Universidade Federal do Rio de Janeiro

Instituto de Economia

Programa de Pós-Graduação em Economia

Essays on capacity utilization and the Sraffian Supermultiplier for the US Economy

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Rio de Janeiro
2020

FICHA CATALOGRÁFICA

S111 Sá, Guilherme Haluska Rodrigues de.
Essays on capacity utilization and the Sraffian Supermultiplier for the US economy / Guilherme Haluska Rodrigues de Sá. – 2020.
110 f.; 31 cm.

Orientador: Ricardo Figueiredo Summa.
Coorientadora: Julia de Medeiros Braga.
Tese (doutorado) – Universidade Federal do Rio de Janeiro, Instituto de Economia, Programa de Pós-Graduação em Economia da Indústria e da Tecnologia, 2020.
Bibliografia: f. 104 - 110.

1. Teoria econômica. 2. Supermultiplicador Sraffiano. 3. Crescimento econômico –
Estados Unidos, 1985-2017. I. Summa, Ricardo Figueiredo, orient. II. Braga, Julia de Medeiros, coorient. III. Universidade Federal do Rio de Janeiro. Instituto de Economia.
IV. Título.

Ficha catalográfica elaborada pela bibliotecária: Luiza Hiromi Arao CRB/7 – 6787
Biblioteca Eugênio Gudin/CCJE/UFRJ

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Essays on capacity utilization and the Sraffian Supermultiplier for the US Economy

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Folha de aprovação

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Summary

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C: Household consumption

C_A: Household autonomous consumption

G: Government consumption

I or I_t: Investment

I_F^A: Firms investment in R&D

I_F^I: Firms induced investment

I_G: Government investment

I_H: Household investment

K or K_t: Stock of capital

M: Imports

T: Personal taxes

Tr: Transfers made by the government

X: Exports

Y or Y_t: Output

Y^* or Y_t^*: Full capacity output

Y^d: Disposable income of the private sector

Y_n: Normal output

Z: Autonomous expenditures

c: Propensity to consume out of income

g or g_t^Y: Output growth rate

g_I^I or g_t^I: Induced investment growth rate

g_{fd}: Final demand growth rate

g_k or g_t^K: Stock of capital growth rate

g^{max}: Maximum possible growth rate that falls within the stability range

g_t^{Y*}: Productive capacity growth rate

g_t^e: Expected growth rate

g_z: Autonomous expenditures growth rate

g_z^a: Growth rate of autonomous expenditures including the durable goods consumption by households

g_z^b: Growth rate of autonomous expenditures excluding the durable goods consumption by households

h or h_t: Propensity to invest or induced investment share

m: Share of import content on aggregate demand

r: Profit rate

s_p: Propensity to save out of profits

t: Tax rate

u or u_t: Capacity utilization

u_n: Normal capacity utilization

v or v_t: Ratio between capital and full capacity output (in chapters 1, 3 and Appendix A), and between capital and normal output (in chapter 2)

x: Fraction of the errors in expectations that are incorporated into new expectations.

δ ou δ_t: Depreciation rate of fixed capital

π: Profit share on output

Acknowledgements / Agradecimentos

Começo esses agradecimentos pelos professores que foram importantes para a minha formação e para o processo de elaboração da tese. Agradeço primeiramente ao Summa pela orientação que começou no mestrado e se estendeu durante o doutorado, por toda a ajuda durante todo o processo, sempre muito solícito e empenhado em me ajudar. Em segundo lugar, à Julia Braga, que aceitou ser co-orientadora e contribuiu muito para a tese também. Agradeço também ao Franklin, que mesmo não sendo orientador ajudou muito durante todo o processo, lendo os textos e dando diversas sugestões. Envio também um obrigado ao Fábio Freitas, Lucas Teixeira e Débora Pimentel, que aceitaram participar da banca.

Agradeço especialmente à Raquel, minha companheira que acompanhou todo o processo de escrita da tese nos últimos dois anos, passando pelos períodos de estresse, sempre me incentivando e sendo muito compreensiva e carinhosa, além de entender quando a elaboração da tese nos impedia de passar tanto tempo juntos como gostaríamos, como quando eu precisava passar finais de semana trabalhando.

Sou muito grato também ao apoio dos meus pais e da minha irmã, pelo amor e carinho dedicados durante toda a minha vida, além de sempre terem me apoiado na decisão de seguir estudando, tanto no mestrado quanto no doutorado.

Aos amigos do IBGE, agradeço pelos almoços e cafezinhos que tornavam os dias mais alegres; aos moradores da República do Excedente, por todo o tempo passado juntos, pelas horas assistindo séries e filmes, pelas conversas longas e estimulantes sobre economia e pelos Uber divididos; aos amigos do PPGE, agradeço pelas tardes de estudo na salinha, pelos cafés no teatro de arena, e cervejas tomadas em vários lugares. Por fim, a todos os demais amigos do Rio, Campinas, São Paulo e os que estão espalhados por outros lugares, obrigado pela companhia e amizade ao longo desse tempo todo.

Abstract

This thesis is composed by three essays on capacity utilization and investment from a Sraffian Supermultiplier perspective and its purpose is to contribute to the debate about the dynamic stability of the model and about the convergence of capacity utilization towards a normal utilization determined exogenously.

It is a well stablished result of the Kaleckian models that capacity utilization is endogenous and positively related to the growth rate of output and attempts by capitalists to adjust productive capacity to demand might trigger Harrodian Instability. This motivated several theoretical proposals by some Kaleckian authors in order to deal with the issue of convergence to normal utilization. Our purpose in the first essay is to rescue the concepts of competition, the determinants of normal capacity utilization and the relation between normal prices, normal utilization and normal profits, according to the classical surplus approach – more specifically the ideas presented by Ciccone (1986,1987,2011) and Steindl (1952) – in order to discuss critically these proposals developed by the Kaleckians in the light of this theoretical background. Our main point is that most of these proposals seems to have ignored some of these concepts from the classical surplus approach, adopting (explicitly or implicitly) some hypotheses that are in contradiction with the concepts of competition and with the determinants of normal utilization presented here – and in some cases even modifies the concept of normal utilization itself.

The second essay constitutes an attempt to test the central hypothesis of the Sraffian Supermultiplier demand-led growth model empirically; videlicet, that the growth of demand induces the share of capacity creating investment in output. By evaluating the relationship between the propensity to invest and the rate of growth of demand for the case of the United States economy in the period from 1985 to 2017, our results provide empirical support for this relation, showing that movements in the output growth rate cause the movements in the induced investment ratio. Other significant result shows that the induced investment share presents a high degree of inertia from on period to another, while the effect of the lagged rate of growth of demand is low but statistically significant, suggesting a tendency for utilization to converge towards some exogenous normal level slowly. This feature, together with other estimated parameters of the model, suggest that the Sraffian Supermultiplier adjustment mechanism has been dynamically stable for the US data in the period under analysis.

The third essay is benefited by elements from the first and second essays, and its purpose is to contribute to the recent theoretical debate about the relation between growth and capacity utilization from the perspective of the Sraffian Supermultplier demand-led growth model, by using the case of the US economy as a benchmark to check both for the possibility of changes in normal utilization, as argued by some Neo-kaleckians, and for evidence of a slow adjustment of capacity to demand, as a decline in the average degree of capacity utilization has been observed in since the early 2000s in this economy. We follow the concept of normal degree of utilization proposed by Ciccone and discussed in the first essay and we use a simple version of the Supermultiplier model. First, we examined the data from several branches of the industrial sector for the US economy and found no reason to believe that this decline in actual utilization can be explained by a general reduction in the normal rates of capacity utilization. Second, we made some simulations based on our simple Sraffian Supermultiplier model to demonstrate that the process of convergence of actual utilization to its given normal degree is slow and the model is compatible with long and lasting deviations between actual and normal utilization after large shocks, such as the decrease in output growth rates in the US economy since the begin of the 2000s.

Resumo

Esta tese é composta por três ensaios sobre grau de utilização da capacidade e investimento a partir da perspectiva do Supermultiplicador Sraffiano e seu propósito é contribuir para o debate sobre a estabilidade dinâmica do modelo e sobre a convergência do grau de utilização efetivo em direção a um grau de utilização normal determinado exogenamente.

Nos modelos de crescimento Kaleckianos, um resultado bem estabelecido é que o grau de utilização é endógeno e positivamente relacionado com a taxa de crescimento do produto, enquanto tentativas por parte dos capitalistas de ajustar a capacidade produtiva à demanda podem desencadear Instabilidade Harrodiana. Isso motivou diversas propostas teóricas por parte de alguns autores Kaleckianos para lidar com essa questão da convergência ao grau de utilização normal. A proposta do primeiro ensaio é resgatar os conceitos de competição, os determinantes do grau de utilização normal e a relação entre preços normais, grau de utilização normal e lucros normais, de acordo com a abordagem clássica do excedente – mais especificamente as ideias apresentadas por Ciccone (1986, 1987, 2011) e Steindl (1952) – e a partir desse arcabouço teórico, discutir criticamente as propostas elaboradas por autores Kalecianos. O principal argumento apresentado aqui é que a maioria dessas propostas parecem ter ignorado alguns desses conceitos da abordagem clássica do excedente, adotando (explícita ou implicitamente) algumas hipóteses que estão em contradição com esses conceitos de concorrência e dos determinantes do grau de utilização normal apresentados aqui – e em alguns casos até modifica o próprio conceito de grau de utilização normal.

O segundo ensaio consiste numa tentativa de testar empiricamente a hipótese central do modelo de crescimento liderado pela demanda do Supermultiplicador Sraffiano, de que a taxa de crescimento da demanda induz a parcela do investimento que cria capacidade em relação ao produto. Ao avaliar a relação entre a propensão a investir e a taxa de crescimento da demanda para o caso da economia dos Estados Unidos no período de 1985 a 2017, nossos resultados oferecem suporte empírico para essa relação, mostrando que mudanças na taxa de crescimento do produto causam mudanças na parcela do investimento induzido. Outro resultado importante mostra que a parcela do investimento induzido apresenta um elevado grau de inércia entre um período e outro, enquanto o efeito defasado da taxa de crescimento da demanda é baixo e estatisticamente significativo, sugerindo que existe uma tendência de o grau de utilização convergir lentamente ao seu nível normal exógeno. Esse resultado, em conjunto com outros

parâmetros estimados para o modelo, sugere que o mecanismo de ajuste do Supermultiplicador Sraffiano tem sido dinamicamente estável para os dados dos Estados Unidos no período considerado.

O terceiro ensaio se beneficia de elementos do primeiro e do segundo ensaio e seu propósito é contribuir para o debate teórico recente sobre a relação entre crescimento e grau de utilização a partir da perspectiva do modelo do Supermultiplicador Sraffiano. O caso dos Estados Unidos é usado como referência para analisar tanto a possibilidade de que tenham ocorrido mudanças no grau de utilização normal – como argumentado por alguns autores Neo-Klakecianos, – quanto as evidências de que esteja ocorrendo um ajustamento lento da capacidade à demanda, já que o grau de utilização médio da capacidade nesse país tem apresentado uma tendência de queda desde o início dos anos 2000. Nós utilizamos o conceito de grau de utilização normal apresentado por Ciccone que é discutido em detalhes no primeiro ensaio e utilizamos uma formulação simples do modelo do Supermultiplicador. Primeiro, analisamos dados desagregados de várias atividades industriais da economia norte-americana e não encontramos indícios de que essa redução do grau de utilização efetivo possa ser explicada por uma redução generalizada no grau de utilização normal das diversas atividades. Em seguida, fazemos algumas simulações baseadas numa formulação simples do modelo do Supermultiplicador Sraffiano para demonstrar que o processo de convergência do grau de utilização efetivo ao seu nível normal exógeno é lento e que grandes choques, como a redução das taxas de crescimento nos Estados Unidos observadas desde o início dos anos 2000, podem provocar desvios duradouros entre o grau de utilização efetivo e seu nível normal.

Introduction

This thesis is composed by three essays on capacity utilization and investment from a Sraffian Supermultiplier perspective. According to the Sraffian Supermultiplier model, growth is driven by autonomous expenditures, which are the expenditures that are not financed by the contractual incomes generated in the production process and that do not create productive capacity for the private sector. In other words, autonomous expenditures are a result of the introduction of new purchasing power into the economy, such as government expenses, exports, consumption or investment by household financed by credit and firms' investment in Research and Development, since it is a type of investment that does not create productive capacity. Capacity creating investment by firms is seen as a fully induced expenditure which is explained by the attempt of capitalists to adjust the size of their productive capacity to the level of expected demand. This attempt by capitalists to adjust capacity to demand combined with the existence of autonomous expenditures results in a tendency for capacity utilization to converge towards its normal level or the level desired by the firms.

The Sraffian Supermultiplier model was first formulated by Serrano (1995), but gained visibility more recently after the publications of Lavoie (2014, 2016) and a symposium on demand-led growth from the surplus approach perspective in Review of Political Economy (Cesaratto and Mongiovi, 2015). This gave rise to a debate about both the stability of the model and the convergence or not to a pre-determined normal utilization position, which can be found in another symposium published in Metroeconomica (Kurz and Salvadori, 2019).

Regarding the debate about the gravitation towards some exogenous normal level of capacity utilization, some authors argue that this desired utilization is not explained by the level of demand and that a model that purposes to explain long run growth must explain how the economy reaches a fully adjusted position where actual and normal utilization coincide (Freitas and Serrano, 2015; Girardi and Pariboni, 2019). On the other hand, some authors provide some alternative explanations in order to justify why capitalists might not target a single value for capacity utilization, why firms might have more important targets that hinder utilization to converge to its normal level or why normal utilization might actually be endogenous to the actual rate (Lavoie, 1995; Hein, Lavoie and van Treeck, 2012, Setterfield, 2019a; Nikiforos, 2013, 2016).

Regarding the second debate about the conditions under which the Supermultiplier model would be dynamically stable, some authors such as Freitas and Serrano (2015) and

Fazzari, Ferri and Variato (2020) argue that the model is stable for a large range of growth rates, while others consider that the model would present stability only under some very restricted conditions, such as Skott (2019).

In this way, the aim of this thesis is to provide theoretical and empirical support to the ideas of stability of the Supermultiplier model and the convergence of capacity utilization towards normal utilization.

In relation to the empirical part of the work, we choose to analyze the US economy both because as an emblematic economy (the most important economy in the World and most of the empirical debate in the international literature is focused on the data of this country) it helps to widen the debate which is taking place in international journals, but also because its statistical system is very complete and advanced and provides detailed and quality information that are not available for every country, such as data on stock of capital, depreciation and a disaggregated information which allowed us to construct data series of autonomous expenditures, induced investment and induced consumption according to our classification, extremely important to the Sraffian Supermultiplier debate.

The thesis is composed by three independent essays on capacity utilization and investment, which are somehow articulated. Both essays one and two are important to essay three, since the first essay rescues the theoretical concept of normal capacity utilization and the second essay provides the parameters which will be used in the simulations in the third essay. In both essays the underlying idea is that both productive capacity and its utilization converge slowly towards respectively the expected demand and the normal capacity utilization.

In the first essay we rescue some concepts from Ciccone and Steindl about the determinants of normal utilization which are grounded on the concepts of classical competition. It is a well stablished result of the Kaleckian models that capacity utilization is endogenous and positively related to the growth rate of output and attempts by capitalists to adjust productive capacity to demand might trigger Harrodian Instability. This motivated several theoretical proposals by some Kaleckian authors in order to deal with the issue of convergence to normal utilization. Our purpose in the first essay is to rescue the concepts of competition, the determinants of normal capacity utilization and the relation between normal prices, normal utilization and normal profits, according to the classical surplus approach – more specifically the ideas presented by Ciccone (1986,1987,2012) – in order to discuss critically these proposals developed by the

Kaleckians in the light of these theoretical background. Our main point is that most of these proposals seems to have ignored some of these concepts from the classical surplus approach, adopting (explicitly or implicitly) some hypotheses that are in contradiction with the concepts of competition and with the determinants of normal utilization presented here – and in some cases even modifies the concept of normal utilization itself.

In the second essay we empirically test the central hypothesis of the Sraffian Supermultiplier model (SSM) – that the growth of demand induces the share of capacity creating investment in output – for the US economy from 1985 to 2017. Our results show that movements in the output growth rate cause the induced investment ratio, indicating that there is a tendency for utilization to converge slowly towards some exogenous normal level. And this together with other estimated parameters of the model suggest that the SSM adjustment mechanism has been dynamically stable for the US data in the period under analysis.

The third essay is benefited by elements from the first and second chapters, and its purpose is to contribute to the recent theoretical debate about the relation between growth and capacity utilization from the perspective of the Sraffian Supermultplier demand-led growth model, by using the case of the US economy as a benchmark to check both for the possibility of changes in normal utilization, as argued by some Neo-kaleckians, and for evidence of a slow adjustment of capacity to demand, as a decline in the average degree of capacity utilization has been observed in since the early 2000s in this economy. We will depart from the idea of the normal capacity utilization as calculated by the actual utilization rate, as proposed by Mark Setterfield (2019) and Florian Botte (2020) and follow the definition of Ciccone (1986, 1987, 2012) discussed in essay one, who assumes that productive capacity is dimensioned in order to be able to meet peak levels in demand and that conventions about normal utilization should depend on the trend of the ratio between average and peak levels of demand averaged out over many cycles. Thus, we will examine if this decline in actual utilization could be explained by a general reduction in the normal rate of capacity utilization in the US economy. We analyze the data from several branches of the industry for the US Economy and our conclusions show that the ratios between average and peaks in demand do not seem to have changed significantly in the recent years. Next, we make some simulations based on a simple version of the Sraffian Supermultiplier model using the parameters estimated in the second essay to demonstrate that the process of convergence of actual utilization to its given normal degree is slow and that the model is compatible with long and lasting deviations between actual and normal utilization after large shocks, such as the decrease in output growth rates in the US economy since the begin of the 2000s.

Chapter 1 – A critical evaluation of some Kaleckian proposals to deal with the issue of convergence towards normal capacity utilization

1.1) Introduction

It is a well stablished result of the Kaleckian models that utilization plays the role of adjusting variable that accommodates different growth rates. This means that the canonical specifications of the Kaleckian models do not assure a convergence of utilization towards its normal level, unless some further hypothesis are presented and properly justified. (Lavoie, 2014, Freitas and Serrano, 2014). This raised some critiques from several authors (Committeri, 1986, 1987, Auerbach and Skott, 1988), who claimed that on the long run normal and actual utilization should be equal. Some Kaleckians also recognize that this is an unsatisfactory result, which motivated several theoretical proposals in order to deal with this issue. We divide these proposals into three different kinds. The first group of authors consider that there is not a single level of utilization targeted by firms. Instead, there is an interval of utilization levels considered accepted by capitalists. The second group of economists consider that achieving some targeted utilization is only one of firms several goals, and the achievement of all these goals are mutually exclusive. The third proposition states that normal utilization is affected by its effective level, so actual and normal utilization are equal on the long run, but utilization remains endogenous and playing the role of the adjusting variable.

Our main point is that these theoretical alternatives do not pay the due attention to the microeconomic principles of competition from the classical surplus approach. Because of that, attempts to accommodate the desired macroeconomic results into the models bring microeconomic inconsistencies, presenting results that are in contradiction with the concepts of competition and with the determinants of normal utilization from the classical surplus approach.

This chapter is organized as follows. After this introduction, the second section starts by discussing the different definitions of full capacity and capacity utilization. After that, we discuss the main determinants of normal utilization, stablishing its relations with the concepts of normal prices and normal rate of profit. Section three presents the proposals from the Kaleckians to deal with the issue of convergence of actual to normal utilization and discusses them critically. The study concludes with some final remarks.

1.2) Full capacity, capacity utilization, and normal utilization determinants

On this section, we are discussing the factors that influence normal utilization. Before that, it is useful to describe what is understood by capacity utilization and what are the different concepts of the utilization rate.

Capacity utilization is understood as the ratio between actual production and full capacity production. There are two different measures of utilization, based on the way full capacity is calculated. The first one is an economic concept of full capacity and takes into account that production takes place under normal work schedule. For example, if a firm works five days a week, with an eight-hour workday, full capacity is the amount that can be produced during this period, and not assuming the firms works seven days a week, 24 hours a day. This is the definition used on most surveys on capacity utilization.[1]

The second concept is an engineering one, where full capacity is understood as the maximum production that can be made if a firm works seven days a week, 24 hours a day.

Nikiforos (2013, 2016) advocates that there are some problems in using the economic measure and proposes an alternative way to measure utilization that is closer to the engineering concept. According to him, the better proxy is the hours a plant works per week divided by the maximum hours it can work (i.e, 7 x 24 = 168 hours). Fiebiger (2020) replies to Nikiforos and argues that his way to measure utilization also present some deficiencies. In summary, Fiebiger point is that only in some kinds of manufactures the adjustments in production takes place through changes in the number of shifts or hours worked. On the other hand, some manufactures always produce under only one shift, while another group consists of continuous processors that operate 24 hours a day, seven days a week, which means that the number of shits or the number of hours a plant works is not the best proxy for changes in production.

Based on that, we consider that the method proposed by Nikiforos (which we are calling here as Average workweek of capital – AWC) is not a better proxy for capacity utilization than the economic and more conventional concept of utilization. During this essay, it is this last one we will have in mind, except in section 1.3.3.2, when we deal with Nikiforos' model and so we have to consider the engineering concept of utilization.

[1] See Corrado and Mattey (1997), Morin and Stevens (2004) and Fiebiger (2020)

Once we have made clear some concepts about full capacity and capacity utilization, we will discuss what are the main determinants of normal capacity utilization, according to some Sraffians and Kaleckians authors. During this thesis, we might call normal utilization as desired or targeted utilization, with the same meaning.

At the root of the issue concerning normal utilization it is the discussion about normal prices – also called long period prices. During the 1980's there was a debate concerning this subject and the relations between normal prices, normal utilization and normal rate of profit.[2] Our purpose here is not to make a review of this debate, but to rescue some of the concepts used by Ciccone (1986, 1987).

There are three important things that have to be made clear during this section. The first one is the relation between normal prices, normal utilization and normal profit rate, as well as the different processes through which prices converges to their normal values and utilization converges towards its desired level. Second, it is important to explain that the normal or desired utilization that enters into the calculation of normal prices is the one expected on new investment, and not necessarily the utilization of the whole existing stock of capital. At third, we explain the main determinants of normal utilization.

Let us start by the first topic. The first important thing to have in mind is how normal utilization affects the determination of normal prices and how it is related to the normal rate of profit. Holding fixed capital constitutes some opportunity cost over this capital that does not depend whether it is used or not. The opportunity cost of fixed capital that enters into unit costs of production depends on how much it is produced with each unit of capital. In other words, it depends on capacity utilization. The capacity utilization that enters into de calculation of normal costs and normal prices is the normal or desired utilization and not the effective one. What is required for normal prices to prevail is that profit rates to be equalized among different sectors, but it is not necessary that the actual rate of profit to be equal to its normal level – the one that would be obtained if prices were at their normal level and if utilization were equal to its desired value. As Ciccone[3] explains, what guarantees the gravitation of prices towards their long period values is the movement of capitals between branches of production. Theses migration of capital

[2] To see more on this debate, see Amadeo (1986), Ciccone (1986, 1987), Committeri (1986), Kurz (1986) Vianello (1985) and White (1989).

