The evidence that the asymmetry and persistence varies across countries should not surprise. The countries' results are driven by different mechanisms, and eventually different net effects for the same mechanisms over time. However, we note some regularities by merging both samples' results (Tables 3-4). The positive shocks located at 6th and 7th deciles are transitory for 11 countries. In 8th and 9th deciles, the positive shocks are transitory for 10 countries. The opposite is true for negative shocks located below the median: 3 countries have transitory shocks located at the 1st and 2nd deciles; the transitory shocks located right below the median are reported in 5 countries. Moreover, in 12 of 15 countries there is evidence that the shocks located at the median are transitory. Given the small number of countries with available long run time series of capacity utilization, any generalization and reconnection with theory should be carefully consider.

As in other empirical approaches, the long run level of actual utilization is taken as a proxy for the desired utilization. In this context, a transitory shock means that after a disturbance the actual utilization returns to its previous level. Some studies, analysing the pattern of survey measures of capacity utilization, as Gahn and González (2019), suggest that the convergence towards the long run level is a global characteristic of the utilization fluctuations. The present result shows that, for most countries of the sample, the transitory shocks are concentrated at the median and upper deciles. The result, in turn, remains inconsistent with the Amadeo-Lavoie-Dutt argument of an adjusting desired utilization rate. The adjustment can be well described in Harrodian lines. As discussed before, the median is relatively close do the mean, and thus the shocks located from the median are positive, including the large expansionary ones located the 9th decile. Hence, starting in an equilibrium position, a positive exogenous shock promotes a gap between actual and desired utilization that induces firms revise their rate of accumulation in order to increase available capacity. It is the actual utilization that converges towards to desired rate.

The novelty is that, for most countries, if a shock occurs below the median, thus being negative or large recessionary (as those at the 1st decile), the actual utilization does not converges to its previous long run level. This pattern is relatively remarkable in Figure 4 panel (b), which shows a concentration of persistent shocks below the median. If one believes that the actual utilization cannot be persistently different from the desired rate, this evidence is consistent with the notion of an endogenous desired utilization rate. The result is related to the Amadeo-Lavoi-Dutt argument in the sense that realizations of relatively low actual utilization makes firms decide that low utilization has now become normal, the new desired level. Eventually, in face of a negative shock, firms may believe that changes in available capacity are relatively costly when compared to the fall of the profit rate at the revised desired level.

A decrease in the level of utilization, in turn, can be relatively small. In Brazil, for instance, during the worst recession of 2016, the fluctuation range of capacity utilization between a peak and a valley is near to 10%, while the new level has dropped in less than 10% (Figure 2). It may be mistaken to associate directly this aggregate fluctuation with the behavior of individual firms. A fall of 5% in the aggregate level of actual utilization, for instance, can be associate with a large microeconomic fluctuation, and eventually, non-negligible waves of unemployment.

An important theoretical contribution to the utilization controversy recognizes the possibility of a satisficing behavior from firms that will tolerate —within clear limits— deviation of the actual level from their desired level of utilization without modifying their behaviour (Dutt, 1990; Setterfield, 2019). In Setterfield (2019), for instance, there is a set of acceptable utilization rates within limits in which the neo-Kaleckian adjustment occurs. The firms will change their rate of accumulation only when the utilization fluctuation exceeds the lower or upper bound. In this case, the current rate of capacity utilization adjusts towards the desired rate. In other words, relatively large shocks, out of the acceptable bounds, are interpreted as transitory.

The present results, in turn, show a notable regularity among the examined countries that large recessionary shocks (at the 1st decile), and therefore, probably out of the tolerable bounds of capacity utilization, are persistent. This new evidence for capacity utilization is consistent with an empirical result from the literature on business cycles. Some relevant contributions, as Hamilton (1989) and Hosseinkouchack and Wolters (2013), find evidence that recessionary shocks have permanent effects on GDP fluctuations. The negative asymmetry of capacity utilization presented by most countries of the sample also finds support on this literature, which also shows that expansionary shocks are, in general, transitory.

This qualitative difference between recessionary and expansionary shocks dates back at least to Keynes (1936). For Keynes, the length of time between the peak and a crisis or a recession, along the business cycles, is much shorter than the length of time from the recession to the recovery. In other words, for Keynes, recessions tends to be relatively persistent. The regularities presented in this study, at least for the examined sample of countries, suggest that the asymmetry and persistence may be a relevant feature to be considered in demand-led growth and distribuin models.

5 Conclusions

The purpose of this study is to analyse the empirical evidence on the existence of asymmetric dynamics and local persistency in capacity utilization fluctuations. We allow for the possibility that shocks of different sign and magnitude have a different impact on capacity utilization by using a quantile autoregression (QAR) model, which tests the presence of unit root along the conditional distribution. This is a first contribution to the literature, once the previous empirical studies dealing with the presence of unit root in the rate of capacity utilization focuses on conventional constant-coefficient time series models.

A second contribution of this study is to show that even by using official survey measures of capacity utilization, as those usually reported by Federal Reserves, which may be arguably global stationary by construction, there is a robust empirical evidence in favor of local unit root tendencies. This evidence is present in all countries of the sample. For most countries, the results show that shocks at the lower conditional quantiles (the recessions) have a persistent effect on capacity utilization. The persistent and possibly permanent effects of recessions, or more broadly, negative shocks, may imply that the cyclical adjustments of actual utilization are not simply movements along an ahistorical level. They, themselves, affect the level. This new result is arguably consistent with the theoretical notion of an adjusting desired utilization rate.

The study also shows that capacity utilization fluctuations are possibly asymmetric. Despite a few relevant exception in Brazil, Argentina, and Mexico, there is evidence in favor of a negative asymmetry. In general, the shocks located below de median are persistent, while shocks located from the median are transitory. The duration of large expansionary shocks located at 9th decile, measured both in months and quarters, is smaller than of the shocks located at the median. This evidence is in line with a large empirical literature on business cycles and GDP fluctuations.

The results are limited by the small number of countries with available long run time series of capacity utilization, and, of course, by the quality of the data, especially those produced in developing countries. Hence, any generalization and reconnection with theory should be carefully consider. Even so, the results raises an importante issue. The coexistence of persistent and transitory shocks on capacity utilization suggests that a more inclusive theoretical demand-led growth model should suppose some nonlinearity in the long run adjustment mechanism of capacity utilization. While transitory shocks suggest that the neo-Kaleckian adjustment mechanism seems unlikely, persistent shocks suggest that, in many circunstances, the desired utilization should not be considered as a strictly exogenous ahistorical level.

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