[3] "[t]he tendency towards long-period prices does not in fact seem to require the simultaneous gravitation of the effective utilization of capacity around its 'normal' level – i.e. the level of utilization implicit in those prices" (Ciccone, 1986, p. 24).

between activities are induced by the rates of profit of new investment expected in each activity, and these movements that are responsible for equalizing the rate of profit among different sectors on the long run.

However, profit rates can be equalized among different industries even if capacity utilization and the rate of profit are above or below their normal levels, and this does not preclude normal prices to prevail.

If normal prices prevail **and additionally** utilization is equal to its normal level, the effective profit rate equals the normal rate of profits. Ciccone states that there can be some mechanism at work that assures that utilization converges towards its normal level. However, "[t]here is no evident reason (…) for thinking that an adjustment of this type must take place 'simultaneously' with the gravitation of prices towards their long-period values" (Ciccone, 1986, p. 25). So the process of gravitation of prices around their normal value is different from the process of convergence of utilization towards its normal level, and the former one takes place on a time horizon shorter than the latter.

If instead we neglect normal utilization and consider that prices are calculated based on actual utilization, we might get some results that are incompatible with the definitions of competition we are adopting here. If prices are calculated with an utilization below normal, it means that the amount of capital per unit of output is higher than it would be required if normal utilization were considered, so prices entail production conditions that are not the cheapest ones. On the contrary, if the utilization that enters into the calculation of prices is above its normal value, capital requirements are lower, but this means that capitalists are considering some abnormally favorable conditions that should not be considered as "normal" and as we will explain in more detail in this section, they are under the risk of not being able to meet peak levels in demand.

As we said, normal prices are calculated based on normal utilization. The second important thing to have in mind is that the capacity utilization that enters into the calculation of normal prices is the one expected for the equipment which constitute gross investment, which does not necessarily coincide with utilization rates of the whole existing stock of capital.[4]

[4] "It follows from this that the degree of utilization of capacity that contributes to determining the costs in question, and hence the long-period prices of commodities, must be understood as referring to equipment which constitutes or might constitute gross investment, and not necessarily to that which constitutes the existing stock of capacity. In particular, this degree of utilization appears specific to newly installed equipment." (Ciccone, 1986, p. 26)

The reason for this is that investment and disinvestment on different branches of production are made based on the expected profit rates in each activity, and it is this process of migration of capital between industries that guarantees that prices will gravitate towards their normal values and profit rates will be equalized among different sectors. However, since it is through investment that this process occurs, the equalization of profits takes place only for the new installed equipment. So the capacity utilization that matters for the determination of normal prices is also the one expected on new investment.

Now we can turn to the main determinants of normal utilization. Capitalist economies present fluctuations in demand. Although these fluctuations can be accommodated by an unaltered production and by inverse variations in stocks, for the majority of the industries, these fluctuations are matched by variations in the production levels and consequently by the utilization of fixed capital. Since capitalists aim to be able to meet peaks in demand without losing market share to their competing firms, the size of installed capacity is determined by the peaks of demand expected during the economic life of equipment. Following Ciccone's argument, the larger the size of fluctuations in demand, the smaller will be the ratio between average production and full capacity, and the smaller will be normal utilization. An interesting way to get an empirical indicator of the path of desired utilization is through the ratio of peak to average level of demand. The higher the volatility of demand, the higher this ratio will be, and all other things being equal, firms will have to maintain higher margins of spare capacity and so the normal level of utilization will be lower.

Fluctuations in demand present two spheres: the first one is regular variations that present a seasonal pattern, as highlighted by Kurz (1986) and Nikiforos (2013), for example. The second dimension refers to unexpected increases in demand. Steindl (1952) draws an analogy with the monetary theory and why agents keep high powered money in their portfolios. People keep money in their balances in order to be able to face unpredicted events that might happen in an uncertain future. Similarly, firms keep some planned excess capacity in order to face an uncertain future: in this case, to respond to unexpected increases in demand without losing market share.

Due to the indivisibility of fixed capital, productive capacity of individual firms growth in a discontinuous way. However, when a firm expands its capacity and a new plant or segment of plant is ready to enter in operation, the firm can only achieve small increases of its sales, since it is not an easy task to increase market share at the expanse of its competitors. Firms do take these factors into account and their capacity installed is larger than que peaks in demand predicted for the near future, so capitalists already expect to operate at low utilization rates on the first years after the installation of a new plant. This aspect is also an important determination of normal utilization, and was emphasized by several authors, such as Steindl (1952), Ciccone (1986) and Freitas and Serrano (2014).

Technical conditions may also be important to determine normal utilization, and in some cases it may be more profitable to maintain some desired excess capacity – even in relation to expected peaks in demand – and produce under lower utilization. For example,

> "(…) if equipment of greater capacity permitted the adoption of more economical methods of production, their employment could turn out to be profitable even for production levels that stayed permanently below their potential. Or, again, an excess capacity could be profitable if the unit costs of production increased as the degree of utilization of the plant increases beyond certain limits" (Ciccone, 1986, p. 32).

Some authors also highlight the role of entry deterrence strategies in influencing normal utilization. Lavoie (2014) summarizes the argument by saying that "[i]t is part of the defensive strategy to limit entry into the industry, since any potential producer knows that existing firms have the ability to increase output and cut prices without necessarily incurring losses." (Lavoie, 2014, p. 152). In this case, these strategies would consist in maintaining some excess capacity beyond the predicted maximum levels of demand.

Some Kaleckian authors suggest that normal utilization is endogenously determined by its past trend. If this was the case, demand could affect normal utilization – since it affects actual utilization, which by its turn influences targeted utilization. These authors use this idea to justify the fact that normal utilization is endogenous on the long run and to tame Harrodian instability on Kaleckian growth models. We will address some comments to this idea below, while these propositions from some Kaleckian authors will be discussed in more details on section 1.3.3.

Ciccone admits that normal utilization might be affected by its past values, but only through a rather indirect way. According to him, since capitalists do not know for sure the size of future fluctuations in demand, they take the actual utilization observed through several economic cycles as a basis for their estimates. However, what is important to have in mind is that it takes long periods of time for past utilization to exert some influence on the desired one, and it will not be altered if effective utilization remains above or below normal for only a short period of time: "The **normal rate of utilization**

will hardly be affected, therefore, **by recent fluctuations, and even less by those currently experienced**." (Ciccone, 1987, p. 98, emphasis added)

The point presented by Ciccone is that demand influences the desired productive capacity. Normal utilization, by its turn, is determined by the "effective breadth and frequency of fluctuations in demand" (Ciccone, 1986, p. 36), and not by its level. This means that, for a given pattern of fluctuations in demand, if actual utilization remains above target for some periods, capitalists will react increasing their desired **productive capacity**, and **not** their **desired utilization**. By this logic, the **level** of aggregate demand does not exert some systematic influence on normal utilization, and the only way through which it can change desired utilization is through changes in the **pattern of oscillations** in demand.

At last, it is important to point out that these determinants of normal utilization are specific to each branch of production, so each activity can present a different desired utilization and there is no reason a priori to expect that normal utilization should be equal among sectors. Industries that face larger oscillations in demand should present a lower normal utilization, while industries that face a more stable demand present a higher desired utilization. The first thing we can infer from this is that the normal utilization of the economy as a whole consists on a weighted average of normal utilization of each activity. So even if the normal utilization of each individual industry remains unchanged the normal utilization of the whole economy can still be altered due to the changes in the relative size of each activity on total output. Second, there is no reason to assume that any changes that occur in economic conditions should affect normal utilization of all activities in a regular or uniform way.

1.3) A critical evaluation of the kaleckian proposals to deal with the absence of convergence between actual and normal utilization

Once we have presented some of the main determinants of normal capacity utilization, our purpose in this section is to present and discuss critically the proposals from some Kaleckian authors to deal with the issue of Harrodian Instability and the convergence of utilization towards its normal level. First of all, it is important to have in mind the main characteristics of the Kaleckian model. Some of the first models of growth in the Kaleckian literature can be found in Rowthorn (1981), Dutt (1984) and Amadeo (1986).

On these models output growth is led by the growth of investment expenditures, and consumption is seen as induced by current income. Distribution and the propensity to save are considered exogenous parameters, as well as the investment rate $\left(\frac{I}{Y}\right)$, which is defined based on the profit share and on the propensity to save out of profits. Capacity utilization plays the role of adjusting variable, presenting a positive relation with the growth rate. As a result, nothing guarantees a priori that utilization will converge to its desired level, and if the current output finds itself above (below) the desired level for the existing stock of capital, attempts by capitalists to adjust capacity to output might result in a further increase (decrease) in utilization, widening the gap between effective and desired utilization, a process known as Harrodian Instability.[5]

On this section, we are presenting some theoretical responses offered by some authors to deal with the issue of convergence towards normal capacity utilization within the Kaleckian model framework. It is important to highlight that we consider that the Supermultiplier model, presented originally by Serrano (1995)[6] constitutes a valid alternative to solve the issue of Harrodian instability and the convergence of utilization to its targeted level. However, we are not discussing this model in more details since our purpose here is to discuss critically what are the macroeconomic results and the microeconomic implications of these proposals within the hypothesis of the Kaleckian model that growth is investment led and that there is no autonomous consumption.

We identified three different lines of arguments that try to address this issue, and each one of these constitute one subsection of the current section.

1.3.1) Firms do not have a single utilization target

Chick and Caserta (1997) distinguish two different concepts of equilibrium in economics: final equilibrium and provisional equilibrium. They argue that “the latter class [provisional equilibria] should be the norm in economics, on the grounds that the economy is an open system, constantly evolving, and that the equilibria which we label

[5] This outcome can be viewed in a more formalized version in Hein, Lavoie and Van Treeck (2012).

[6] Although this model was presented originally by Serrano (1995), other issues concerning the stability of the model and its comparison with the Kaleckian and the Cambridge models were addressed in more recent papers, as in Freitas and Serrano (2015), Serrano and Freitas (2017) and Lavoie (2016). According to this model, “growth is led by the autonomous components of demand that do not create capacity (autonomous consumption in the present case), productive investment is an induced expenditure and income distribution is exogenous” (Freitas and Serrano, 2015, p. 1-2). The most important result in our case is that utilization converges towards an exogenous desired level on the long run under some specified conditions, and unlike the Kaleckian model, the investment rate – or, alternatively, the propensity to save out of profits – is endogenously determined and plays the role of adjusting variable.

provisional are consistent with the modelling of such processes, while final equilibria are not" (*ibid*, p. 223). Additionally, they state that "finding final equilibria is a challenging but ultimately futile intellectual game and only provisional equilibria are suitable for use in economic models." (*ibid*, p. 223-4).

According to this view, the fact that on the Kaleckian model capacity does not adjust to demand at a desired ratio by the firms should not be a source of major concerns, since this convergence of utilization to its normal level is interpreted as a final equilibrium. Still according to the authors, "an equilibrium rate of growth with a constant other-than-normal degree of capacity utilization is a perfectly legitimate construct" (*ibid*, p. 233) if we take into account the notion of provisional equilibrium.

Along this same line, some authors provide arguments to justify that Harrodian instability should not be a true concern on capitalist economies. The main idea is that firms would not target a single level of desired utilization. Instead, there would be a range of utilization levels, and when utilization is within this interval, firms would not alter its behavior and Harrodian instability would not be triggered.

Setterfield (2019) develops a more formalized explanation. In his model, there is an exogenous level of normal utilization (u_n) that constitutes the center of the corridor of accepted levels of utilization. This interval goes from $(u_n - c)$ to $(u_n + c)$, and $2c$ is the size of the corridor. In terms of the investment function, he supposes that "(…) in the spirit of Harrod (and following Simon (1955, 1956)), firms are satisficers for whom there is a **range** of variation in u about u_n that is deemed acceptable, so that variation in u within this range is thought unworthy of behavioural response." (Setterfield 2019, p. 452, emphasis in the original).

This means that deviations of u from u_n smaller than c do not provoke changes on capitalists' behavior in regard to their investment decisions. If utilization lies within this interval, the adjustment occurs through changes in utilization, there is a positive relation between growth and utilization and Harrodian instability is ruled out. However, "variations in actual capacity utilization that lie outside this tolerable interval will attract attention and provoke behavioural change" (*ibid*, p. 13).

We address some critiques to these proposals. First of all, according to the principles presented in section two, we believe that if utilization is different from normal, it is unlikely that capitalists will remain indifferent to this outcome. If utilization is persistently below normal, this means that firms are not using the most economic method of production, which is in disagreement with the principles of competition. Inversely, if utilization remains above the desired one capitalist might not be able to meet peak levels in demand, being under the risk of loosing market share to their competitors.

Second, we admit that there is no theoretical problem with the existence of some range of accepted utilization rates and that when the economy lies within this interval, capitalists do not necessarily change their behavior in a mechanical way. Since capitalists do not know exactly the size of future oscillations in demand, it is reasonable to assume the existence of such a corridor, but it should be small and explained by uncertainty regarding the peak-to-average ratio of future demand. However, on this model the concept of the range for utilization is introduced as a theoretical amendment in order to accommodate the results of the Kaleckian model and reassure capacity utilization as the adjusting variable. More specifically, we consider that fluctuations inside this interval are not large enough to accommodate a considerable interval of growth rates. To make our point, let us assume some stylized values for the parameters of the model. The Cambridge Equation is $g = s_p r$, where g is the growth rate, s_p is the propensity to save out of profits and r is the profit rate. Decomposing the profit rate as $r = \frac{\pi u}{v}$, – where π is the profit share on output and v represents the capital to full-capacity output ratio – the first equation can be expressed by $g = \frac{s_p \pi u}{v}$. Since we are dealing with an example closer to the reality, we must include capital depreciation (with the term δ accounting for fixed capital depreciation rate), and the Cambridge Equation must be altered to the following version:

$$g = \frac{s_p \pi u}{v} - \delta \qquad (1.1)$$

Taking the growth rate as given, equilibrium utilization can be expressed by:

$$u = \frac{v(g + \delta)}{s_p \pi} \qquad (1.2)$$

Since $r = \frac{\pi u}{v}$, replacing u for equation 1.2 and simplifying we get the expression for the equilibrium rate of profit:

$$r = \frac{g + \delta}{s_p} \qquad (1.3)$$

Let us assume the following values for the parameters: $s_p = 0{,}5$; $\pi = 0{,}4$; $\delta = 5\%$ and $v = 2$. From this data, we can calculate the utilization rate required by a specific growth rate and the resulting rate of profit, as well as to measure the sensibility of both u and r to changes in g. Taking the partial derivative of u and r with respect to g, we obtain:

$$\frac{\partial u}{\partial g} = \frac{v}{s_p \pi} = 10 \quad (1.4)$$

$$\frac{\partial r}{\partial g} = \frac{1}{s_p} = 2 \quad (1.5)$$

This means that if long run growth rate increases 1 percentage point (pp), this would result in an equilibrium utilization and an equilibrium profit rate 10 pp higher and 2 pp higher, respectively. Assuming a range of acceptable utilization rates of 10 pp – from 75% to 85%, for example – which is already a large corridor according to our view, growth would be able to oscillate only 1 pp without falling outside the stability zone. Another interesting example is to calculate the required utilization and profit rate for different growth rates. Under this set of parameters, a growth rate of 0% would be associated with an utilization of 50% and a profit rate of 10%, while a 4% growth would require an utilization of 90% and a profit rate of 18%. This means that for utilization to be in fact the adjusting variable, this would require rather large range for changes in utilization, and we consider this result as unrealistic. Besides, this change in growth of 4 pp would practically double both utilization and the rate of profits.[7]

1.3.2) Firms have multiple targets that are mutually exclusive

The second theoretical proposal we are examining postulates that firms pursue a specific utilization rate, but there might be some reasons that prevent effective utilization from being equal to this target. For now, we are still assuming that normal utilization is determined exogenously, and we will consider the possibility that it changes

[7] We consider that this model present other deficiencies, although not directly related to the inconsistencies with the surplus approach and competition concepts, which are our focus here. Another criticism is that when utilization falls outside the corridor, the issue of Harrodian instability remains and should be addressed somehow. In the specific case of Setterfield's proposal, when capacity utilization lies outside this corridor, the adjustment occurs through changes in distribution, in the same way as in the Cambridge models. However, no economic rationale is offered to explain why the adjustment mechanism changes precisely at the point where utilization crosses these critical values represented by $u_n - c$ and $u_n + c$, and neither is explained why the adjustment occurs in the Cambridge fashion in these cases.

endogenously only on the next subsection. This proposal was developed originally by Dallery and van Treeck (2011), and presented also by Hein et al (2012), who introduce the issue in the following way:

> "The idea is to treat the normal rate of capacity utilization as a fixed target of firms, while recognizing that firms also have various other important objectives, the realization of which may not necessarily coincide with the realization of the utilization target. Hence, firms need to trade off the utilization rate target with other targets." (*ibid*, p. 149)

Dallery and van Treeck identify three groups with conflictive goals in a capitalist economy: managers, shareholders and workers. The first dimension of this conflict is between managers and shareholders about firms' desired growth and profitability. This conflict is weighted by the power of both groups and results on firms' desired growth rate and profit rate, and which of these will be a priority depends whether firms are dominated by managers or shareholders. Since this internal conflict is not so important for the discussion about the convergence towards normal utilization, we are not explaining this dimension in much detail.[8] Anyway, even if firms' priority is a specific growth rate, this rate also can be translated into a desired profit rate required to finance this desired growth. So the important here is that a given target profit rate, combined with given technical conditions and the normal capacity utilization, implies also a desired profit share.

The second dimension of the conflict is between workers and firms. Workers have a target real wage, and given technical conditions, this target real wage implies a specific targeted wage share.

Under normal conditions, income claims by workers and capitalists are incompatible, and assuming that each class have some bargaining power, neither one is capable of achieving its desired income share. This means that if utilization is equal to its normal level, the actual profit share will be insufficient to make firms achieve their desired profit rate. Inversely, if profit and wage shares are determined through distributive conflict, utilization would have to stand above its normal value to enable firms to achieve

[8] The authors explain the conflicting goals of shareholders and managers in the following way:

> "As is traditionally assumed in Post-Keynesian analysis (Galbraith, 1967; Wood, 1975), managers mainly seek growth as a means to ensure the firm's survival by increasing its power, limiting uncertainty, and so forth. In contrast, shareholders seek profitability for intuitive reasons: because they hold diversified portfolios, they are not really committed to the long-term goals or survival of individual firms (e.g. Crotty, 1990). (…) For shareholders, the accumulation decision is subordinated to the profitability target, whereas managers are interested in profitability mainly as an intermediate objective and as a means to finance a desired rate of growth." (Dallery and van Treeck, 2011, p. 196)

its target profitability. Succinctly, the desired utilization and the desired profit rate cannot be achieved simultaneously.

The solution proposed in both papers consists in assuming that, faced with an inconsistency between desired utilization and other targets – which can be a desired profit rate or a desired growth rate, – firms chose to pursue other goals, leaving normal utilization as a secondary objective.[9] This can be found in Dallery and van Treeck, when they impose the condition that on the long-run equilibrium of the model, actual profit rate and firms' desired profitability rates must be equal.[10] Hein et al, by its turn, also say that in this situation, " firms' quest for growth (market shares) and the distributional struggle with workers **supersede concerns about the optimal utilization rate**." (*ibid*, p. 153, emphasis added)

In this closure proposed by the authors, utilization rate becomes an adjusting variable that accommodates the real wage and the rate of profit desired by workers and firms, respectively. Quoting Dallery and van Treeck,

> "We may arrive at a 'fully-adjusted position' regarding profitability, but this does not coincide with a fully-adjusted position in the usual sense. **The rate of utilisation is still seen as a free variable**, and this ensures that firms' and workers' objectives are not fully contradictory, as variations in utilisation allow them to partly reconcile their respective profitability and distribution targets." (*ibid*, p. 199, emphasis added)

Let us present now some critiques addressed to this proposal. The first one refers to its distributive features. Normal profit rate depends on normal distribution and normal utilization. According to the fundamentals we discussed in section two, competition guarantees that prices will converge towards their normal values and so normal distribution will prevail on the long run. Additionally, if utilization equals normal, actual profit rate will be equal to the normal profitability. This is the distributive outcome that can be considered an attractor one towards which the economy gravitates.

[9] This does not mean that firms' desired profit rate is exogenous and does not change, it means only that firms will give priority to other goals instead of achieving normal utilization. If firms are dominated by managers, they pursue growth targets and desired profitability is subordinated to this target, changing in an adaptive way and converging towards the actual profit rate. In the opposite case, when firms are dominated by shareholders, they pursue an inflexible profitability target, and other parameters have to adjust to assure this goal will be achieved. In the closure proposed by Dallery and van Treeck, "[a]s long as shareholders' profitability claims are not realised, shareholders require that managers adjust their financial policies and distribute a larger share of profits and borrow in order to buy back firms' shares." (Dallery and van Treeck, 2011, p. 201)

[10] According to them: "If we make $r^* = r_{sf}$ [here r_{sf} is firms' target profit rate] a condition for long-run equilibrium, implying that firms achieve their profitability, or growth, target, two different types of adjustment are possible." (Dallery and van Treeck, p. 199)

If capitalists **desire** a higher profitability, this does not mean that they can **get** it. However, both for Dallery and Van Treeck and for Hein et al **the desired profit rate shows no relation with the normal profit rate** – i.e., the one that would be obtained when normal prices prevail and when utilization is at its desired level. For this to happen, these authors presuppose that capitalists can **choose** some utilization rate above normal that shows **no relation** with this last one, and nothing prevents them from achieving any desired profitability they want, even if the utilization required for this outcome is inconsistent with the principles of competition we are assuming here.

This result is also strange when compared to heterodox theories about distributive conflict. In general, capitalist economies present some form of conflict, and if workers and capitalists have some bargaining power, neither class will achieve their claims over distribution and both groups will desire to increase their incomes. This is a common feature of both Kaleckian and Sraffian models, were it is assumed that if workers have some bargaining power, they can prevent capitalists from achieving any profit share desired by them. However, even if capitalists worry about the profit rate and workers care about the real wage, the conflict occurs through the profit and wage shares on output taking normal utilization and technical conditions as given, and so the distributive conflict affects **the normal profit rate and not the effective one**. Effective profit rate, by its turn, is admitted to change for many reasons during the economic cycles, since at any given point in time prices may not be equal to normal and utilization may differ from the desired one.[11]

However, the closure proposed by this adjustment is different from the most common heterodox theories: while on most of the theories capitalists try to increase their profitability by increasing the share of profits on output, on Dallery and van Treeck and by Hein et al capitalists try to increase their profit rate by changes in utilization, taking normal prices and distribution as given. If this is the case, the concept of distributive conflict and the idea that workers and capitalists have income claims that are inconsistent with each other lose its theoretical strength, since it is always possible to mitigate the conflict even on the long run if firms choose to operate under higher utilization rates. As pointed out by Skott:

> "The core of this statement is the observation that if firms have a target for the profit **rate** and workers a target for the wage **share** then these targets can be made

[11] For more details on Kaleckian theories of inflation and distribution, see Kalecki (1971) and Lavoie (2014, cap 8). To study in more detail the Sraffian theories, see Pivetti (1991), Serrano (1993) and Stirati (2001).

> mutually consistent if the utilization rate is a free variable. This is clearly correct but does not establish that utilization **will** be a free variable." (Skott, 2012, p. 125, emphasis in the original).

Second of all, even if we abstract from the first problems exposed above and assume that there is no problem that normal and desired returns are different, there still remains other problems. According to the concepts we discussed previously, full capacity desired by capitalists is determined by the expected peaks in demand that entrepreneurs expect for the economic life of the equipment and normal utilization depends on the breath and frequency of fluctuations in demand. If average utilization remains systematically above its normal level in order to enable capitalist to achieve higher rates of profits, this means that capitalists choose to operate at some utilization rate that may not be able to meet the highest levels of demand, being subject to the risk of losing market share to their competitors, so this behavior is not compatible with the concepts of competition we are adopting here.[12]

1.3.3) Normal utilization adjusts towards observed utilization

The third proposition to deal with the issue of Harrodian instability postulates that when utilization rate is different from its normal level, normal utilization changes in an adaptive process. Some of the first papers to present this solution (with different levels of formalization) was Amadeo (1986), Lavoie (1995) and Dutt (1997).

Lavoie et all (2004) postulates that "The normal rate of capacity utilization, in that context, is thus a convention, which may be influenced by historical experience" (Lavoie et al, 2004, p. 133). On the same line, Amadeo (1986) says that:

> "Indeed, one may argue that if the equilibrium degree is systematically different from the planned degree of utilization, entrepreneurs will eventually revise their plans, thus altering the planned degree. If, for instance, the equilibrium degree of utilization is smaller than the planned degree (…) it is possible that entrepreneurs will reduce [normal utilization]" (*ibid*, p. 155)

According to these models, desired utilization changes in the way described by the following expression:

$$\Delta u_n = \tau(u^* - u_n), \text{ with } \tau < 1 \qquad (1.6)$$

[12] Additionally, if this situation prevails for a sufficient period, it will eventually induce firms to revise up their desired capacity, accelerating their investment projects, triggering Harrodian instability anyway. So even if achieving normal utilization is not the top priority of firms, it is not guaranteed that this equilibrium will prevail – with utilization different from normal on the long run.

The adjustment proposed in equation 1.6 is capable of assuring the stability of the equilibrium. If the economy finds itself above normal utilization, this change in normal utilization reduces the gap between actual and normal utilization, which reduces the growth rate of investment expenditures, reducing effective utilization. The same logic works when the economy is initially below normal utilization.

However, this effect of past utilization on targeted utilization is not consensual neither among Sraffians nor between Kaleckian authors, and we will address some comments to this question. The main argument against this proposal is that it does not provide any economic rationality for why firms should adjust their expected utilization in this way. Skott, for example, says that: "Adjustments in the target would only be justified if the experience of low actual utilization makes firms decide that low utilization has now become optimal, and neither Amadeo nor Lavoie presents an argument for this causal link." (*ibid*, p. 120).

As we explained in section two, past utilization might influence normal utilization in an indirect way, since capitalists do not know for sure the size of future fluctuations in demand and take into account the oscillations of effective utilizations observed in the past. Ergo, past utilization data is used to estimate the future peak-to-average ratio. Besides, Ciccone highlights that capitalists take into consideration not only the utilization observed on the recent past, but the data observed during several economic cycles. This means that this channel is capable to explain only **minor** changes on normal utilization and that it is not influenced by effective utilization in a systematic and mechanical way, as it would be required for the adjustment proposed by Lavoie, Amadeo and Dutt to work. Additionally, this influence does not imply any relation between growth rates and normal utilization, nor that if the economy growths at a faster pace during some time and effective utilization happens to be above normal during this period, this would result in an increase on desired utilization.[13]

However, if utilization is equal to normal on the long run and it plays the role of adjusting variable, accommodating different growth rates, this means that normal utilization would have to be able to assume a range of values almost as large as the range

[13] An additional problem that arises is that if utilization remains above normal for several periods, capitalists should revise upwards their targeted productive capacity, but if the average-to-peak ratio remains unaltered, there is no reason to expect some change on normal utilization. In this scenario, it is more plausible to expect that firms will accelerate their investment projects instead of revising up desired utilization. If this happens, the result will be a further widening of the gap between actual and normal utilization, rather than a convergence between both.

of values of actual utilization, in the way described on section 1.3.1. If this is the case, the adjustment proposed by equation 1.6 would actually imply **major** changes on normal utilization. This is very different from the small and indirect influence of past utilization on its desired level admitted by Ciccone. Besides, accepting that normal utilization is endogenously determined in that way and subject to such major changes imply in ignoring the rest of its determinants we discussed in section two, such as the peak-to-average ratio, which we consider the most important one.

In response to these criticisms, some Kaleckians have tried to provide explanations for why this utilization gap would induce changes in normal utilization through mechanisms other than this "conventional" explanation. We will present two of these proposals, the first one by Hein et all (2012) and the second one by Nikiforos (2013, 2016).

1.3.3.1) Hein, Lavoie, and van Treeck proposal: normal utilization as the one that makes income claims by workers and capitalists consistent with each other

Hein el all include the distributive conflict and the monetary policy into the model, in order to show how normal utilization changes in our equation 1.6 fashion.

This model draws some resemblance with the one proposed by Duménil and Lévy (1999), in the sense that the monetary authority intervention plays the role to stabilize the economy. However, in Duménil and Lévy model, normal utilization is exogenous, and monetary policy exerts its influences through changes on the autonomous component of the investment function – which might be called expected growth or the animal spirits component – while on the model proposed by Hein et al, investment is influenced through the principle of increasing risk and normal utilization also changes.

The authors assume that the wage share desired by workers depends positively on utilization, which is used as a proxy for the employment level and consequently for the bargaining power of workers. The share of profits targeted by capitalists, on the other hand, is taken as given on the short run. On the long run, it is considered to depend on the interest rate and on the debt-to-capital ratio of the firms, since firms set prices adding a markup over costs, and these costs must include also interest costs. According to the definition used by the authors, the normal utilization is the one that makes income shares targeted by workers and capitalists to be consistent:

> "For claims to be consistent, the rate of utilization needs to be at a certain level, which we can call the normal rate of utilization u_n, (…) implying a NAICU [non-accelerating inflation rate of capacity utilization]. The normal rate of utilization

> in this framework is thus not given, but is derived from distribution conflict. **It is the rate of utilization which makes distribution targets of firms and workers consistent with each other, assuming that workers' targets are positively related to economic activity and hence to capacity utilization.** To further simplify the analysis, we assume adaptive expectations and also that firms set prices once nominal wages have been agreed upon in the labour market. The latter assumption implies that **firms can always realize their income distribution target** (as in Duménil and Lévy, 1999)." (Hein et al, 2012, p. 161-2, emphasis added)

The results of the model can be divided into short and long run outcomes. On the short run, utilization gap causes unexpected inflation, which triggers a response from the monetary authorities, who use interest rates to stabilize inflation. This increase in real interest rate might reduce demand and ergo capacity utilization. On the long run, such an increase in interest rates induces an increase in the desired profit share by firms, and since utilization is the variable that accommodates workers' and firms' aspirations, it reduces normal utilization on the long run. However, whether or not utilization converges towards the (moving) normal utilization depends on the set of parameters of the model.

The first and main criticism addressed to this proposal is that it changes the concept of normal utilization as it is used in the growth literature. As we discussed in section two, normal utilization depends on several factors, such as the desire of firms to be able to meet expected and unexpected increases in demand, the indivisibility of investment which makes it impossible for individual firms to increase its productive capacity in a smooth way, cost minimization and entry deterrence strategies. All these determinants have to do with strategic goals of firms, such as preserve its market share, discourage entry, maximize profits, and so on. Neither of these factors have to do with normal utilization being an adjusting variable that accommodates conflicting claims between workers and capitalists. Hein et all, by its turn, redefine the concept of normal utilization to arrive – through a rather complex and undetermined model – at the result that utilization is endogenous in the long run and that targeted utilization converges to the value of actual utilization.

The second comment made to this adjustment proposal is similar to the one we made to Dallery and van Treeck idea: the distributive conflict here is also resolved through changes in normal utilization. As Skott (2012) says, although there **could be** an utilization level that makes distributive claims between capitalists and workers consistent, there is no reason to assume that normal utilization **will move in such a way** to assure the compatibility of these claims. Besides, it weakens the idea of distributive conflict, since is always possible to change normal utilization in order to make income claims of workers and capitalists consistent with each other, and as in the model presented on section 1.3.2, nothing prevents capitalists to from achieving any desired profit rate they want.

In synthesis, this proposal maintains unusual results for the distributive outcome, similar to the ones present on the model from section 1.3.2 – where changes in utilization makes conflicting claims by workers and capitalists consistent with each other – and requires also a large range of values for normal utilization– as the ones presented in section 1.3.1 – in order to be able to accommodate different growth rates. Additionally, it redefines the concept of normal utilization to justify that it changes in the way required by the model.

1.3.3.2) Nikiforos proposal: engineering concept of utilization and changes in the AWC

A second attempt to provide some economic rationale for this strong endogeneity in normal utilization was developed by Nikiforos (2013, 2016), who tries to provide a microeconomic justification for why normal utilization adjusts in the way described by equation 1.6.

The author considers that the engineering measure of utilization is the most appropriate one and uses the average workweek of capital (AWC) as a proxy, so it is important to have in mind that exclusively during this subsection we are dealing with this different definition of utilization. Nikiforos develops a model to show how firms choose the number of shifts of production in order to minimize their costs. In summary, there are four determinants of the number of hours worked. Everything else being equal, the higher it is the wage differential paid for people who work outside normal hours, the smaller it is the stimulus to produce under the second shift, since this implies an increase in the wage cost by unit of production. The higher the capital requirements, or the relation between capital and output, the higher it is the incentive for the firms to economize capital, using a smaller stock of capital under two or three shifts. By the same logic, the higher the opportunity cost of capital, the larger is the stimulus to choose the double shift system, which requires less capital.

In the case where there are economies of scale, there is an advantage of having a larger factory even if operating in only one shift, since in this case the average costs are smaller due to the existence of returns to scale. For this reason, the higher the rate of returns to scale, the higher the incentive to produce with a larger factory in only one shift.

The author argues that in the real world, the rate of returns to scale at the firm level tends to decrease[14] – which does not mean that there are not increasing returns to scale, only that this ratio decreases through time as the economy growths, – and if this is the case, this will constitute a stimulus to produce under more shifts or hours of production.

Following his idea, it is still necessary to explain how to derive the macroeconomic results regarding growth, utilization and normal utilization from these microeconomic principles. In other words, it requires some explanation on what happens to the firms' size as the economy as a whole growths. The author adopts two hypotheses, supported by the data on Business Size from the U.S. Census Bureau. First, the average size of firms remains unchanged on steady state, and growth is accommodated by an increase in the number of firms. Second, when growth rates change, growth expectations are shown to be wrong for some time, and during these periods, some fraction of the growth is accommodated by an increase in the size of the firms – or a decrease, in case effective growth falls behind expected growth.

Let us suppose the economy is initially on steady state, with $g^* = \gamma$ and $u^* = u_n$ – γ represents expected growth rate. Under this equilibrium, the size of the firms remains unchanged and capitalists have no stimulus to change the number of shifts and consequently the level of utilization. If growth rate increases, economy will be in a situation where $g^* > \gamma$ and $u^* > u_n$. According to these hypotheses, this will be accompanied by an increase in the firms' size. If this is the case, and if the rate of returns to scale at the firm level is indeed decreasing as firms growth, this will induce capitalists to produce under a higher number of shifts/hours worked, which constitutes an increase in desired utilization. In this case, when growth rate increases and utilization surpasses normal utilization, an increase in desired utilization will take place, along the line suggested by expression 1.6.

We are going to base our critiques on the work of Girardi and Pariboni (2019), who reserves their whole article to discuss critically Nikiforos' proposal. Those authors argue that there are two independent kinds of weaknesses on this proposal. Some arguments are addressed to the restrictive assumptions of the microeconomic model, while other critiques are made to the derivation of the macroeconomic adjustment based on the microeconomic analysis.

[14] Nikiforos, 2016, section 5 (p. 15-7)

Starting from the microeconomic arguments, Girardi and Pariboni argue that it cannot be generalized that all firms present increasing returns to scale, neither that this rate of returns to scale are decreasing as production increases.

Second, since according to Nikiforos firms do not growth on steady state, this hypothesis implies that the real economy presents some sort of deconcentration process in production, converging to a situation similar to perfect competition, where each individual producer is insignificant compared to the size of its market. In line with this outcome, Nikiforos assumes that all firms are price takers. These results can be considered strange if firms present increasing returns to scale, as he claims. Steindl (1952), for instance, argues that larger firms have cost advantages over small companies due to the existence of returns to scale – and this does not depend on whether the rate of returns to scale is increasing or decreasing. Since these larger companies have smaller unit costs, they can obtain higher than normal profits. This enable them to: a) accumulate capital at a higher pace than their small competitors, and b) sacrifice some portion of this above normal profit margin in order to pursue aggressive sales campaigns and increase their market share at the expense of the small firms. This process provokes the expulsion of some small companies from the market and results in a concentration process, that might stop when there are only a few big companies in some specific industry. In summary, these firms will present some market power that enable them to fix prices.

Still within the microeconomic problems, Girardi and Pariboni point out that the treatment of capital given by Nikiforos does not survive to the critiques of the Cambridge capital controversy.

Let us move on to the problems that arise from the transition to the micro to the macro model. Nikiforos does not provide any theoretical explanation for why firms' size remains constant when effective growth equals expected growth. The only justification is an empirical one. Still, this justification also presents several problems. Nikiforos uses as a proxy for the average size of firms the number of employees per firm, while the best indicator would be output per firm, a data which is also available and as Girardi and Pariboni show, presents a clear increasing trend over time. Second, even abstracting from the problems of the measure of the size of the firm, when Nikiforos presents its regression between the number of employees per firm and the gap between actual and expected output, the estimated constant is positive, which means that the number of employees tends to growth even if there is no output gap. If this is the case, there will be some tendency for the number of shifts/hours worked to increase, and consequently for the utilization rate to change **even on steady state**, which would be considered a rather odd result for the literature.

Girardi and Pariboni also criticize the fact that Nikiforos uses as a proxy for expected growth the HP filter to the actual growth-rate series. According to them, 'it is far from uncontroversial that the trend growth rate estimated through the HP filter can be used as a proxy for firms' expected growth rate. Because of how it is constructed, the HP filter includes, in each year t, information on future dynamics not available in year t' (Girardi and Pariboni 2019, p. 13).

We are making now some final considerations to close this section. First of all, this adjustment would also require a large range of variation in actual utilization in the way described in section 1.3.1 and consequently normal utilization would also present a range of variations almost as large. Nikiforos is indeed careful in defining normal utilization based on cheapness. However, his attempt to reach the desired final result from its starting point – i.e., to provide microeconomic justifications to these changes in normal utilization – incurs in several problems in the micro model as well as on the passage from the micro to the macro.

Additionally, it is also necessary to redefine the concepts of full capacity and utilization in order to reach these results. As we mentioned earlier, Nikiforos uses the engineering concept of capacity utilization and takes as a proxy for this data the ratio of the number of hours a plant work per week to the maximum hours it can work over a week (i.e, 7 x 24 = 168 hours). As we commented on the second section, and supported by Fiebiger's paper, we consider that this measure of utilization present some problems and we prefer to adopt the conventional (economic) measure of utilization. The author states that as output per firm increases, the number of shifts/hours worked also increases. If we put aside all the problems raised by Girardi and Pariboni and look at this same issue but considering the economic concept of full capacity, an increase in the number of shifts can be interpreted as an increase in full capacity. So the increase in actual output would be accompanied by an increase in full capacity and nothing can be said a priori on what happens to utilization. This means that Nikiforos results are undermined when we take the economic definition of utilization, which is the one we consider the most suitable.

1.4) Conclusion

During this chapter, we rescued some concepts from the classical surplus approach with the purpose of explaining the relation between normal utilization, normal prices and normal profits and the main determinants of normal utilization. Normal utilization is the one that enters into the calculation of normal prices, and what is required for these prices to be persistent is that profit rates are equated among different sectors. It is the movement of capitals between branches of production that guarantees the gravitation of prices towards their long run values and the process of equalization of profit rates. Since it is through investment and disinvestment that this movements of capital takes place, what is important for the determination of normal utilization is the utilization expected for new investment, and not the one expected for the hole stock of productive capacity.

The main determinant of normal utilization we highlighted here is the relative size of fluctuations in demand, which include both the predictable fluctuations that present a seasonal behavior and the unpredictable oscillations. The higher it is demand's volatility, the higher the planed spare capacity and lower it is normal utilization. The latter might also be influenced by some technical factors, which may make it more profitable to produce bellow full capacity output. Indivisibility of fixed capital also play a role, as well as entry deterrence strategies by firms.

With these concepts in mind, we evaluated the new solutions proposed by some authors to deal with the problem that on the Kaleckian models of growth, capacity utilization does not converge towards a normal utilization determined exogenously. These proposals try to reach macroeconomic results that can either explain the divergence between actual and desired utilization or why it is normal utilization that changes to be equal to the effective one, at the same time they can preclude Harrodian instability.

However, the contribution we intend to make in this essay is that these attempts to solve the problems about these macroeconomic results modify the models and make assumptions – implicitly or explicitly – that are in disagreement with the principles of competition, distribution and the determinants of normal utilization from the surplus approach discussed in the 1980's. In restating the role of adjusting variable of capacity utilization, these models assume that it can present a rather large range of values, which is incompatible with what we see in the real world. The models that suppose that normal utilization is endogenous to the actual rate implicitly assume that normal utilization can also present a range of values almost as large as the range of values of effective utilization. Some of these proposals assume that firms can choose any profit rate they want and that its desired profitability shows no relation with the normal rate of profit. Additionally, it is assumed that firms can choose to operate at some utilization level above or below normal without any further consequences. Finally, one of the models redefines the concept of normal utilization, while another one changes the concept of utilization itself to the engineering concept in order to try to accommodate the macroeconomic results.

Chapter 2 – Growth, investment share and the stability of the Sraffian Supermultiplier model in the United States economy (1985-2017)

2.1) Introduction

The Sraffian Supermultiplier demand-led growth model posits that economic growth is led by autonomous expenditures that do not create productive capacity, while private capacity creating investment is supposed to be an induced expenditure. On fully adjusted positions, capacity tends to adjust to demand, and utilization converges to its normal level. For this adjustment to take place, the propensity to invest is required to be endogenously determined, playing the role of the adjusting variable that accommodates different growth rates (Serrano, 1995).

The wider acceptance of the Supermultiplier model after Lavoie (2014, 2016) also raised a debate about the dynamic stability of the model, that is, if the mechanism of adjustment of productive capacity to the long period level of effective demand proposed by the model will not face capacity constraints. As Freitas and Serrano (2015) show theoretically that the model is dynamically stable for some set of parameters, Skott (2017, 2019) believes that the values of the parameters necessary to stabilize the model are very implausible while Lavoie (2017) and Fazzari, Ferri and Variato (2019) are much more optimistic about the dynamic stability of the model calibrated for the real-world data.[15]

In this way, the contribution of the present chapter to this debate will be to empirically check for the recent US data (1985-2017) what the evidences says about the stability of the Sraffian Supermultiplier mechanism. In order to do this stability assessment, we investigate if the investment share behaves in the way described by the model, expressly: 1) if the growth of demand induces the share of capacity creating investment in output; 2) if this adjustment is sufficiently slow. We also estimate the main parameters of the model. The methodology adopted follows and updates the estimates of Braga (2006).

Besides this introduction, the chapter has six more sections. Section two introduces the Supermultiplier model's primary results and the dynamic stability

[15] Serrano, Freitas and Bhering (2019) demonstrates that the Supermultiplier model is statically stable “because the reaction of induced investment to the initial imbalance between capacity and demand has, at some point during the disequilibrium process, a greater impact on the rate of growth of productive capacity than on the rate of growth of demand” (p. 273). In other words, the adjustment process goes in the right direction. The static stability is a necessary condition for the model to be dynamically stable, but not a sufficient one. The dynamic stability requires also that the intensity of the adjustment is not excessive. Therefore, we are assuming that static stability is ensured and restricting our discussion to the dynamic stability.

conditions for an open economy with the public sector. The empirical literature on the Sraffian Supermultiplier is reviewed in the third section. In the fourth section, the methodology for the construction of the data series is presented. The fifth section presents a descriptive analysis of the data while the econometric results and the assessment of the dynamic stability condition of the models for the estimated data is made in section 6. Concluding remarks are made in the last section.

2.2) The Supermultiplier model

The Sraffian Supermultiplier model posits that “growth is led by the autonomous components of demand that do not create capacity (autonomous consumption in the present case), productive investment is an induced expenditure and income distribution is exogenous” (Freitas and Serrano, 2015, p. 1-2) and capacity utilization converges towards an exogenous desired level on the long run under some specified conditions.[16]

Serrano (1995) defines autonomous expenditures as "all those expenditures (…) that are neither financed by the contractual (wage and salary) incomes generated by production decisions nor are capable of affecting the productive capacity of the capitalist sector of the economy" (p. 71). According to Cesaratto, Serrano and Stirati (2003), these expenditures include the totality of government spend (which comprehends consumption, investment and transfers made by the government), exports, autonomous consumption financed by credit or accumulated wealth, residential investment by households and business expenditures, which includes R&D expenditures. Although the portion of the investment that creates capacity for the private sector is seen as an induced expenditure, it does not mean that the entire investment should be treated as induced. What we mean by induced investment is firms' investment in equipment and structures. The idea of the induced investment is that capacity should be built to meet expected demand. Government investment is considered autonomous because a) public gross capital formation does not create productive capacity for the private sector, and b) it is submitted to political decisions, and it is not motivated to adjust capacity do demand. The investment made by households should be treated as an autonomous expenditure since a) it does not create productive capacity, and b) it depends on other factors besides current income, such as credit, accumulated wealth, and the income expected for the future.

[16] For a comparison with the Kaleckian and the Harrodian models, see, respectively, Serrano and Freitas (2017) and Serrano, Freitas, and Bhering (2019).

Finally, firms' investment in R&D should also be treated as autonomous because it does not create capacity.

To present the formal model, we assume that the product is homogeneous, being consumed by workers and capitalists, and also used as fixed capital. There is only one technique of production available with fixed coefficients of labor and capital. We presume that the relation between the stock of capital and normal output (which is the output obtained if utilization were equal to normal) is exogenous (normal capital-output ratio). Labor supply is infinitely elastic and does not constitute a restriction even in the long run, and the economy presents excess capacity. Wage and profit shares on income are determined by distributive conflict and institutional factors and do not depend on demand conditions.

Neglecting changes in inventories, output plus imports should be equal to aggregate demand:

$$Y + M = C + I + G + X \tag{2.1}$$

Where Y is output, M represents imports, C is household consumption, I represents investment, G is government consumption, and X stands for exports. Since part of the aggregate demand leak through imports, we define m as the share of import content on aggregate demand, assuming that the import coefficient is equal for all types of expenditure:

$$M = m(C + I + G + X) \tag{2.2}$$

Household consumption is composed by an autonomous portion (C^A) and an induced one, which depends on the propensity to consume (c) and on disposable income (Y^d):

$$C = cY^d + C_A \tag{2.3}$$

Disposable income is equal to total output minus personal taxes (T) plus current transfers made by the government (Tr), such as social security benefits and unemployment insurance $(Y^d = Y - T + Tr)$. Taxes, by its turn, are expressed by $T = tY$, where t represents the tax rate. Combining these two expressions with equation 2.3, we get to:

$$C = c(1 - t)Y + cTr + C^A \tag{2.4}$$

It is worth noticing that transfers made by the government does not create demand directly, but only increases household disposable income, so its effect must be weighted by the propensity to consume. Although the consumption out of transfers is an induced expenditure, transfers are considered an autonomous expenditure. So, from the perspective of the economy as a whole, it must also be taken as autonomous.

Investment, by its turn, is divided between government investment (I_G), household investment (I_H), firms investment on R&D (I_F^A) and firms induced investment (I_F^I)[17] – Expressed in equation 2.5. Induced investment, by its turn, is given by equation 2.6, where h represents capitalists' propensity to invest.

$$I = I_G + I_H + I_F^A + I_F^I \tag{2.5}$$

$$I_F^I = hY \tag{2.6}$$

The model is presented in two stages, and for now, we suppose that h is given – this assumption will be modified later. Combining equations 2.1, 2.2, 2.4, 2.5 and 2.6, we determine the level of output according to the following expression:

$$Y = \left(\frac{1-m}{1-(1-m)[c(1-t)+h]}\right)Z \tag{2.7}$$

The term in parenthesis is the value of the supermultiplier, while Z calls for the total amount of autonomous expenditures that equal to:

$$Z = cTr + C^A + I_G + I_H + I_F^A + G + X \tag{2.8}$$

Considering that m, c, t and h are given, the value of the supermultiplier is also exogenous, and the growth rate of output is determined by the growth rate of autonomous expenditures $(g = g_z)$. Induced investment growth rate (g_I^I) is also equal to g_z, and since this type of investment increases the productive capacity of the private sector, the growth trend of the stock of capital (g_k) depends on the growth of induced investment so that it will converge to the growth of autonomous expenditures too.[18]

The following equation expresses the growth rate of the stock of capital at any given period:[19]

[17] The superscripts A and I on firms' investment represents the autonomous and induced expenditures, respectively.

[18] When using the terms stock of capital, we are considering only the private capital that consists of productive capacity, in a way that it is compatible with the definition of induced investment.

[19] This equation is derived from:

$$g_k = \frac{I}{K} - \delta = \frac{I}{Y}\frac{Y}{Y^*}\frac{Y^*}{K} - \delta = \frac{hu}{v} - \delta$$

$$g_k = \frac{(I/Y)u}{v} - \delta \quad (2.9)$$

Where u represents capacity utilization, v is the ratio between capital and normal output, and δ is the depreciation rate – we take the latter two as exogenous. Utilization is normalized at its normal degree so that $u_n = 1$. When output and productive capacity growth at the same pace, capacity utilization remains stable. This means that when $g_z = g_k$, we can calculate the value of capacity utilization using equation 2.9:

$$u^* = \frac{v(g_z + \delta)}{h} \quad (2.10)$$

When taking the propensity to invest as given, we can see that there is a positive relationship between the growth rate and capacity utilization. This occurs because when the growth rate of autonomous expenditures increases, output and investment will grow at this new higher rate. However, the growth rate of the stock of capital converges to the growth rate of investment expenditures only after some lag, and initially, the stock of capital will be growing at the lower older rate, converging to the new growth rate slowly and only after some time. During this transitional period, the output will grow faster than productive capacity, and utilization will increase.

Let us move to the second stage of the model when we drop the assumption that h is exogenous and assume that it is endogenously determined instead. We consider that competition between capitalists will result in a tendency for the capacity to adjust do demand in order to reach normal capacity utilization.[20] The aggregate propensity to invest depends on the normal capital-output ratio, the depreciation rate and the expected growth rate of demand[21]:

Where I is investment, K is the stock of capital, δ is depreciation rate, Y is actual output, Y^* is normal output, h is the propensity to invest, u is capacity utilization (defined as Y/Y^*) and v is normal capital-output ratio (K/Y^*).

[20] According to Ciccone (1986, 1987), full capacity is determined by the peaks in demand expected during the economic lifecycle of the equipment, while normal utilization is determined by some conventional historical pattern of the ratio between average and peaks in demand. Capitalists aim to be able to meet peak levels in demand in order to maintain their market share. Inversely, firms do not want to keep excess capacity above the required to meet the maximum expected levels of demand, since it is costly to keep idle capacity.

[21] In some specifications of the Supermultiplier model, the propensity to invest might be expressed as a function of the expected growth, while the latter one is gradually adjusted according to actually observed growth. This specification can be found in Serrano (1995), Cesaratto, Serrano and Stirati (2003), Serrano, Freitas and Bhering (2019) and Garrido Moreira and Serrano (2019). Alternatively, the propensity to invest might adjust itself according to deviations between actual and normal utilization, a specification present in Freitas and Serrano (2015) and Serrano and Freitas (2017). As normal utilization is an unobserved variable, and since the purpose of this essay is to test empirically the propensity to invest function, we are presenting the model according to the former specification.

$$h_t = v(\delta + g_t^e) \quad (2.11)$$

The expected growth rate by its turn is gradually adjusted to the effective growth, according to the following rule:

$$g_t^e = g_{t-1}^e + x(g_{t-1} - g_{t-1}^e) \quad or \quad g_t^e = (1-x)g_{t-1}^e + xg_{t-1} \quad (2.12)$$

Where x represents the parameter of expectations adjustment and it is subjected to the restriction that $0 \leq x \leq 1$. It is more likely that the value of x is low, which means that expected growth adjusts slowly to changes in actual growth. The first justification for this is that firms are aware that demand is subjected to cyclical fluctuations and might not adjust their expectations immediately if growth increases for only one or a few periods. The second reason is that firms do not intend to adjust capacity to demand in each moment in time but rather for the whole economic life of the equipment. Our empirical work will focus on equations 2.11 and 2.12, trying to identify if the propensity to invest adjusts to the growth rate of output in the way described by the model.

Let us assume that the economy is initially on its fully adjusted position, where growth expectations are fulfilled, and utilization is equal to its normal level and simulate what happens when a persistent increase in the growth rate of autonomous expenditures takes place. As mentioned above, the growth rates of output, investment, and productive capacity will all increase to this new level. However, in this case, effective growth will surpass capitalists' expectations, and since capital stock growth increases only after some time lag, utilization will increase and remain above its normal level. In this case, capitalists will start to adjust their expected growth rate according to the observed growth, increasing their propensity to invest and enabling investment to grow faster than output, which will allow productive capacity to grow at a higher pace than demand and result in a decrease in utilization, converging towards its normal level. The same mechanism applies when there is a decrease in autonomous expenditures growth rate.

On fully adjusted positions, the growth rate of output, investment, and of the stock of capital remain determined by the growth rate of autonomous expenditures. However, utilization will converge towards its normal level and will not show any relation with growth rates. Under these conditions, we can calculate the value of the propensity to invest in fully adjusted position based on equation 2.9:

$$h^* = v(g_z + \delta) \quad (2.13)$$

This is an essential result of the Supermultiplier model: the propensity to invest is endogenous in the long run and depends positively on the growth rate, playing the role of the adjusting variable that enables capacity to adjust to demand.

The dynamic stability of the model requires that the propensity to spend stays below unity during the adjustment process. The stability condition for the present specification of the model is expressed in equation 2.14[22]:

$$(1-m)[c(1-t)+v(g_z+\delta)+vx+vxg_z]<1 \tag{2.14}$$

The term $c(1-t)$ represent the propensity to consume already taking into account the taxes, $v(g_z+\delta)$ is the propensity to invest in long-run steady state, the term vx expresses that there must be some space for the adjustment to occur when the economy is outside the fully adjusted position and vxg_z represents an interaction term involving the two previous terms. The sum of all these items is multiplied by $(1-m)$, which is the share of domestic content in total demand, meaning that a higher import coefficient contributes to reducing the propensity to spend of the economy. The fulfillment of the above condition requires that the parameter x cannot be too high, indicating that the speed of adjustment of growth expectations must be slow, otherwise the system is only demand led for very low rates of growth of autonomous demand.

2.3) Review of the empirical literature on the Supermultiplier

By reviewing the few papers that have already performed empirical tests for the Supermultiplier model, we can identify two different types of experiments performed by the authors. The first kind tries to identify if autonomous expenditures explain the level of output, while the second aims to test, in a broad sense, the investment function of the model, looking for a relationship between investment and growth rates. In some cases, the authors take into account the investment share, while in others, it is considered the investment level or growth. Additionally, in some situations, the growth rate of output is used, while in others, the data considered consists of the growth rate of autonomous expenditures. The first type of test can check if growth is led by autonomous expenditures but does not guarantee the existence of some mechanism that adjusts capacity to output. The second test aims to check if the investment share is sensitive to the growth rate, a condition required for actual utilization to converges towards its normal level.

[22] This stability condition is based on Serrano, Freitas, and Bhering (2019).

Girardi and Pariboni (2016) focus on the United States, using quarterly data from 1947 to 2014. The first part of this study investigates the relation between autonomous expenditures and output, trying to check if autonomous expenditures cause output or if it is the other way around. The authors notice that the first years of the data series are very unstable and choose to consider only the period from 1960 to 2014. They also observe that the tests show better results when the consumption financed by credit is excluded from the autonomous expenditures. In this case, the latter has a positive effect on output, and there is no sign of reverse causality. However, the intensity of Z on Y is low, and the explanation suggested is that there might be some endogeneity on autonomous expenditures. To solve this problem it would be required some strategy to take into account the factors that explain the autonomous expenditures more appropriately.

Girardi and Pariboni (2016) also look for a relation between the propensity to invest and the growth of autonomous expenditures. It is important to notice that what the authors consider as induced investment comprehends the totality of firms' private investment, which also includes the expenditures in intellectual property products. As will be explained in more detail in the next section, this constitutes a difference from the classification of induced investment used to construct our series. As mentioned before, the first years of the data series present major volatility so the authors find better results when considering only the period from 1960 to 2014. In this case, autonomous expenditures seem to have a strong effect on the investment share and there is no evidence of reverse causality.

These two authors continue their empirical research in another paper (Girardi and Pariboni, 2018). In this case, they study a group of 20 OECD countries. The first part of their estimates uses quarterly data from 1960 to 2016 and search for the causality between the propensity to invest and the growth of autonomous expenditures. The interest rate and the profit share are included in the tests as control variables, in order to check if the causality going from g_z to h disappears when these series are taken into account. In this case, g_z continues to present a positive effect on h, although the effect of the control variables included is also statistically significant.

Girardi and Pariboni (2018) also try to deal with the endogeneity of the autonomous expenditures using instrumental variables approach. They use three instrument variables for autonomous demand: a) total imports from the US weighted by each country openness to trade with the US, b) weighted average of trade openness of the five most important destinations of each country exports and c) military spending. The basic idea is that the first two instruments influence the exports of each country, while the last one affects government expenditures, and that these instruments are not induced by each country output. Due to the availability of data, this exercise uses annual data from 1970 to 2015 and the US is excluded from the sample since the first instrument cannot be applied to them. The tests confirm the validity of the instruments and the results seem to show that the autonomous expenditures have a positive effect on the investment share.

Goes, Moraes and Gallo (2018) investigate the causality between autonomous expenditures and output for a group of ten European countries. The range of selected years varies for each country, starting as far as 1975 and ending in 2016. The authors find Granger causality from Z to Y in five of the ten countries. Instantaneous causality is confirmed for all countries, although this test does not specify the direction of causality between the two variables. They also calculate orthogonalized impulse-response functions between Y and Z. The results show that a positive shock in autonomous demand has a positive effect on output for all countries, although the size and the time lag of this response differ from one country to another. Since autonomous expenditures are not completely exogenous and present some degree of endogeneity, impulse-response function for the effect of a shock on Y on Z are expected to be positive. However, the results differ from one country to another, depending on the specificities of each nation.

Pérez-Montiel and Erbina (2020) research focuses on a group of 16 selected European countries, using quarterly data from 1995 to 2017. The first part of the paper focuses on the relation between autonomous expenditures and output. Results point to a causality going from Z to Y but also to reverse causality from Y to Z. However, impulse response function shows that the effect on Z of a shock on Y tends to dissipate through time, while a shock on Z has a lasting effect on Y. Next, the author investigates the relationship between investment and growth. This experiment is composed of two parts. The first estimative is between investment and output growth rates, and the tests suggest that output Granger-cause investment, but investment does not Granger-cause output, a result that supports the hypothesis that investment is an induced expenditure. The second stage of the experiment consists in estimating the relation between investment share and autonomous demand growth rate. In this case, Pérez-Montiel and Erbina finds a long-run causality from g_z to h, while results for reverse causality from h to g_z point to a positive short-run effect that tends to dissipate on the long run.

Braga (2018) estimates the relation between output and investment for the case of Brazil. The first empirical exercise consists in estimating the relation between GDP growth rate and the propensity to invest. Because of lack of availability of data that allow us to identify the type of investment by institutional sector, investment in equipment is used as a proxy for induced investment, using annual data from 1962 to 2015. Results indicate the existence of Granger causality from g to h, with structural breaks in 1973 (the year of the first oil crisis) and in 1995 (the first year of price stability), while causality going from h to g is not confirmed. The second part of the tests uses quarterly data from 1996 to 2017 and looks for a relation between the growth rate of final demand and of investment in equipment, with final demand being defined as the sum of all expenditures that to not create productive capacity for the private sector. Results also provide support to the Supermultiplier approach. The estimation of the parameters indicates the existence of a structural break in 2008 (the year of the global financial crisis), suggesting that from this year on, investment became more sensitive to changes in final demand.

Table 1: Summary of the empirical studies on the Supermultiplier model.

Paper	Countries	Period	Experiments	Results
Girardi and Pariboni (2016)	United States	1947-2014 (quarterly)	1. Relation between Z and Y. 2. Relation between h and g_Z.	1. Z has a low positive effect on Y 2. g_Z has a strong effect on h.
Girardi and Pariboni (2018)	20 selected OECD countries.	1960-2016 (quarterly) 1970-2015 (annual)	Relation between h and g_Z, using Instrumental Variable to avoid endogeneity in g_Z.	Tests point that the instrument is valid and that g_Z has a positive effect on h.
Goes, Moraes and Gallo (2018)	10 selected European countries.	1975-2016 (annual)	Relation between Z and Y.	Z Granger causes Y in five countries. A positive shock in Z has a positive effect on Y in all countries.
Pérez-Montiel and Erbina (2020)	16 selected European countries.	1995-2017 (quarterly)	1. Relation between Z and Y. 2. Relation between g and g_I 3. Relation between h and g_Z	1. Z has a persistent positive effect on Y. 2. g Granger causes g_I. 3. Long run causality from g_Z to h.
Braga (2018)	Brazil	1962-2015 (annual) 1996-2017 (quarterly)	1. Relation between h and g. 2. Relation between g_I and growth rate of final demand.	1. Granger-causality goes from g to h. 2. g_I is sensitive to the growth rate of final demand.

Source: Elaborated by the authors

Table 1 contains a summary of the main characteristics of each of the mentioned empirical works, with the group of countries studied, time period, type of empirical exercise, and its results.

2.4) Methodology used to construct the data series

The methodology used to construct our data series will be presented in this section. As mentioned in the previous section, the empirical research on the Supermultiplier focuses on two relations: a) between autonomous expenditures and output, and b) between the propensity to invest and the output growth rate. The present essay is concerned about the second relation and our study is restricted to the United States.

As we mentioned in the second section, autonomous expenditures are defined as the expenditures that are not financed by the contractual incomes generated by production decisions neither alter the productive capacity of the private sector of the economy. Another way to put it is by saying that autonomous expenditures introduce new purchase power in the economy, either through government spending, exports, new credit for consumer or from accumulated wealth by capitalists. However, this does not mean that autonomous expenditures are completely exogenous neither that its growth rate does not change through time. Depending on the institutional arrangement, government spending might be procyclical, presenting a high degree of endogeneity. Credit is also procyclical, although banks are capable of creating new money whenever they want to. Since we are studying the case of the largest world economy which is also the country that issues the currency accepted to settle international payments, it is reasonable to assume that US exports – which are the imports of goods and services produced in the US from the rest of the world – depends on the income of the rest of the world, which by its turn also depend in some degree on the economic performance of the United States. Summarizing, there is no reason to assume autonomous expenditures to be completely independent from output and it is expected to find some degree of endogeneity in the former one, so we consider that studying the causality between autonomous expenditures and output might not bring definite conclusions, which is the reason why we are not studying the relation between booth.[23]

[23] Girardi and Pariboni (2018) recognize that autonomous expenditures are partially endogenous and as we mentioned on section three, the authors try to address the issue using instrumental variable approach, isolating some elements that are in fact utterly independent from current output – in their case, the instrument consists on US imports, trade openness of the most essential destinations of each country exports and military spending.

We can rewrite the investment share, by replacing equation 2.12 on 2.11, as:

$$h_t = v\delta + (1 - x)vg_{t-1}^e + vxg_{t-1} \quad (2.15)$$

From equation 2.11 we get that $h_{t-1} = v(\delta + g_{t-1}^e)$. Reordering, we know that $vg_{t-1}^e = h_{t-1} - v\delta$. Replacing vg_{t-1}^e on equation 2.15 and reordering brings us to:

$$h_t = vx\delta + (1 - x)h_{t-1} + vxg_{t-1} \quad (2.16)$$

Our empirical study aims to test if the growth rate influences the propensity to invest and to estimate the parameters of our equation 2.16. This is also the same specification tested in Braga (2006).

As we mentioned in the previous section, most of the empirical studies on the Supermultiplier investigate the existence of a relation between the growth rate of autonomous expenditures and the propensity to invest. However, it is important to highlight that the theoretical model establishes a relation between the propensity to invest and the growth rate of **total** output. Although the model also establishes that output growth tends to be equal to autonomous demand growth, this is only true if all the other parameters that determine the value of the supermultiplier (propensity to consume, to invest, to import and tax rates) remains unaltered, a condition that is not satisfied for the period we are considering, since the value of the supermultiplier seems to have declined mainly due to an increase in the import coefficient. This means that considering the period as a whole, autonomous expenditures grew at a higher rate than output. Additionally, capitalists invest in order to meet the aggregate demand of the economy, not being concerned if this demand consists of autonomous expenditures, induced consumption or the induced investment itself.

With this in mind, we are constructing data series of h, g, g_{fd} (the growth rate of final demand) and g_z (the growth rate of autonomous expenditures). Final demand is defined as the amount of expenditure that do not create capacity for the private sector, which is equal to total demand minus the induced investment. Although we consider that the most important relationship is between g and h, we believe that we can get a broader view on the issue if we perform Granger causality tests between the propensity to invest and each one of the growth rates (g, g_{fd} and g_z) separately, trying to determine if growth rates help to predict the propensity to invest and if there is some reverse causality going from the latter to the former ones. Next, when estimating the parameters of equation 2.16, we take into account only total output growth, since this is the relevant one to explain capitalists' investment decisions.

To construct the series for h, g, g_{fd} and g_z, the first task is to determine which expenditures are considered induced investment, induced consumption, autonomous expenditures and final demand. The categories of investment, according to the US National Accounts, are organized as follow: first, investment is divided between private and public. The private investment consists of fixed investment and change in inventories. The private fixed investment is composed of residential and nonresidential expenditures. Finally, the nonresidential investment is divided between investment in structures, equipment and intellectual property products (IPP). According to the discussion made in section two, we classify as induced investment firms' expenditures on structures and equipment. From now on, the propensity to invest we are taking into account consists of the ratio between the sum of these expenditures to GDP. On the other hand, we consider as autonomous expenditures: a) government investment b) residential investment, which corresponds to household investment, and c) nonresidential investment in IPP, which correspond to firms' investment that do not create capacity[24].

We are ignoring the change in private inventories from our analysis, not classifying this component of demand in any type of expenditures. The reason for this decision is because: a) it is impossible to distinguish which part of the change in private inventories is planned by firms and which part is due to an error in predicted demand, and b) US National Accounts release only money values for this variable but not volume indexes.

According to our equation 2.8, autonomous expenditures are composed of: a) government consumption, b) government investment, c) exports, d) investment by households, e) firms' investment in intellectual property products, f) transfers made by the government and g) credit financed consumption by households. The first five components mentioned can be obtained directly from the National Accounts, while the other two require some special treatment. Since transfers made by the government only

[24] Intellectual property products include investments in R&D and software. Investment in R&D is an autonomous expenditure, but the investments in software should be taken as induced since it might be interpreted as a type of investment that does create capacity. However, this segment of investment presents a growth rate far above the average GDP growth and its share on output increases practically uninterruptedly from 0.6% in 1985 to 1.8% in 2017, which might represent some sort of structural change rather than an investment induced by demand. Additionally, its relative weight on the remaining segments of induced investment is low, so we opted to take it as autonomous and consider only investment in structures and equipment as induced.

increases private sector disposable income but does not constitute direct demand for goods and services, its impact must be weighted by the household propensity to consume[25]. Credit financed consumption by households cannot be directly measured from the National Accounts, and to incorporate it into the analysis, we use the methodology suggested by Serrano and Braga (2006) and Freitas and Dweck (2013), who take durable household consumption as a proxy for autonomous household consumption. It is worth pointing out that consumer credit presents a high degree of endogeneity, leading Girardi and Pariboni (2016) to conclude that their estimates show better results when excluding this component from autonomous expenditures and considering it as induced consumption. Taking this into account, we estimate two alternative series for autonomous expenditures: one that includes durable goods consumption (called series "a" or g_z^a) and another one that excludes it (called series "b" or g_z^b).

Household consumption is divided between a) durable goods, b) non-durable goods and c) services. Depending on the definition of autonomous expenditures, the definition of induced consumption is also modified. When we classify durable goods consumption as an autonomous expenditure, induced consumption consists on the sum of non-durable goods and services. Alternatively, if we assume that durable consumption is induced by income, induced consumption is equal to total household consumption.

Final demand is used here in the specific sense of Garegnani (1962 (2015)) of aggregate demand minus the capacity generating investment by firms. Here it would be is defined as the sum of total household consumption, government consumption, government investment, investment by households, firms' investment in IPP and exports.

We assume that normal capital-output ratio and depreciation rate are given and remain unaltered. However, since these data enter into equation 2.16 which we are trying to estimate, we also calculate it in order to evaluate our estimates. In this case, we consider only its average values observed during the period we are considering, assuming that: a) the depreciation rate remained unchanged during those years and b) that effective capital-output ratio during some long period of time can be taken as a good proxy for normal capital-output ratio and that it also remained unaltered. The data on capital stock and

[25] The effect of transfers on autonomous consumption is thus calculated by $c * Tr$, as presented in equation 2.8. Induced consumption (from households point of view) equals to cY^d. So c is given by:

$$c = \frac{Induced\ Consumption}{(1-t)Y + Tr}$$

Depending of the definition of autonomous expenditures, induced consumption might include only the sum of non-durable goods and services or the total household consumption. So depending on the specification of the model, c must be calculated accordingly.

depreciation of fixed capital is organized using the same classification of gross fixed investment, so we are considering only the stock of nonresidential private fixed assets in structures and equipment. The capital-output ratio (v) we are calculating here is equal to the sum of these assets divided by GDP, while the depreciation rate (δ) is equal to the amount of depreciation of structures and equipment of enterprises and nonprofit institutions divided by the total stock of these assets[26].

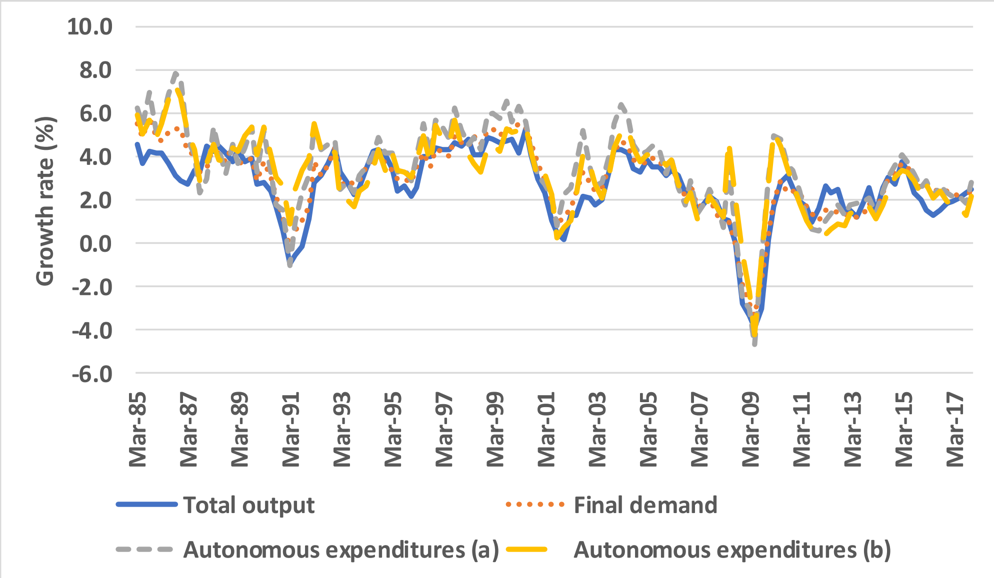
Information on quarterly data starts in 1947, but we selected the interval from 1985 to 2017. The year 1985 was chosen because from this time on growth rate presents a more stable path than during the previous period of the Golden Age (the 1950's and 1960's) and also the crisis that characterized its end (the 1970's and beginning of the 1980s). All the growth rates expressed were calculated between one quarter and the same quarter of the previous year.

2.5) Presentation of the data

We present here a brief description of the data series constructed before presenting the econometric tests. Figure 1 brings the time series of g, g_{fd}, g_z^a and g_z^b, while Figure 2 shows g and h, which are the main variables we are investigating. As we can see in the first Figure, all four series of growth presents a very similar behavior trough time. In the second image, we see that both the growth rate and the induced investment share present a declining trend during the period in the analysis. It is worth noticing that the inflections in g seem to precede the inflections in h by a few quarters, indicating that when the growth rate changes, capitalists start to adjust their expected growth rate and to change their propensity to invest accordingly.

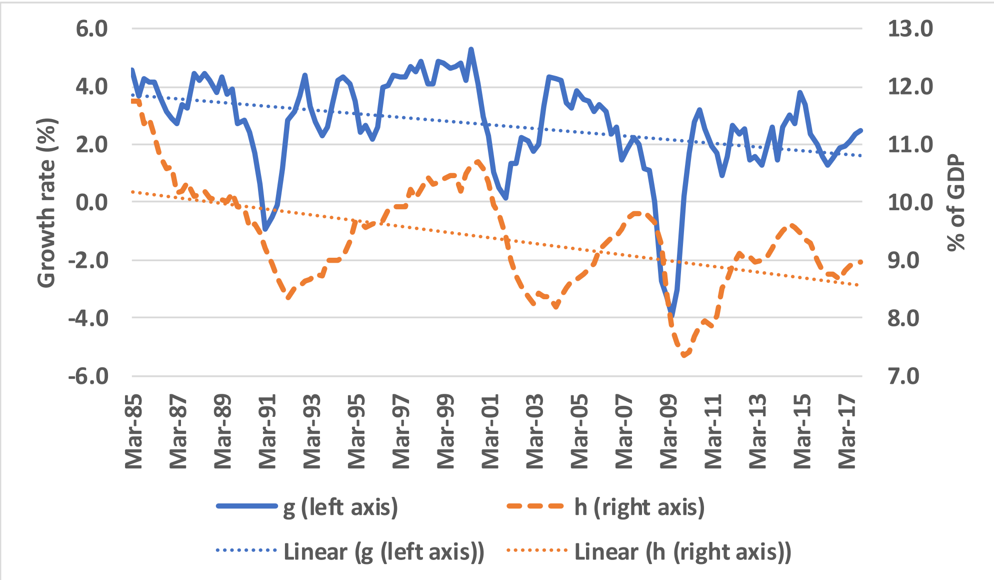
[26] The depreciation rate is calculated dividing the depreciation in t by the stock of capital existing at the end of the previous year $(t-1)$. It requires bringing the stock of capital of $t-1$ to the prices of t. Although BEA does not release price indexes for the stock of capital, it can be calculated from nominal values and quantity indexes, which are available.

Figure 1: g, g_{fd}, g_z^a and g_z^b



Source: BEA. Elaborated by the author.

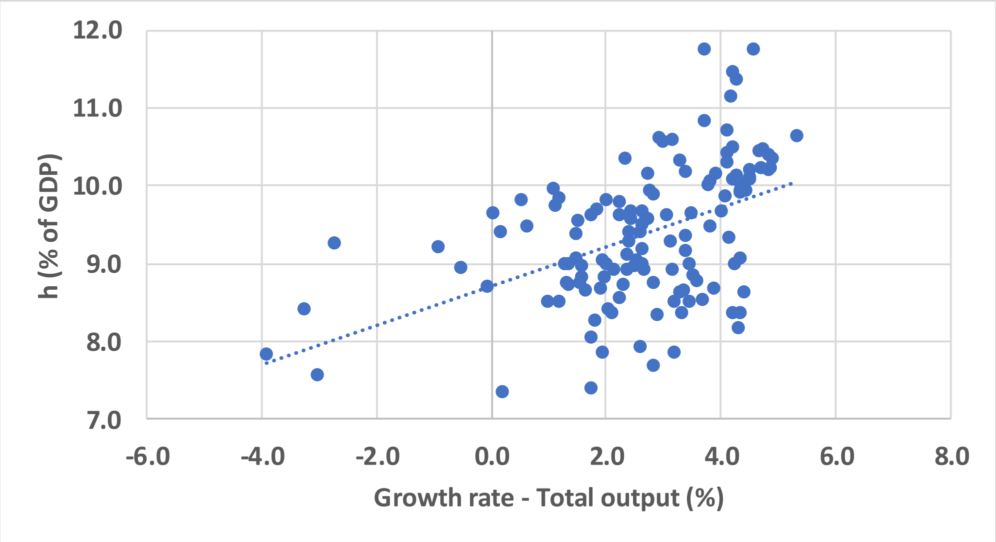
Figure 2: g and h



Source: BEA. Elaborated by the author.

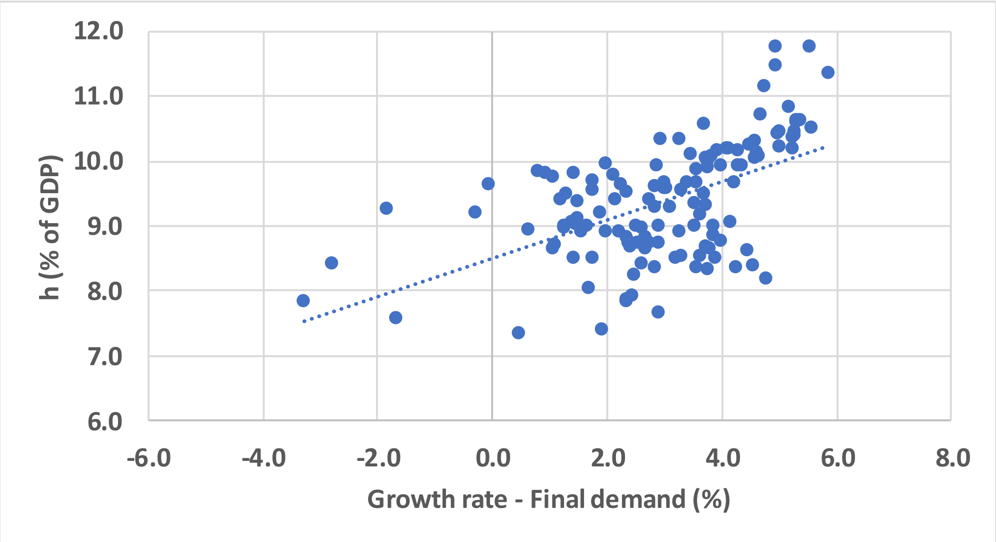
Next, we plot each one of the growth rate series vs the propensity to invest to see the empirical relation between them (Figures 3 to 6). Although correlation does not imply causality, in all pictures, there is a clear positive relationship between growth rate and the induced investment share, a stylized fact expected according to the Supermultiplier approach.

Figure 3: g vs h



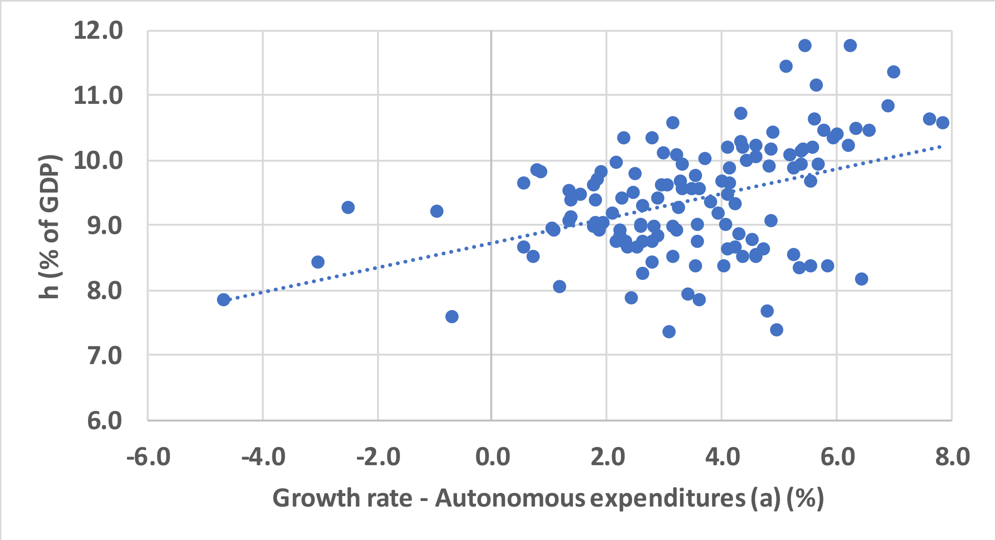
Source: BEA. Elaborated by the author.

Figure 4: g_{fd} vs h



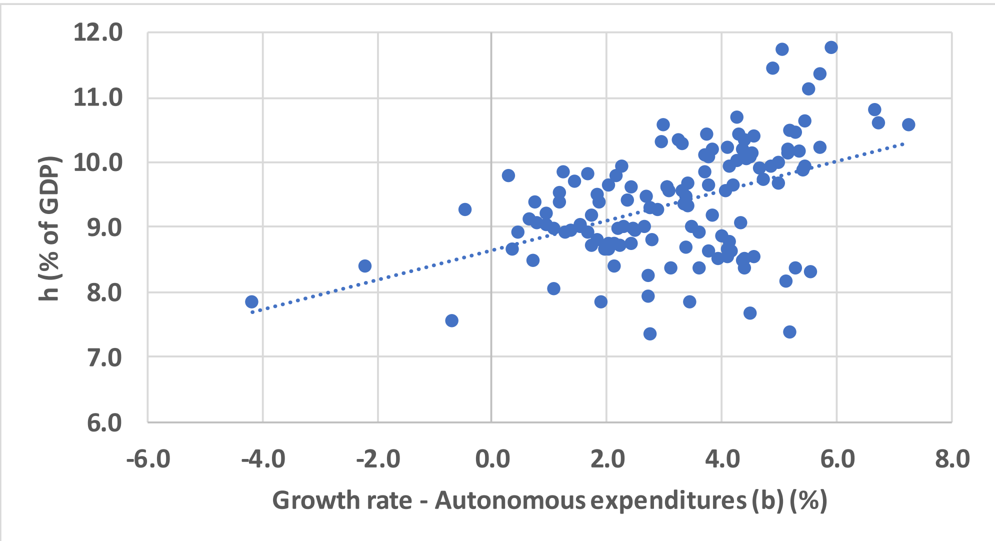
Source: BEA. Elaborated by the author.

Figure 5: g_z^a vs h



Source: BEA. Elaborated by the author.

Figure 6: g_z^b vs h



Source: BEA. Elaborated by the author.

2.6) Causality between growth and propensity to invest and estimation of the propensity to invest function

In this section, we check for the causality (in the econometric sense) between the growth rate and propensity to invest, and the estimation of the parameters of the propensity to invest function presented in equation 2.16. We present the results in the context of the discussion of the dynamic stability condition of the model.

We begin by performing unit root tests on the series of h, g, g_{fd}, g_z^a and g_z^b. Taking the 5% level as our criterion, it is not possible to reject the null hypothesis (of the existence of unit root) for neither of the five series so that we can consider all of them as non-stationary. Although we do not expect to see growth rates or investment share that increase or decline persistently, we saw on Figure 2 that during the period we are considering growth rates and the propensity to invest presented a declining trend, so this non-stationarity seems consistent for the sample window. Since the series present unit root, we perform cointegration tests before proceeding to the estimation of the VAR equations. Cointegration tests between each one of the growth rates and h reject the null hypothesis of no cointegration at least at the 5% level, as can be seen in Table 2.

Table 2: Cointegration tests

Cointegration	Are the series cointegrated?	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob
Between h and g	yes	0.1311	23.38	20.26	0.018
Between h and g(fd)	yes	0.1263	23.78	20.26	0.016
Between h and g(z)(a)	yes	0.1373	26.57	20.26	0.006
Between h and g(z)(b)	yes	0.1432	27.26	20.26	0.005

Source: Elaborated by the author.

Our next step is to estimate a VAR between g and h, g_{fd} and h, g_z^a and h and g_z^b and h. In order to do so, we choose the number of lags using the lag order selection criteria[27]. In most of the cases, the number of lags selected is 5, and in only one case, we chose 7 as the optimal number of lags. After estimating all VAR equations, we test for causality between the variables. Since all the series considered are non-stationary, Granger causality test does not apply, and we have to use Toda Yamamoto procedure to test for causality. The results of the test are reported in Table 3.[28]

Table 3: Toda Yamamoto tests

Variables	Number of lags (VAR)	Dependent variable: h		Dependent variable: g, d(fd), g(z)(a) or g(z)(b)	
		Is there causality?	Prob	Is there causality?	Prob
h and g	5	yes	0.000	yes	0.042
h and g(fd)	7	yes	0.000	no	0.310
h and g(z)(a)	5	yes	0.000	no	0.531
h and g(z)(b)	5	yes	0.001	no	0.667

Source: Elaborated by the author.

[27] To choose the number of lags, we take into account the LR, FPE, AIC, HD and SC criteria.

[28] There is autocorrelation in the VAR estimated between h and g_z^a. However, we re-estimated it using 7 lags, and in this case there is no autocorrelation present and Toda Yamamoto results remain basically the same. In the case of the VAR between h and g and between h and g_z^b, there is a weak autocorrelation that did not disappear when using a different number of lags.

As can be seen above, causality going from the growth rates to the propensity to invest is confirmed at the 1% level in all tests, providing empirical support to the Supermultiplier model. On the other hand, the existence of reverse causality must be interpreted with caution and deserves some commentaries. When we check for causality between the propensity to invest and total output growth, it is not possible to rule out the existence of reverse causality going from the induced investment share to the growth rate, although in this case causality is only present at the 5% level and it is not so undoubted as the one going from g to h. A possible explanation for this is the fact that the induced investment (which is the numerator of the ratio we are trying to explain - h) is included on total demand, so the variable we are taking as "exogenous"– the growth rate of output – in order to explain the induced investment ratio is in fact not completely exogenous.

Following the procedure used by Braga (2018), an alternative method to deal with this issue is to exclude the induced investment from the total output and consider only final demand (in the sense of Garegnani, 2015). In this case, the reverse causality going from the propensity to invest to the growth of final demand is completely ruled out, meaning that the former does not Granger-causes the latter. In this test, the p-value (chance of error when rejecting the null hypothesis of no causality) is 31%.

However, final demand includes the induced consumption, which is also an endogenous component of demand, so final demand is still not entirely exogenous. Our next step is to exclude the induced consumption from final demand, getting to non-capacity creating autonomous expenditures. First, we are discussing the scenario in which durable goods consumption is included in autonomous expenditures. In this case, causality going from h to g_z^a is also completely ruled out, and the p-value of the test is higher than in the previous one (53%), meaning that when excluding an endogenous part of demand, the existence of such causality becomes even more unlikely. At last, we exclude the consumption of durable goods from autonomous expenditures, since this is probably the component of autonomous demand that presents the highest degree of endogeneity, moving thus to our second specification of autonomous demand (g_z^b). As discussed in the fourth section, it does not mean that this variable is one hundred per cent independent of current output, but it represents the most exogenous portion of demand as possible. As expected, Toda Yamamoto test indicates that h does not Granger causes g_z^b, and the p-value is even higher than before (67%). We can conclude from these tests that to the extent that we exclude endogenous elements of demand, demand growth rates become more independent from the propensity to invest, ruling out the possibility of reverse causality.

Once we have discussed the causality relations between growth and the propensity to invest, we proceed to the task of estimating the parameters of this function. As discussed in section four, the relevant variable to determine firms' investment is total demand, so we are leaving aside final demand and autonomous expenditures for now and considering only output growth. Our estimates are based on equation 2.16, and we begin estimating h using the generalized method of moments (GMM). The theoretical model states that the relevant variable to be considered is g_{t-1} (with a lag), and even though we estimated the parameters using g_t (without lags), g_{t-1} is taken into account in the instrument specification (we use six lags both for g and h). The results are reported in equation 2.17 below. The numbers in the parenthesis in the line below the equation represent the p-value of the parameters, expressing the chance of error in rejecting the null hypothesis that the values are different from zero.

$$h_t = 0.629 + 0.909 h_{t-1} + 0.075 g_{t-1} \qquad (2.17)$$

(0.000) (0.000) (0.000)

All the parameters are statistically different from zero at the 1% level. The propensity to invest present a high degree of inertia from one period to another, while the effect of the growth rate is low. As pointed out in equation 2.17, $vx = 0.075$. Assuming that $v = 1.07$ (which is the average capital-output ratio for the period 1985-2017), we calculate that $x = 0.070$. Using an average depreciation rate of $\delta = 6.7\%$ a year, the constant term calculated based on average values of v, δ and the estimated value of x would be $vx\delta = 1.07 * 0.070 * 6.7 = 0.500$, which is close to the estimated value of the constant term (0.629).

As discussed in the second section, for the adjustment of capacity to take place, the propensity to invest must be sensitive to the growth rate – i.e., x must be positive. At the same time, for the Supermultiplier model to be dynamically stable, it is required that the parameter x to be sufficiently low (see equation 2.14), meaning that when the economy is outside fully adjusted position the speed of adjustment cannot be too high, under the risk that the propensity to spend to be higher than one. The combination of a high degree of inertia and a low value of x obtained in our estimates suggest that there is some tendency for the capacity to adjust to demand and that the speed of this adjustment is slow, providing empirical support to the Supermultiplier approach.[29]

Still, according to the theoretical model, it would be expected that the sum of x and $(1 - x)$ to be equal to one. In order to investigate if the estimated equation is compatible with the theoretical model, we performed a test of restriction of the parameters to check if this condition is fulfilled. Since the parameters we estimated are $(1 - x)$ and vx, and assuming that $v = 1.07$, we tested for the following restriction:

$$0.909 + \frac{0.075}{1.07} = 1 \tag{2.18}$$

The left side of the above equation is equal to 0.979, slightly below unity. However, since there is some confidence interval in the estimated values, the results show that this sum is not statistically different from one. The null hypothesis of the test is that the condition above holds, and the results show that the null hypothesis cannot be rejected even at the 10% level. The results of the Wald test are reported in Table 4 below:

Table 4: Wald test results for parameter restrictions – parameters obtained from estimates using GMM method.

Test Statistic	Value	df	Probability
t-statistic	-1.428	123	0.156
F-statistic	2.038	(1, 123)	0.156
Chi-square	2.038	1	0.153

Source: Elaborated by the author.

In order to validate our calculations, we also estimated the propensity to invest function equation through the cointegration vector, including a term to capture deterministic trend, since we concluded that both g and h have a declining trend from 1985 to 2017. Results are reported in equation 2.19:

$$h_t = 0.603 + 0.909 h_{t-1} + 0.072 g_{t-1} \tag{2.19}$$

(0.002) (0.000) (0.000)

We can see that the parameters estimated are very similar to the ones obtained using the GMM method and that all values are different from zero at the 1% level. Taking $v = 1.07$, we obtain $x = 0.067$. The sum of the inertia coefficient $(1 - x)$ plus x equals

[29] Notice that Fazzari, Ferri and Variato (2019, appendix) found persistent expectations of growth rates (calculated from a survey of professional forecasters), meaning that the adjustment of expectations of growth rates on lagged growth rates is very small, about 0.10 as a benchmark, which presents some similarity with our result of $x = 0.070$.

to 0.977 in this case. Although this sum is slightly below one (just like in the previous estimates) the Wald test for parameter restrictions indicates that this sum is not statistically different from one, suggesting again that our estimates are compatible with the model. The results of the test are reported in Table 5.

Table 5: Wald test results for parameter restrictions – parameters obtained from estimates using cointegration vector.

Test Statistic	Value	df	Probability
t-statistic	-1.264	126	0.209
F-statistic	1.597	(1, 126)	0.209
Chi-square	1.597	1	0.206

Source: Elaborated by the author.

At last, after estimating all the parameters, we are able to discuss under which circumstances the US economy presents dynamic stability. Based on expression 2.14, which presents the stability condition for the model, we can calculate the maximum possible rate of growth that falls within the stability range:

$$g^{max} = \frac{1 - (1 - m)[c(1 - t) + v\delta + vx]}{(1 - m)v(1 + x)} \qquad (2.20)$$

Basing on our decomposition of the supermultiplier model for the US economy, we calculated the values for m, c, t, v and δ. The remaining variable is x, which we estimated on our econometric exercises, so we know all the parameters required to calculate the maximum rate of growth.[30]

Our objective here is to discuss the role of three variables that affect the determination of this ceiling for demand-led growth. The first one is taxes. The supermultiplier model establishes a positive relationship between growth rate and the induced investment share. In a hypothetical situation where the propensity to spend is equal to one, for the economy to grow at higher rates without triggering instability, it would be required that the share of induced consumption to decrease. For a given propensity to consume, a higher tax rate implies a lower share of induced consumption on total output, increasing the "space left" for investment, which means the economy can grow at a faster pace. The second variable we are highlighting is imports: on an open economy, some fraction of demand leaks through imports, so it also contributes to

[30] In order to provide more conservative estimates for g^{max}, our calculations are made using the data from the second decomposition of the supermultiplier – called series "b", – that takes the total household consumption as induced by disposable income and consequently imply in a higher propensity to consume.

reducing the induced demand for the goods and services produced domestically – independently if this demand consists on induced consumption or induced investment – contributing to increase the maximum rate of growth that does not trigger instability.

At last, it is also important to take into account the space required for the adjustment to occur when the economy is outside its normal capacity utilization level. If the speed of adjustment – represented by x – is fast, deviations of utilization from its normal level will lead to a strong reaction of capitalists' investment, resulting in a higher propensity to spend. So a faster speed of adjustment decreases the ceiling for growth.

In order to illustrate the effect of taxes and imports, we calculated the maximum rate of growth in three different ways: a) considering the hypothetical case of a closed economy without government, b) including taxes but excluding imports – also a hypothetical situation, – and c) including both taxes and imports, which renders us the actual ceiling for stable growth. To evidence the contribution of the space required for adjustment, we also calculate the maximum growth rate excluding this variable – i.e., considering that $x = 0$. These values are presented in Table 6.[31]

[31] The hypothetical maximum rate of growth ignoring taxes and imports was calculated using the following expression: $g^{max} = \frac{1-[c+v\delta+vx]}{v(1+x)}$. The maximum rate of growth considering taxes but excluding imports is given by: $g^{max} = \frac{1-[c(1-t)+v\delta+vx]}{v(1+x)}$. Finally, the ceiling for growth, ignoring the space required for the adjustment to occur is obtained by the following expression: $g^{max} = \frac{1-(1-m)[c(1-t)+v\delta]}{(1-m)v}$.

Table 6: Parameters to calculate the maximum rate of growth

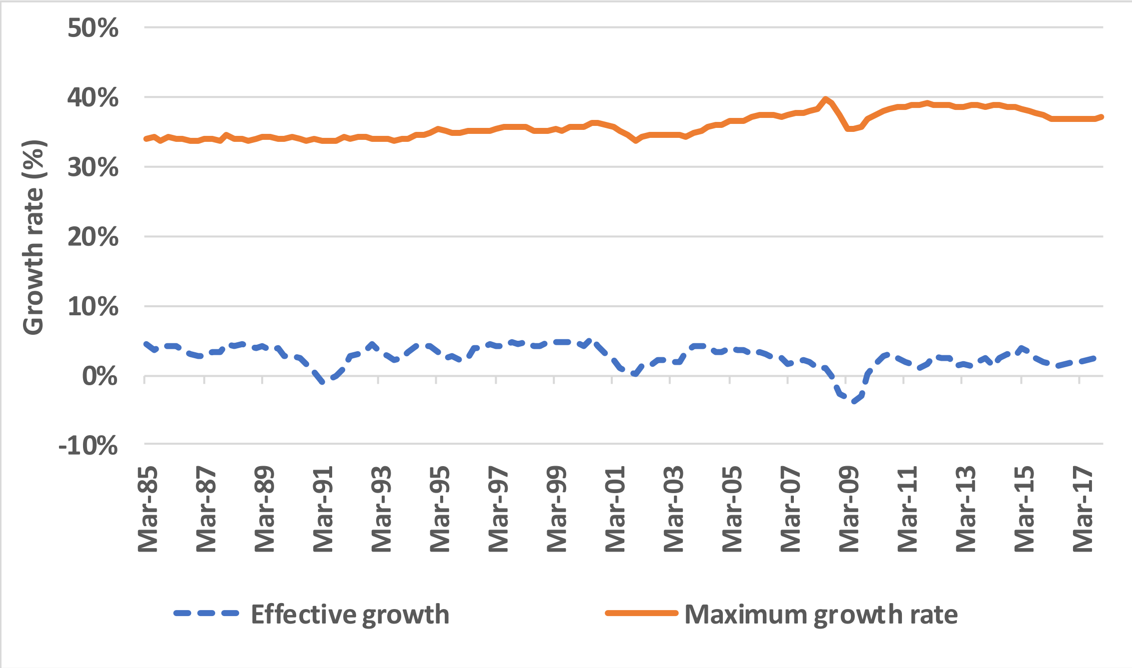
Parameters	Values (for 2017)
c	0.701
t	0.171
m	0.131
v	1.068
δ	6.7%
x	0.070
Evidencing the effect of taxes and imports	
Maximum growth (Excluding taxes and imports)	13.4%
Maximum growth (Including taxes and excluding imports)	23.9%
Maximum growth (Including taxes and imports)	37.0%
Evidencing the space required for the adjusment to occur	
Maximum growth (Ignoring the space required for the adjustment to occur)	46.6%
Maximum growth (Including the space required for the adjustment to occur)	37.0%

Source: BEA. Elaborated by the author.

Figure 7 presents the series of effective growth and the maximum demand-led rate of growth that falls within the stability range. As can be seen, the maximum growth rate is currently around 37% and actual growth is always far below the upper limit, which suggests that a) the demand-led growth framework proposed by the Supermultiplier model is indeed very stable for a very large range of growth rates and b) during the period we are considering the US economy has never approached the stability limit. The upper limit has also increased since the early 2000's mainly due to the raise of penetration of imports.

Note that these limits are somewhat overestimated, to the extent that some of the components of autonomous demand that here are treated as totally exogenous might actually be partially endogenous. If some of those autonomous expenditures are found to be in part a function of output these upper limits would be reduced accordingly, but given the very high limit rates of growth estimated we think that including these effects would not change our basic conclusion that the maximum rate of demand led growth is indeed very high.

Figure 7: Maximum rates of growth – the role of taxes and imports



Source: BEA. Elaborated by the author.

2.7) Conclusion

In this chapter, we tried to contribute to the debate about the Sraffian Supermultiplier demand led model by examining the specific case of the US Economy. Our results provide empirical support to the model, showing that (1) autonomous demand growth Granger-causes the propensity to invest (2) investment share presents a high degree of inertia from on period to another, while the effect of lagged growth is small but statistically significant, and (3) these results taken together suggest that there is a tendency for utilization to converge towards its normal level and that the speed of this adjustment is slow. Moreover, we combined the estimated value of the parameters with other US data to calculate the maximum rate of growth that fulfills the dynamic stability condition of the model. We find that (1) the range of growth rates compatible with dynamic stability is indeed extensive, allowing for very high growth rates of demand and (2) that the US economy has never approached the dynamic stability upper limit during the period we are considering.

Finally, it is important to make some comments about this limit for growth that we discussed. This ceiling represents simply the maximum rate of growth compatible with demand-led growth for a given distribution and taking into account the mechanism of adjustment of capacity to demand. However, there might be other kinds of constraints for demand-led growth that might arise before the economy reaches this limit. The first one relates to the balance of payments constraint. Although the US might not be subjected to this kind of constraint by issuing the world’s currency, for other countries higher growth rates will probably entail a higher growth rate of imports, and a country might run short of foreign currency to pay for its imports and its external debt services. Second, faster economic growth induces a higher rate of growth of employment and reduces the unemployment rate, which can increase the bargaining power of the working class and lead to conflict inflation. This can be incompatible with policy rules or targets and lead to policy response from the monetary authority and the government; or in case of a strengthened distributive conflict can also lead to a stronger reaction from the ruling class by pressuring for change in the macroeconomic policy stance towards austerity in order to reduce growth and to get rid of wage inflation. This is why many recent papers dealing with the Sraffian Supermultiplier are focusing on these more important external and policy constraints to demand-led growth.

Chapter 3 – The decline in the actual degree of capacity utilisation in the US Economy, as seen through the Sraffian Supermultiplier

3.1) Introduction

The well-known result of the Neo-Kaleckian growth model of a positive relation between the long run rate of growth of output and the equilibrium degree of capacity utilization – thus implying the possibility of permanent large deviations between the actual and the given normal or "planned" degrees of capacity utilization, even in a steady-state – has long been subject to criticism (see for example Commiteri, 1986, Skott, 2012, Serrano and Freitas, 2017). Recently, some authors following the Neo-Kaleckian perspective such as Nikiforos (2016,2018,2020c) and Setterfield (2019,2020) have argued for the importance and relevance of this positive long run relation between the rate of growth of output and the equilibrium degree of capacity utilization. They respond to the objections to the large and permanent deviations between the actual and normal degrees of capacity utilization by proposing that it is the normal degree of utilization that endogenously adjust to the actual degree of utilization in the long run[32]. From this particular Neo-Kaleckian perspective, in actual economies, a reduction of the trend growth rate of demand and output would lead to lower average actual degrees capacity utilization, and this would lead also to a tendency towards lower levels of the normal degree utilization.

By contrast, the Sraffian Supermultiplier demand-led growth model (Serrano, 1995, Freitas and Serrano, 2015) implies no necessary theoretical relationship between the growth rate and the normal of planned degree of capacity utilization since the model's mechanism of adjustment of capacity to demand generates a tendency for the actual degree of utilization to converge towards its exogenously given normal or desired value in fully adjusted positions. From the Supermultiplier perspective, the normal degree of utilization is exogenous, in the sense that it has no systematic relation to the level or growth rates of demand, and normal utilization is seen to depend on the technology and on the expected norms of the ratio between average of peaks in demand, that is, on the patterns of fluctuations of demand, instead of their levels or rates of growth of demand (following Ciccone, 1986, 1987, 2012). In the Sraffian Supermultiplier model, investment makes capacity gradually adjust to the trend of expected demand, following a flexible

[32] For recent criticisms on the idea of endogenous normal rate of capacity utilization, see Girardi and Pariboni (2019), Huang (2020) and the first chapter of this thesis.

accelerator mechanism. Since some time ago Sraffians have argued that, due to the well-known dual character of investment, which implies that increases (decreases) in investment operates by first generating more (less) demand and only in subsequent periods adding more (less) to productive capacity, the process of adjusting capacity to demand, although ever present in capitalist economies, is bound to be rather slow. Thus, the gravitation towards fully adjusted positions, after a shock, may take a long time (and may well be interrupted by further shocks before completion) such that divergencies between the average and actual degrees of capacity utilization should not be seen as restricted to the short run (Ciccone, 1986, Garegnani, 1992, Freitas and Serrano, 2015). Therefore, large changes in the trend of growth rates in one direction can significantly affect the average degree of capacity utilization, even if the exogenous normal degree of utilization remains fixed during the adjustment process.

The purpose of this chapter is to contribute to the theoretical debate on the relation between growth and capacity utilization from the perspective of the Sraffian Supermultplier, using the case of the performance of the US economy in the last few decades as reference to check the relative plausibility of both the Neo-Kaleckian explanation of the occurrence of an endogenous changes in the normal degree of utilization and the alternative Sraffian supermultiplier explanation of large changes in the growth of demand provoking long-lasting deviations of the average actual degrees of capacity utilization form their normal degrees, quite independently of any changes in the latter. We choose the U.S. case as a benchmark for three reasons. First, because a decline in the average degree of capacity utilization has been observed since the early 2000s in such economy while for other advanced economies the oscillation of the actual degree of capacity utilization seems to have been stationary and thus independent from the observed changes in the rate of growth (Gahn and González, 2019). Second, because a large part of the researchers who believe that this decline in actual utilization was accompanied by an endogenous decrease in the normal degree of utilization also naturally use the US case as a benchmark (Setterfield, 2019, 2020, Setterfield and Avritzer, 2020, Botte, 2020, Bassi et all, 2020). Third, because the version of the Sraffian Supermultiplier proposed by Serrano, Freitas and Bhering (2019) precisely to examine the process of adjustment of capacity to demand was estimated in the second chapter of these thesis and concluded that the speed of this adjustment is indeed slow (similar results were obtained by Fazzari et all (2020)).

Given this, here we will try to show that (i) we find no evidence that the recent decline in the average actual degree of utilization can be explained by a general reduction in the normal degrees of capacity utilization in the various sectors of the American economy and that (ii) this behavior of actual capacity utilization is compatible with the slow adjustment of capacity to demand of the Sraffian Supermultiplier model in a context of successive decreases in the trend of output growth rates in the US economy since the begin of the 2000s

The rest of the chapter is organized as follows. In section 2 we discuss the concept of normal utilization proposed by Ciccone, partially based on Steindl. In section 3, we critically discuss the recent empirical estimations of normal utilization based on averages of actual degrees of utilization. In the fourth section we look at industrial data from the US to check if it is plausible that normal utilization (in Ciccone´s sense) has undergone a definite general change. In the fifth section we simulate the behavior of the actual rate of capacity utilization using our simple Sraffian Supermultiplier model to have a sense of the order of magnitude of the deviations between actual and normal utilization, given large shocks to demand. Final remarks are made in section six.

3.2) Determinants of normal utilization

In this section we will discuss the determinants of the normal degree of capacity utilization. We will follow the concepts presented by Ciccone (1986, 1987, 2012), partially based on Steindl (1952).[33]

It is useful to make a distinction between two types of oscillations in effective demand, i.e., profitable demand that pays at least the normal (or supply) prices: (i) seasonal and predictable fluctuations, and (ii) unexpected fluctuations. Examples of seasonal fluctuations with annual frequency are the increase in retail trade sales before Christmas, the increases in demand for natural gas for heating purpose during the months of the winter, for ice cream during the summer, and for sugar and confectionery products in the last quarter of the year – which comprehend the holidays of Halloween, Thanksgiving and Christmas. Seasonal fluctuations in demand might also be perceived during a month, a week or even during one single day. It can take place (i) during a month

[33] We will thus use the concept of normal utilization different than that of Kurz (1986). For a more detailed discussion on these differences, see Ciccone (1987) and the first essay of this thesis. In fact, Kurz (1986) and the authors which follow his conception of normal utilization – such as Nikiforos (2013,2016) and Huang (2020) seem to focus mostly on the problem of the choice of technique not giving sufficient emphasis to what we consider the central issue of the expected pattern of demand fluctuations, as Ciccone does.

if, for example, workers consume more of a product immediately after they receive their monthly wages, (ii) during a week, as in the case of movie theaters, when demand is higher during the weekend, or (iii) even within a day, as is the case of restaurants, where demand is higher at lunch and dinner hours and lower during the afternoon.

In some cases, these fluctuations in demand are accommodated by changes in inventories, especially in the case of very short run fluctuations, but in other situations they are met by changes in production and thus usually, by changes in the degree of capacity utilization because (i) it might be too costly to keep large inventories, (ii) in some cases it is not possible to keep inventories, as in the case of services or perishable products.

Independently if fluctuations in demand are met by changes in production of in inventories, each individual capitalist wishes to be able to meet these peaks in effective demand because on the contrary they are under the risk of losing market share to their competitors, so the size of productive capacity is installed to be able to meet peak levels in demand expected during the economic life of the equipment. On the other hand, capitalists do not want to keep idle capacity beyond the maximum expected levels of demand because investing in fixed capital is costly. The normal degree of capacity utilization, by its turn, will depend mainly on the ratio between the average demand and those peaks in demand expected over the life of the installed equipment (Ciccone, 1986, p. 26-28).

It is important to notice that there is no reason to expect that an economic crisis or a particular boom will change the way these seasonal fluctuations take place, since it depends on factors that are not explained by aggregate demand, such as holidays, cultural habits, the timing of payment of wages, weather conditions, etc.

Leaving these regular fluctuations aside, an economy is subjected to unpredicted changes in demand and as it was said above, capitalists want to be able to meet these maximum levels of demand because they do not want to lose market share to their competitors. However, it takes some time for firms to adjust their productive capacity, so they also tend to keep some extra margin of planned spare capacity – beyond what would be required to supply the predictable maximum levels – to be able to meet unpredictable increases in demand. Steindl (1952, p. 9) illustrates this point by comparing the reasons to keep cash with the reasons to keep idle capacity. People keep cash in their portfolios as an insurance to face unpredicted events. Under the same logic, capitalists keep idle capacity so that they can face unpredicted increases in demand. Once again, it is hard to see why an overall increase or decrease in the levels or rate of growth of demand would make firms revise their planned margins of spare capacity for **unexpected** increases in demand, a point that was also raised by Skott (2012).[34]

The reason why normal utilization is usually considered **exogenous** in relation to demand is because it depends on a set of factors that are not explained nor directly correlated to the levels of demand, such as the breath and frequency of demand fluctuations and the margins of extra spare capacity kept by firms. Attempts to stablish a systematic connection between macroeconomic conditions such as the level or rate of growth of aggregate demand and the sizes of seasonal oscillations of demand and of extra planned spare capacity would have to be made considering the particularities of each industry and product and could hardly be extended for the entire economy.

There are other factors that may explain why these margins of spare capacity could be higher in one industry than in another – and consequently affecting the ratio between predicted average demand and installed capacity. Due to technological factors, it is possible that a firm adopts a method of production that presents lower unit costs, but which is only feasible for large scale production, for example. In this case it could be more profitable to adopt this method even if this results in a higher spare capacity. Additionally, in some cases unit costs might increase when production is above some specific level, so that maximum capacity might be dimensioned considering that the peaks in demand can be met without being required to reach this higher utilization levels. This could be the case if it is necessary to pay a higher wage for extra hours or for work shifts that fall outside normal hours. (Ciccone, 1986, p. 31-32)

The indivisibility of fixed capital also plays an important role. This characteristic implies that most of individual firms can only increase its capacity in a discontinuous way, while the demand for its production usually increases in a gradual pace, depending on the growth of total demand in each specific branch, since it is more difficult for an individual firm to expand its sales at the expense of its competitors. (Steindl, 1952, p. 10). Firms do take this into account and already expect to operate under low utilization immediately after an increase in capacity takes place, and full capacity output production might be higher than the peaks in demand expected for the near future. This means that normal utilization is the one that capitalists expect to observe, on the average, during the

[34] "There [is not] any reason why a negative demand shock and a decline in sales should make the firm think that the optimal degree of excess capacity has changed permanently." (Skott, 2012, p. 123)

whole economic life of the equipment, and not in every single period. (Ciccone, 1986, p. 31)

The process of adjustment of capacity to demand will probably not be perfectly symmetrical when utilization is above or below its normal level. If utilization is too high, firms can increase their gross investment, but since fixed capital is durable and often indivisible, firms can only reduce their installed capacity slowly relying on gross investment being lower than replacement for depreciation (Ciccone, 1986, p. 30). This means the adjustment of capacity to demand might be slower if the economy is initially below its normal utilization.

Since firms also do not know exactly the size of future fluctuations in demand, they consider the capacity utilization observed in the past, since it reflects the breath and frequency of demand in the past. However, what matters in this case is **the pattern of fluctuations** in demand observed during several economic cycles, so that normal utilization, tends not to be directly affected by the average of the actual degree of capacity nor even by the more recently observed values of the ratio between average and peak demands (Ciccone, 1986, p. 36, Ciccone, 1987, p. 98).

Once we have presented the main determinants of normal utilization, it is possible to conclude that normal utilization tends to be different for each sector, depending on the size of the oscillations in demand in each industry and on several technological aspects that are singular to each one of them. This also means that if normal utilization changes for one or a few activities, there is no reason to expect a priori that these changes can be generalized to all industries, nor it is likely that they should change in the same direction as the levels or rates of growth of demand.

3.3) Measuring normal capacity utilization through the actual utilization

The normal degree of capacity utilization is, however, something that poses an obstacle for empirical studies. A widespread method is to use actual utilization data to calculate normal utilization as some sort of average of it. Some studies use statistical filters that consider both past and future values of utilization to determine normal utilization in each specific period, while others argue that normal utilization should depends only on past data.[35] Either way, these authors consider that actual data can

[35] Botte (2020) criticizes the use of HP filters to estimate normal utilization because "the Hodrick–Prescott filter incorporates past values as well as future values of the utilization rate" (p. 2) and it "implies that firms have remarkable forecasting abilities and reduce their normal level of productive capacity utilization even

somehow provide a good estimate for normal utilization, as can be seen in Lavoie, Rodriguez, and Seccareccia (2004, p. 139), Skott (2012, p. 132), Nikiforos (2016, p. 445), Setterfield (2019a, p. 455), Setterfield (2019b, p. 4), Setterfield and Avritzer (2020, p. 10) and Botte (2020, p. 3).

The use of statistical filters to estimate normal utilization from actual utilization leads to the conclusion that normal utilization has declined in the US since the beginning of the 2000s, which is the period of our main concern. This result is achieved both if normal utilization is calculated either through some Hodrick-Prescott filter that isolates the cyclical component from the trend – as can be found in Setterfield (2019a, p. 456) and Setterfield and Avritzer (2020, p. 13-14) – or it is calculated as a moving average from past utilization, as in Botte (2020, p. 6).[36]

These methods of estimating normal utilization using data about the realized degree of utilization rate assume implicitly that some sort of moving average of actual utilization is a good proxy for normal utilization. However, if the process of adjustment of capacity to the trend of demand is slow, effective utilization can deviate from its normal level during long periods of time, and any such average will not be able to distinguish such longer lasting deviations from changes in the normal degree of utilization. So, this kind of proxy for the normal degree of capacity utilization by construction might be influenced by longer lasting changes in the actual degree of capacity utilization, which is in contradiction with the view adopted here, according to which persistent changes in the levels and growth of demand, through their effects on investment, will tend to affect the size of productive capacity instead of the desired normal degree of utilization.

Other authors use unit root tests to check if the series of actual utilization are stationary and investigate if there is a tendency for utilization to revert towards its mean (Braga (2006), Gahn and González (2019, 2020) and Nikiforos (2020a)). Normal utilization would be equal to the long period mean actual utilization obtained throughout the sample, which the actual data on utilization would converge.

before they face a decrease in their actual utilization rate" (p. 3). According to the author, firms revise their desired utilization ratio based only on the values observed in the past – contrary to the HP method which uses both past and future values – and he proposes that "the procedural measure of u_n is a weighted average of past values of u with exponentially decaying weight." (p. 3), a method that "is consistent with a radically uncertain economic environment and with procedural rationality à la Simon (1976)" (p. 5).

[36] Fiebiger (2020) is also critical of the idea of using HP filters to estimate the normal rate of utilization but "proceed to empirical findings based on the assumption that the normal utilisation rate can be approximated by long-run time averages" p.396).

Implicit in this kind of analysis is (i) the idea that not only normal utilization is exogenous, but also that it does not change over the sample; (ii) the economy faces symmetrical demand shocks of zero mean during deviations from the fixed normal rate, so that the economy on the average is operating under normal utilization. But if the process of adjustment of capacity to demand is slow and even if normal utilization does not change, successive non symmetric demand shocks in one direction could make utilization differ from normal for a long time, leading the tests to show unit roots, which could be wrongly interpreted as either (i) the absence of a tendency for the adjustment of capacity to demand or (ii) a change in the normal degree utilization, when all that happened was that the economy was not on the fully adjusted position on an exact average during the period.

Some authors believe that normal utilization is a variable influenced by conventions (Lavoie et al, 2004). It is important to clarify that according to our view, besides technology, conventions do also play a role. As firms do not know exactly what is going to be the ratio between average and peaks in demand in the future, they tend to follow the convention in each sector about what is the usual or normal pattern in terms of breath and frequency of demand fluctuations which in turn is likely to be based on what has been collectively observed during several previous economic cycles, and thus is unlikely to be just an average of what has been observed in the recent past (Ciccone, 1986,p.36).

Setterfield and Avritzer (2020) also state that normal utilization is affected by the actual rate, providing a particular economic rationale for that. According to them, normal utilization is a function of demand variability, basing their ideas in concepts from Steindl (1952) that are like the ones we discussed in the previous section. Basically, firms keep planed excessive capacity to (i) "'build ahead of demand' in an environment in which the economy is growing continuously but capital investments are discrete and 'lumpy'" (p. 16) and (ii) "hedge against potential loss of market share due to unforeseen variations of demand" (p. 16). But they add a further proposition that demand **variability** depends negatively on the **level** of demand itself, because:

> "as a long boom ends and the economy enters a crisis, the level of macroeconomic performance deteriorates and this is accompanied by an increase in the volatility of the macroeconomic environment. Macroeconomic volatility is low, meanwhile, when the economy reconstitutes an institutional framework capable

of fostering buoyant animal spirits and improved macroeconomic performance." (p. 13)

The variability of demand is what stablishes the connection between actual and normal utilization. According to the argument, higher (lower) levels of demand and of the actual degree of utilization reduce (increase) the variability of demand, leading to an increase (decrease) in normal utilization. However, firms do not adjust normal utilization in response to every change in actual utilization. The model proposed states that if the variability of actual utilization (σ_u^2) remains within a specific interval ($\sigma_{uL}^2 < \sigma_u^2 < \sigma_{uH}^2$), firms do not change the normal utilization. However, when variability surpasses σ_{uH}^2, desired utilization decreases, and inversely, when variability falls below σ_{uL}^2, normal utilization increases.

By associating some information about demand variability to normal utilization, the method used by these authors is like ours. However, it is not clear that such a regular inverse relation between levels of demand and actual capacity utilization and their variability exists either in each sector or even for the economy as a whole. Moreover, Setterfield and Avritzer (2020) also assume that temporary disturbances in economic conditions, if they are large enough, can change normal utilization, an interpretation which we do not find plausible. As discussed in the previous section, we see no reason to expect that a temporary change in aggregate demand will change the three main determinants of the normal degree of utilization, namely, (i) the pattern of seasonal fluctuations in demand, since it depends on cultural and social habits that are not affected by aggregate demand, (ii) technological factors and indivisibilities and (iii) the margin of extra spare capacity to meet future unexpected increases in demand.

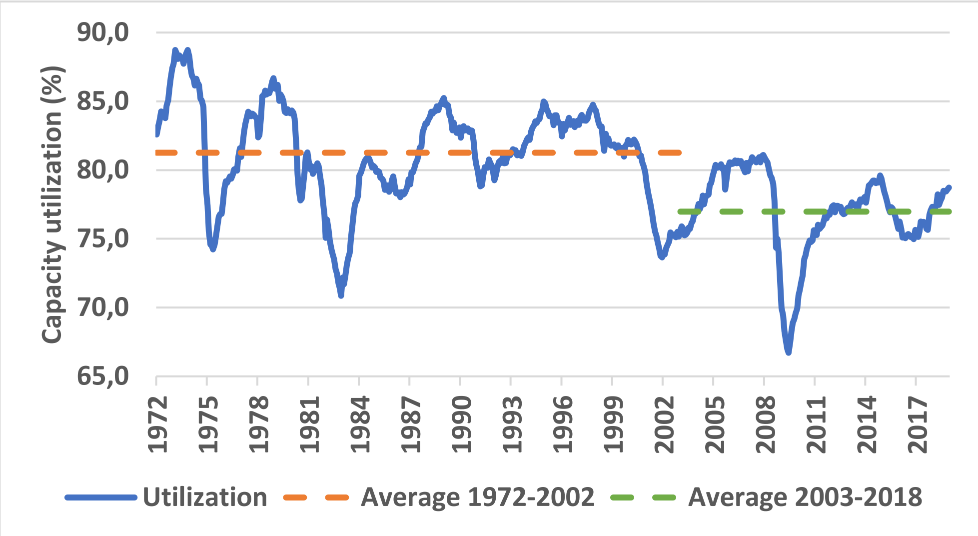
One of their conclusions is that the increase in volatility during the Great Recession from 2007-2009 was strong enough to lower normal utilization in the US (Setterfield and Avritzer (2020), p. 19). A more detailed discussion on this issue is made in the next section, but our conclusion finds no support for the thesis that normal utilization has changed.

Finally, it is important to notice that all these authors try to estimate the normal degree of capacity utilization based only on aggregated data for the industrial sector, while its determination seems to us to be highly specific to each productive branch. Thus, it is useful to look at a disaggregated level of the different branches of the industrial sector[37].

3.4) Was there a change in normal utilization in the US?

In this section, we look at the data for the US economy to see if we find evidence supporting the notion that not only the average but also the normal degree of capacity utilization has fallen significantly in the last decades. Figure 8 shows the aggregate capacity utilization degree of the US industrial sector estimated by the FED.

Figure 8: Capacity utilization and averages by period



Source: FRED. Elaborated by the author.

It is important to clarify that this decline in utilization was generalized within the different branches of industry and it is not the result of changes in the composition of industrial production towards activities that present a lower utilization. Among 30 activities that compose the industrial sector, 27 of them – which represent 80.3% of total industrial output – presented a decline in average utilization in the period from 2003 to 2018 compared to the previous years – 1972 to 2002 (see detail information in Table 7 in the Appendix B). These results are supported by Pierce and Wisinewski (2018), who calculate aggregate utilization with the weight of each industry fixed at its 1972 level and conclude that this fixed-weight utilization is like the actual utilization data, calculated with time-varying weights. These authors also find out that the decline in utilization from 1972 to 2016 is widespread among the several industries, although the magnitudes vary between them.

[37] For one exception, see Bassi et al. (2020).

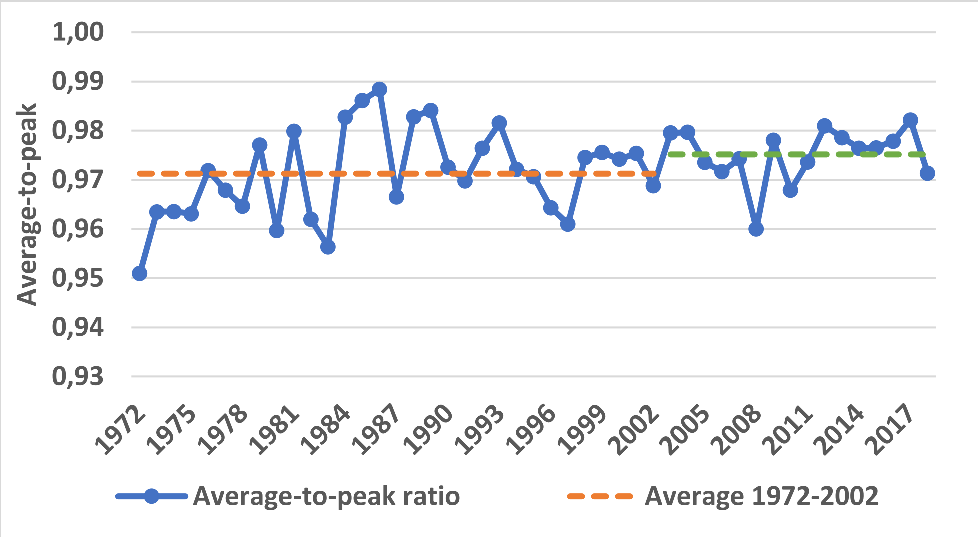
As we mentioned in section 2, maximum capacity is built to supply the maximum levels of demand predicted during the economic life of the equipment plus some margin of desired extra spare capacity maintained to meet unexpected increases in demand and perhaps some further spare capacity due to technical indivisibilities. Normal utilization depends thus on the ratio between average and expected peaks in demand and on the size of these is margin of extra spare capacity maintained even beyond the expected peaks. To assess the hypothesis that normal utilization in US has declined in the recent period, we will use the data of production for mining, manufacturing and utilities sectors provided by the Federal Reserve Economic Data (FRED)[38] as a proxy to check for average and expected peaks in demand. Since the determinants of normal utilization are specific to each sector, our analysis in this section is made at a disaggregated activity level. To check for the oscillations in output used to meet the seasonal fluctuations in demand we will use non-seasonally adjusted data on industrial production, to look at the seasonal part of the fluctuations within the different months of the year. Since the frequency of this data is monthly, we cannot check for changes in the seasonal fluctuations that take place within a month.

We calculated average-to-peak ratios for the several industries to check for the seasonal oscillation in production within each year. These ratios were calculated for each year and each industry, dividing the average production level of the 12 months of each year of each industry by the month with the highest production of the respective year and industry. Comparing the means of the average-to-peak ratios observed between 1972 and 2002 with the ones observed between 2003 and 2017, these ratios have increased in the most recent period in 70 out of 102 branches, which corresponds to 64.8% of the industrial

[38] Recently, this more 'conventional' data for capacity utilization has been criticized by Nikiforos (2013, 2016, 2020b), who claims that it would be stationary by construction and suggests that the average workweek of capital (AWC) – which is the number of hours a plant works per week divided by the maximum hours it can work – provides a better information. In response to that, Fiebiger (2020) replies to Nikiforos saying that the AWC does capture properly the changes in production for most industrial activities. The author quotes Corrado and Mattey (1997) who "distinguish between three types of stylised technology used by manufacturing firms: pure assemblers (for example, automakers), flexibly operated workstation assemblers (for example, apparel) and continuous processors (for example, oil refinery)." (p. 387). However, the AWC does not provide a good proxy for changes in output in the case of continuous processors (who produce uninterruptedly) neither for workstations assemblers industries, which usually operate only under one single shift (*ibid*, p. 387 and 392). Only in the case of pure assemblers can the AWC provide a good proxy, but even in that case "it cannot be generalized that (…) varying the number of shifts is the main method for adjusting production levels in response to short-run rhythmic variations in demand" (Fiebiger 2020, p. 387). With that in mind, we opt to use the conventional data from the Fed, which considers the economic concept of full capacity output, instead of the AWC which is more closely related to the engineering concept of full capacity. For more empirical debates on the data of capacity utilization for the US economy, see Gahn (2020), Gahn and González (2020) and Nikiforos (2020a).

production. Table 8 in the Appendix B presents the detailed data for each sector, while Figure 9 illustrates the average-to-peak ratio of total industrial production so that we can take a broader view. These results show a stability in the size of seasonal fluctuations, which in principle does not provide support to the thesis that normal utilization has decreased. On the contrary, these data are more prone to show a decrease in the size of seasonal fluctuations, which, to the extent that the firms 'conventions regarding what is the typical sectoral average to peak demand pattern were modified by this recent trend (which we find unlikely), would in fact indicate that normal utilization had increased, instead of decreased.

Figure 9: Average-to-peak ratio of industrial production.



Source: FRED. Elaborated by the author.

Our results thus differ from the ones obtained by Setterfield and Avritzer (2020), who conclude that the rise in volatility during the years of the Financial crisis was strong enough to make firms reduce their desired utilization. The average-to-peak ratio seems to have decreased only in 2008 – perhaps suggesting an increase in volatility, – but quickly returned to its previous levels, higher on average, than in the preceding period.

It is important to clarify that this average-to-peak ratio of output should not be interpreted as proxy or some sort of estimation of normal utilization in each year. If that were the case, it would imply that normal utilization suffers small changes every year, which is not the argument being made here. These indexes evaluated here provide an overview of the direction in which the patterns of seasonal fluctuations in output are changing during a longer period that encompasses one or more economic cycles, to assess the plausibility of considering that normal utilization have decreased. We thus believe from the analysis of the data that there is no clear evidence for supposing that the normal degree of utilization has decreased in the US economy.

3.5) Adjustment of capacity to demand in the Sraffian Supermultiplier model

In this section, we will show that the Sraffian Supermultiplier model (see Serrano, 1995, Freitas and Serrano, 2015 and Serrano, Freitas and Bhering, 2019) with a flexible accelerator and a slow process of adjustment of capacity to demand can generate long-lasting deviations between actual and a given exogenous normal utilization if the economy faces successive changes in the pace of growth of effective demand.

To demonstrate this point, we will simulate what happens with the actual capacity utilization following successive decreases in the growth rate of output. We will use the version of the Supermultiplier model presented by Serrano, Freitas and Bhering (2019) in which the induced investment share depends on the expected demand growth, while the expected growth rate adjusts according the deviations between actual and expected growth. The parameters used in the simulations are based on the estimates of the model´s investment function from the second chapter for the US economy, which finds the adjustment process of adjustment is quite slow. We suppose that normal utilization is exogenous and remain unaltered in the simulations presented in this section. The formal model as well as the values of the parameters used in the simulations are presented in Appendix A.

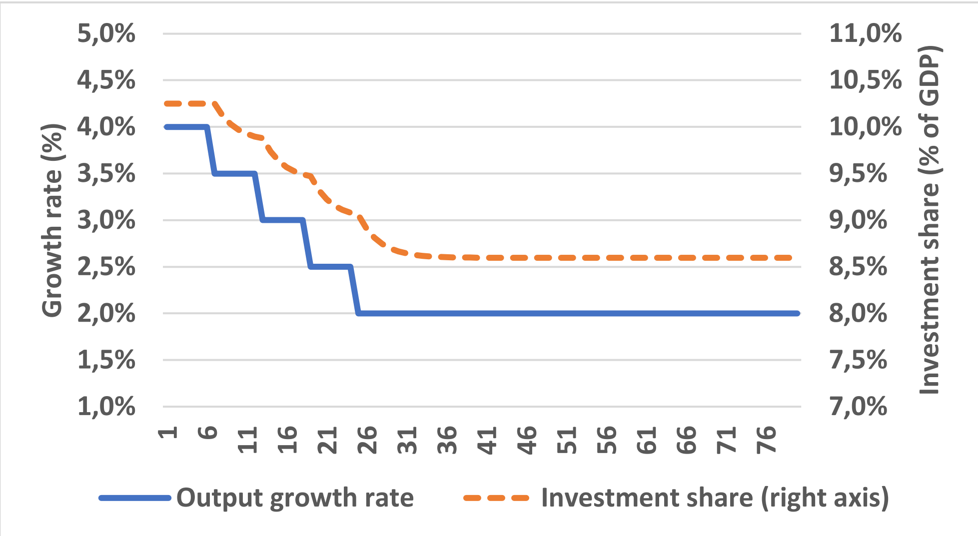
In this model, investment is responsible for increasing the stock of capital and consequently the productive capacity, but since new investment represents a small portion of the existing stock of capital, changes in the investment growth rate at first induces only a small change in the growth rate of the stock of capital, and the latter converges to the former only after some time. With the growth rate of productive capacity and the given output growth we get to the changes in capacity utilization.

We will run two different kinds of simulation. In the first simulation, we will suppose a hypothetical pattern for the growth rate of the economy, which is successively reduced from 4% to 2%. In the second, we will use the actual data on growth for the US economy. For both simulations, we assume that the economy is initially in its fully adjusted position, with utilization equal to its desired level.

In the first simulation, we suppose that output, investment and capital start growing at 4% a year. Next, we simulate how these variables reacts to successive 0.5 per cent decreases in output’s growth rate, which drops from 4% to 2% a year. After output growth decreases, capitalists' expectations are not fulfilled, so they start to revise downwards their forecasts and the induced investment share declines slowly. This decline in the propensity to invest is responsible to make investment to grow less than output. However, since it takes some time for the growth of the stock of capital do adjusts to the pace of investment growth, productive capacity will grow more than output for a while and utilization will fall. After some time, the growth of the stock of capital also decreases and starts growing less then output and from this point on utilization starts to rise again, converging to its normal level. Figures 10, 11 and 12 present the basic results of the simulations.

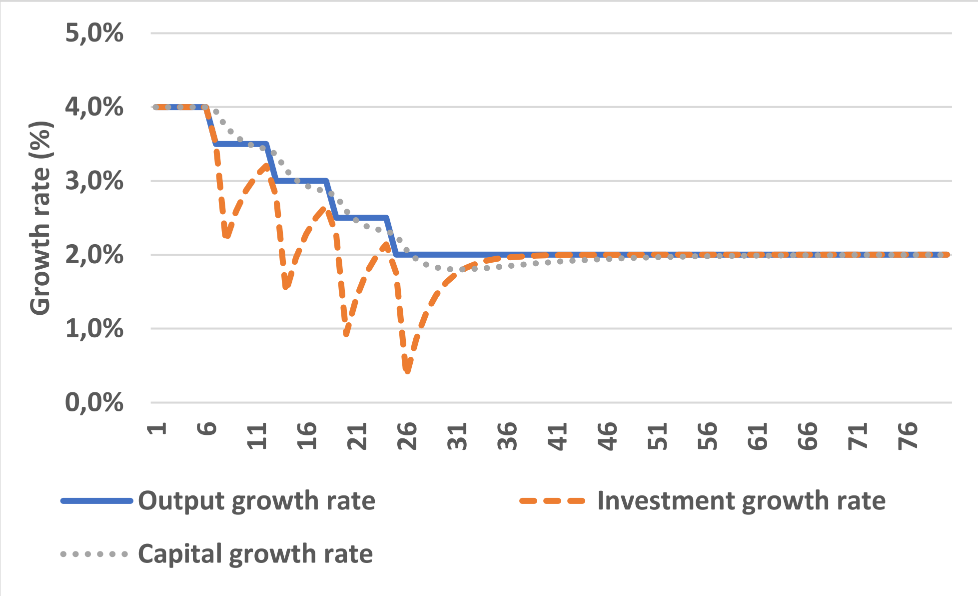
It is important to distinguish two different aspects in this adjustment process. The first one is the time required for growth expectations to change, and consequently, alter the propensity to invest – which can be seen on Figure 10. The second process is slower and depends on the first: it consists of the time required for the changes in the investment growth to provoke changes in the stock of capital that adjusts capacity to demand – Figures 11 and 12.

Figure 10: Output growth rate and investment share



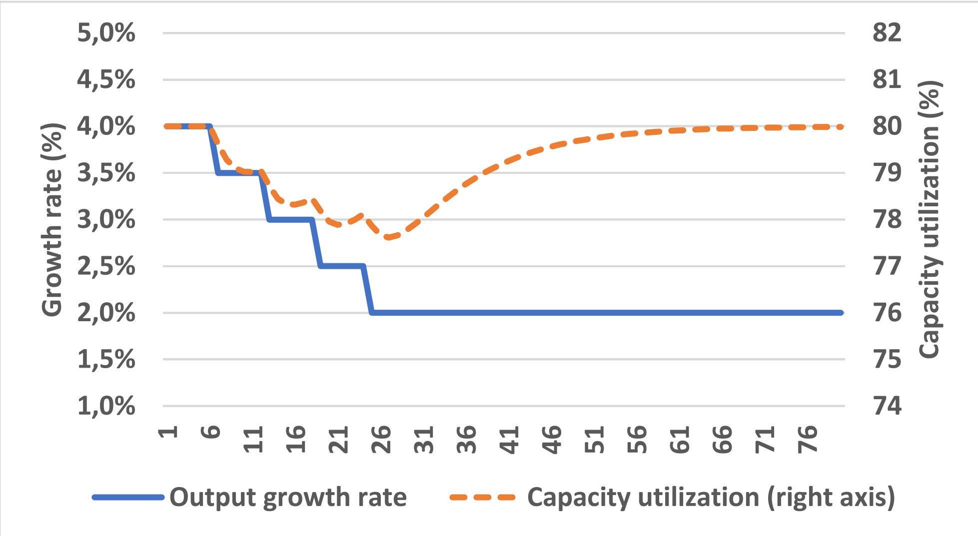
Source: Elaborated by the author.

Figure 11: Output, investment and capital stock growth rates



Source: Elaborated by the author.

Figure 12: Output growth rate and capacity utilization

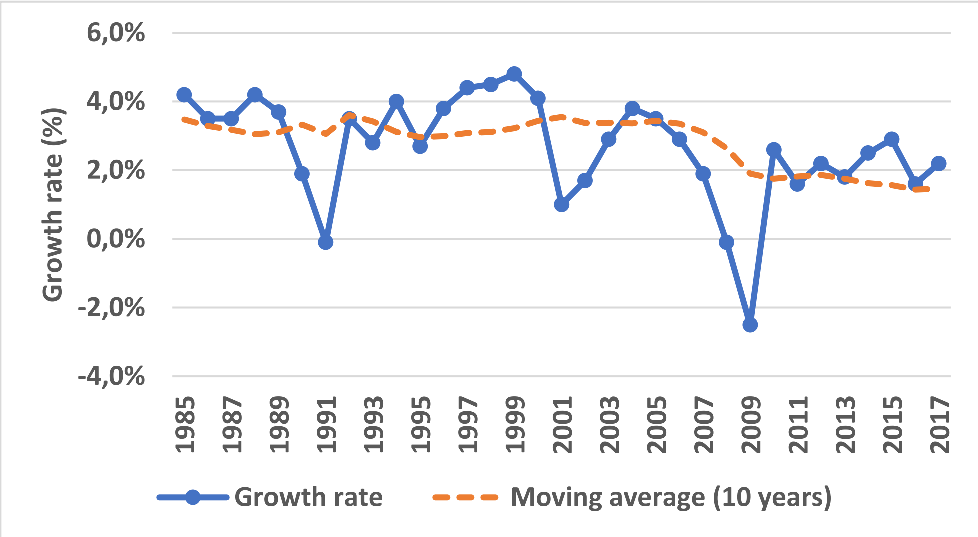


Source: Elaborated by the author.

The first conclusion we want to highlight here is that during the transition from a higher to lower growth steady-state, there is no reason to expect that average utilization will converge quickly to its normal degree and it is probable that it will remain below its desired level during this period. Second, since it is likely that the economy will remain outside its fully adjusted position for a considerable time, taking average utilization might not be a good proxy for normal utilization even if we consider a large period, and specially, if the growth rate suffered significant changes during these years.

In the second simulation we use the effective rate of growth instead of a hypothetical one. Before presenting the simulations results, it is important to show the growth rate of the US economy and its moving average. As can be seen in Figure 13, the 10-year moving average oscillated between 3.6% and 3.0% from 1985 to 2001 and after that it presented a gradual decline, reaching 1.5% in 2017.

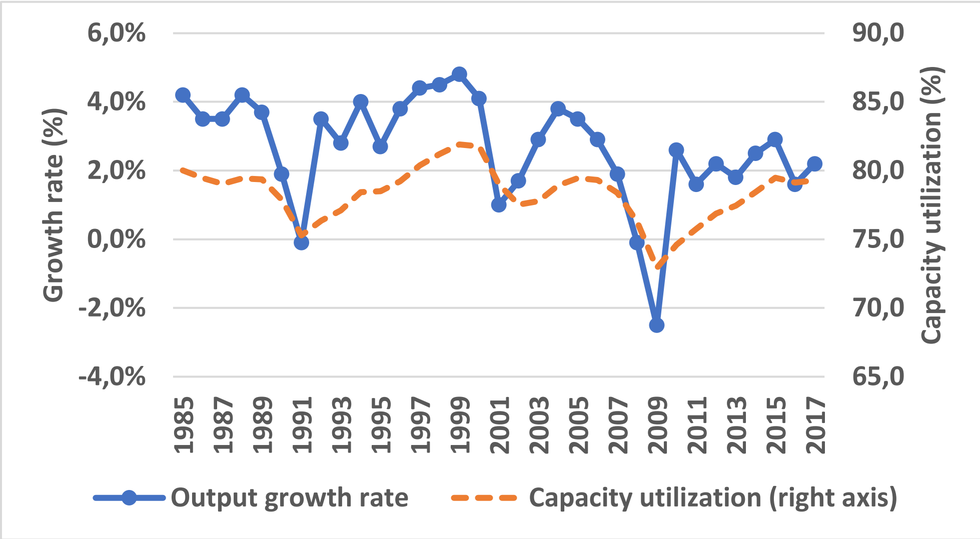
Figure 13: US GDP growth rate and its 10-year moving average



Source: BEA. Elaborated by the author.

For the second simulation, we suppose that in the first year (1985) the growth rates of investment, stock of capital and productive capacity are all equal to the growth rate of GDP (4.2%), utilization is equal to its normal level (assumed here to be 80%) and the expected growth rate that is considered to determine the induced investment share in the first year is being fulfilled. The results of the simulation using the actual rate of growth can be seen in Figure 14 below.

Figure 14: Output growth rate and capacity utilization



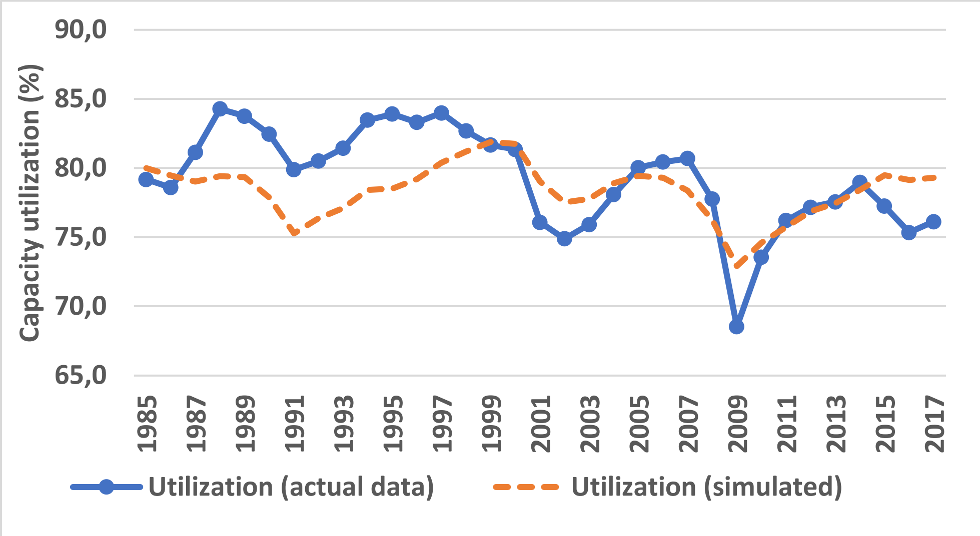
Source: BEA. Elaborated by the author.

The simulated series of capacity utilization declines 2.6 percentage points from its peak of 81.9% in 1999 to 79.3% in 2017. Average utilization from 2001 to 2017 is equal to 77.7%, 1.4 pp lower than the average from 1985 to 2000 of 79.1 %. This result suggests that the decline in output growth rates observed in the US combined with the flexible accelerator mechanism (which embodies a slow adjustment of capacity to changes in growth expectations) can prevent utilization to converge to its normal level during a considerable period.

It is worth noticing that our purpose with these simulations is not to perfectly match the simulated series with the actual data, but only to demonstrate that a continuous decline in trend growth rates as observed in the US since the begin of the 2000s can deviate actual capacity utilization from its normal level for several years, in a model with slow mechanism of adjustment of capacity to demand such as our simple Sraffian Supermultiplier Model. In this way, it is important to clarify that there are some simplifications in the simulations, so it is necessary to be careful in comparing the simulated series with the actual data. First, we did not include changes in relative prices of capital and output, in the capital-to-normal output ratio and the depreciation rate. Second, the variables we are simulating refers to the whole economy, while the actual data on utilization is restricted to the industrial sector. Third, we assume that the economy is initially in its fully adjusted position, so the initial values of several variables are fixed and might present divergencies with the actual ones.

Despite the several simplifying assumptions involved in this simulation and the restrictions that must be considered to compare the simulated and actual series of capacity utilization, both series share a similar pattern of fluctuations, as can be seen in Figure 15[39], [40].

Figure 15: Capacity utilization: actual and simulated data



Source: BEA, FRED. Elaborated by the author.

3.6) Conclusion

In this chapter we attempt to contribute to the theoretical debate between growth and capacity utilization from the Sraffian Supermultplier perspective. We follow the concept of normal degree of capacity utilization proposed by Ciccone and we use a simple version of the Supermultiplier model, in which the adjustment of productive capacity to

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[39] As can be also seen in Figure 15, both simulated and actual series of capacity utilization present two important declines: the first one following the crisis from 2001 and the second one following the Great Financial crisis from 2008-09. In these years, the decreases in actual utilization are larger than in the simulated series, which can be explained mainly by the fact that the simulations were calculated considering GDP growth, which encompasses the entire economy, while the actual data on utilization is restricted to the industrial sector, which is subjected to larger fluctuations. As Corrado and Mattey (1997, p. 158) explain, "most of the fluctuation in aggregate output comes from changes in the demand for goods and new structures; by comparison, final demand for services is relatively stable". Since goods and structures are precisely what is produced by the industrial sector, this means that the effects of crisis are higher on industrial production than on the services activities.

[40] A further factor that might have played a minor role in explaining the slowness of the adjustment process described above, could be due to asymmetric responses of the adjustment of capacity to demand. When demand increases, firms can invest and increase capacity considerably, but when demand decreases, the downward adjustment of capacity is done by making gross investment fall below required replacement investment and this will limit the fall in capacity even if gross investment falls to zero. Although GDP growth rates in the US have always remained positive during the 2000s (except in the 2008-2009 crisis), growth was quite different among the several industrial branches, and the lower growth from the 2000s resulted in a much larger share of activities presenting decreases in production. From 1972 to 2002, only 19 out of 102 industries presented an accumulated decrease in production (representing 14.4% of industrial production in 2002) while between 2002 and 2017, the number of industries with an accumulated decline in production rose to 58 out of 102 (representing 40.0% of industrial production in 2017). See Table 9 from the Appendix B for detailed data.

effective demand is slow. We use the US economy case as a benchmark, as a definite decline in the average degree of capacity utilization has been observed since the early 2000s in this economy, to check both the Neo-Kaleckian explanation of changes in the normal degree of capacity utilization and the alternative explanation based on the slow adjustment via the Supermultiplier model with an exogenous normal degree of utilization. We found no reason to believe that the decline in actual utilization can be plausibly explained by a general reduction in the normal rate of capacity utilization, while the successive slowdown in the rates of growth of effective demand in the United States since the beginning of the 2000s could well explain the long-lasting deviations between actual and normal utilization if the process of adjusting productive capacity to demand converges slowly as proposed by the Sraffian Supermultiplier model.

Concluding remarks

In this thesis, we rescued some concepts about the determinants of normal utilization and the importance of this variable as a center of gravitation as well as the pace of accumulation and the slow adjustment of productive capacity to expected demand which were debated in the academic journal *Political economy: studies in surplus approach* during the 1980s, in an attempt to shed some light in the recent international debate over the stability of the Sraffian Supermultiplier model and the convergence or not of the utilization rate towards a normal level.

In this debate in the 1980s, the subjects that were in discussions were the convergence of market prices towards their normal prices, the role of normal utilization in this process and whether or not the gravitation of prices to their normal level requires the simultaneous convergence of utilization to is normal value. Ciccone (1986, 1987), Kurz (1986), Amadeo (1986), White (1989), Committeri (1986, 1987) and Vianello (1985) were some of the authors that contributed to this debate. However, this discussion about the determinants of normal utilization was left aside in the theories of demand led growth. Only recently some elements of this controversy were resumed and applied to growth models by Nikiforos, who used the concept of normal utilization as proposed by Kurz (1986) as a starting point in order to show how demand could influence normal utilization. However, in the first chapter we raised some problems in Nikiforos' proposal, since there was a debate between Kurz and Ciccone, with the view by the latter being more accepted between some Sraffians. Using the concepts from Ciccone as a theoretical basis, we studied how these ideas can be applied to the debate on economic growth and the controversy about the convergence of actual utilization towards its normal level, evaluating the problems entailed in the fact that utilization is endogenous in Kaleckian models and investigating if some proposals from these authors are in accordance with our interpretation. At the empirical level, we used these ideas in order to try to answer the question if normal utilization has changed in the US during the past few years.

We also demonstrated the importance of normal utilization as a center of gravitation. In the first chapter, we explained the determinants of normal utilization grounded on the principles of competition, showing at a theoretical level how deviations of actual utilization from its normal level would exert some influence on capitalists' investment decisions, with the latter being guided by attempts to adjust productive capacity to expected demand. In the second chapter, we demonstrated that this mechanism of adjustment of capacity to demand seems to be present in the US economy and that the speed of this adjustment is slow. Finally, in the last chapter we showed that it is completely plausible that actual utilization to remain below normal for a considerable time and that it does not imply that the mechanism of adjustment of capacity to demand is absent.

In the debates in the *Studies in surplus approach*, a few authors had already defended points of view similar to the ones that we tried to elaborate in a more formalized version in this work. Committeri (1986) said that there is a "certain 'sluggishness' of response of investment decisions to discrepancies between the current utilization rate and its normal level" (p. 179) because "entrepreneurs would not let themselves be fooled by an unexpected change in the current utilization degree, and would refrain from modifying their investment plans until their expectations turned out to be systematically frustrated by experience." (p. 179), endorsing the view that capitalists are caution in changing their investment plans in response to changes in demand. Vianello (1985, p. 71) states that this process of convergence towards fully adjusted positions could take as long as ten years, while Ciccone (1986) affirms that "the achievement of a particular size of capacity relative to that of demand appears in itself to be a process that is liable to be frustrated for long periods of time." (p. 25) and that "divergences of the actual utilization from that particular [normal] level therefore appear conceivable also beyond the short period" (p. 25), supporting the view that the process of adjustment is indeed very slow.

Some authors, such as Chick and Caserta (1997) and Nikiforos (2020c), have defend a different point of view regarding the importance of normal utilization and fully adjusted position, questioning the relevance of this concepts because a) the time required for this position to be achieved would be too long, making it useless for some economic questions, and b) during this time, the economy would be subjected to many other shocks that would deviate it from this fully adjusted position.

Although it is true that during the time required for the economy to converge towards is normal utilization it will probably suffer new shocks that might put it away from its fully adjusted position, this does not mean that it is not important as a center of gravitation. Even if normal utilization is not achieved, it is important to understand how competition induces capitalists to adjust their investment plans trying to adjust capacity to demand, which is the reason why the Sraffian Supermultiplier model shows a positive relation between growth rates and the induced investment share in output. By demonstrating the (slow) adjustment as predicted by the model of both the investment share and the utilization rate – in respectively essays two and three – for the US data, which suffered many shocks in the period under analysis (for example, the Great Financial Crisis of 2007-2008), we think it is an important response to this kind of criticism presented in the paragraph above.

Another point we hope to have contributed was to clarify a misunderstanding about the theoretical model and the simplifying assumption of autonomous expenditures growing at a constant pace. Some authors consider (implicitly or explicitly) that this simplifying assumption turns the model unable to explain economic fluctuations. In the second chapter, we presented the series of autonomous expenditures growth rate and it showed that: a) these expenditures indeed present considerable fluctuations and b) fluctuations of output growth rate coincide with the former ones. These evidences are in line with Fiebiger and Lavoie (2019). According to this interpretation, the oscillations in output are explained by these oscillations in autonomous expenditures (and also by changes in the parameters of distribution, taxes, the penetration of imports, etc). Additionally, it is worth mentioning that the shocks that a capitalist economy is subjected to and that preclude utilization to reach its normal level – which according to some authors makes the concept of normal utilization useless – consist precisely in these variations in autonomous expenditures.

Appendix A – Theoretical model

In this appendix, we are presenting the equations that are used in our simulations. Let us ignore changes in relative prices and assume that the depreciation ratio and the ratio between capital and full capacity output are constant for the sake of simplicity. We are adopting the specification of the Sraffian Supermultiplier model presented in Serrano, Freitas and Bhering (2019), according to which the induced investment share in output (h_t) depends on the growth rate of demand expected by capitalists (g_t^e), the depreciation ratio (δ), the technical relation between capital and full capacity output (v) and normal utilization (u_n), as in the expression below:

$$h_t = \frac{v}{u_n}(g_t^e + \delta) \tag{A.1}$$

The ratio v/u_n is also equal to the ratio between capital and normal output – the output that would be obtained if utilization were equal to normal. The expected growth is gradually adjusted as a fraction of the discrepancies between expected and actual growth – represented by g_t^Y – as in equation A.2:

$$g_t^e = g_{t-1}^e + x(g_{t-1}^Y - g_{t-1}^e) \quad or \quad g_t^e = (1-x)g_{t-1}^e + xg_{t-1}^Y \tag{A.2}$$

Where x represents the fraction of the error in expectations that is incorporated in new forecasts, with x positive but lower than one, and it is more likely that its value is low, which means that the propensity to invest adjusts slowly and consequently the speed of convergence of utilization towards its normal level is also slow. Combining equations A.1 and A.2 and after some algebra, we get to the following expression:

$$h_t = \frac{v}{u_n}x\delta + (1-x)h_{t-1} + \frac{v}{u_n}xg_{t-1}^Y \tag{A.3}$$

Induced investment (I_t), by its turn, is equal to output (Y_t) multiplied by the propensity to invest:

$$I_t = h_t Y_t \tag{A.4}$$

Its growth rate is given by:

$$1 + g_t^I = \frac{h_t}{h_{t-1}}\,(1 + g_t^Y) \tag{A.5}$$

The stock of capital (K_t) at the end of period t is equal to the stock existing at the end of the previous period plus the gross investment made in t minus the depreciation. The depreciation is expressed by the depreciation ratio (δ) multiplied by the stock of capital existing at the end of the previous period.

$$K_t = K_{t-1} + I_t - \delta K_{t-1} \tag{A.6}$$

Dividing all the expression A.6 by K_{t-1} and subtracting one, we obtain the expression of the growth rate of the stock of capital:

$$g_t^K = \frac{I_t}{K_{t-1}} - \delta \tag{A.7}$$

The growth rate of the stock of capital can also be written as a function of its growth rate in the previous period and the investment growth, as in equation A.8[41]:

$$g_t^K = (g_{t-1}^K + \delta)\left(\frac{1 + g_t^I}{1 + g_{t-1}^K}\right) - \delta \tag{A.8}$$

Equation A.8 tells us that if investment growth surpasses (fall behind) the growth of the stock of capital, the later increases (decreases), so that the growth of the stock of capital converges towards the growth of investment expenditures.

Full capacity output (Y_t^*), by its turn, is determined by the stock of capital and the technical capital-full output ratio. Since we are considering the stock of capital at the end of each period, full capacity depends on the stock of capital existing at the end of the **previous** period, because that is the one which constitutes capital available to be used during the whole period t. The new capacity installed **during** the period t is not available to be used during this entire period, only in the next one.

$$Y_t^* = \frac{K_{t-1}}{v} \tag{A.9}$$

Let us assume for now that the capital-capacity ratio remains unaltered, so the growth rate of full capacity output depends on the growth of the stock of capital in $t - 1$:

$$g_t^{Y*} = g_{t-1}^K \tag{A.10}$$

At last, capacity utilization is the ratio between actual output and full capacity output (equation A.11).

$$u_t = \frac{Y_t}{Y_t^*} \tag{A.11}$$

Since Y_t and Y_t^* can be expressed by $Y_{t-1}(1 + g_t^y)$ and $Y_{t-1}^*(1 + g_t^{y*})$, respectively, in our simulations we are assuming an initial value for u_t and in the next periods it will be given by:

$$u_t = u_{t-1}\left(\frac{1 + g_t^Y}{1 + g_t^{Y*}}\right) \tag{A.12}$$

[41] According to equation A.7, we know that $\frac{I_{t-1}}{K_{t-2}} = g_{t-1}^K + \delta$. We can also rewrite equation A.7 in the following way: $g_t^K = \frac{I_{t-1}(1+g_t^I)}{K_{t-2}(1+g_{t-1}^K)} - \delta$. Replacing $\frac{I_{t-1}}{K_{t-2}}$ for $g_{t-1}^K + \delta$ in the above equation, we get to our expression A.8

Our simulations were calculated based on equations A.3, A.5, A.8, A.10 and A.12. Output growth rate (g_t^Y) is taken as exogenous and from this variable, combined with other parameters, we simulate the series of $h_t, g_t^I, g_t^K, g_t^{Y*}$ and u_t. The initial conditions were stablished assuming the economy is in a fully adjusted position, with output, investment, capital and capacity growing at the same rate and growth expectations being fulfilled (that is, $g_0^Y = g_0^e = g_0^I = g_0^K = g_0^{Y*}$), utilization is at its normal level, assumed to be 80% ($u_0 = u_n = 80\%$) and the propensity to invest in the initial period (h_0) is calculated using equation A.1. The other parameters were obtained from the estimates from the second essay for the years from 1985 to 2017. The equation for the propensity to invest estimated in that chapter corresponds to equation A.3 of this Appendix and is presented below:

$$h_t = 0.629 + 0.909h_{t-1} + 0.075g_{t-1}^Y \quad \text{(A.13)}$$

According to these values, it is possible to calculate the remaining parameters required for the simulation. The ratio between capital and normal output $\left(v/u_n\right)$ – which is the one estimated in the second chapter – is equal to 0.826, and since we are assuming that $u_n = 80\%$, capital-full capacity ratio (v) is equal to 0.661. Depreciation rate (δ) is 8.4% a year and the parameter x that represents the fraction of the errors in expectations that is incorporated into new expectations is equal to 0.091.

The value of the parameter x used in the simulations deserves some comments. The estimates from chapter two were made using quarterly data. The growth rate considered is calculated between one quarter and the same quarter of the previous year – i.e., four quarters before – while the propensity to invest is equal to nominal investment divided by nominal GDP in each quarter. This means induced investment share is affected by the growth rate of the immediately previous quarter, but this growth rate is expressed in comparison with four quarters before.

To calculate annual growth rate of the stock of capital it is required to sum the investment made during four quarters, being necessary to take into account the fact that the relative size of output and investment during each quarter of the year might change. In the case of our second simulation that uses actual GDP growth, we know the distribution of GDP through the several quarters (since we know the values of actual GDP), so we calculate h on quarterly basis using exactly the same parameters of equation A.13, multiply h by the nominal GDP of each quarter to calculate nominal induced investment by quarter, sum the investment of the four quarters of each year and divide it by annual GDP, obtaining the induced investment share on annual frequency. The rest of the simulation is made on annual basis using annual GDP growth and induced investment share by year.

However, our first simulation that assumes some hypothetical growth rate is made only on annual frequency, without establishing the values of output in each quarter, which means that the parameters from equation A.13 must be adapted. In this simulation, h_t represents the propensity to invest of the entire year and must be calculated as a function of the propensity to invest and the growth rate of the previous year and not the previous quarter, as in equation A.13. In this case, the propensity to invest during a year must take into account the changes in growth rate that occurred from one year to another, and not only from one quarter to the next one. In terms of our model, this implies that the value of x will be higher.

To get an approximate estimate, let us rewrite equation A.13 in the following way:

$$h_t = a + bh_{t-1} + cg_{t-1}^Y \qquad \text{(A.14)}$$

Where $a = \frac{v}{u_n}x\delta = 0.629$, $b = 1 - x = 0.909$ and $c = \frac{v}{u_n}x = 0.075$. If we replace h_{t-1} by expression A.14 adjusting the lags accordingly, we obtain h_t as a function of h_{t-2}, g_{t-1}^Y and g_{t-2}^Y. Replacing h_{t-2} by expression A.14 again, we obtain h_t as a function of $h_{t-3}, g_{t-1}^Y, g_{t-2}^Y$ and g_{t-3}^Y. As last, we replace h_{t-3} by expression A.14 one more time and obtain h_t as a function of $h_{t-4}, g_{t-1}^Y, g_{t-2}^Y, g_{t-3}^Y$ and g_{t-4}^Y and get to the following expression:

$$h_t = a(1 + b + b^2 + b^3) + b^4 h_{t-4} + c(g_{t-1} + bg_{t-2} + b^2 g_{t-3} + b^3 g_{t-4}) \qquad \text{(A.15)}$$

The inertia coefficient in this case has four lags, which is equal to one year. Adopting the simplifying assumption that the propensity to invest in a year is a simple average of the propensity to invest in each quarter of the year, it is reasonable write our equation A.3 in annual terms using the inertia coefficient expressed in equation A.15, which is equal to $b^4 = 0.684$. Since $b = 1 - x$, we obtain the value of $x = 0.316$. Maintaining the values of $v/u_n = 0.826$ and $\delta = 8.4\%$, equation A.3 can be written in annual frequency, in a way that is appropriate to be used in the first simulation:

$$h_t = 2{,}196 + 0{,}684 h_{t-1} + 0{,}261 g_{t-1} \qquad \text{(A.16)}$$

Appendix B – Detailed tables by industry

Table 7: Average capacity utilization by industry and by time period

Industry code	Industry description	Average 1972-2002	Average 2003-2017	Increased/ Decreased?	Weight (%)
B50001	**Total index**	**81.3**	**77.0**	**Decreased**	**100.0**
G321	Wood product	79.5	70.9	Decreased	1.4
G327	Nonmetallic mineral product	78.5	64.0	Decreased	2.2
G331	Primary metal	80.7	73.3	Decreased	2.6
G332	Fabricated metal product	77.5	77.7	Increased	5.5
G333	Machinery	78.9	74.6	Decreased	5.4
G334	Computer and electronic product	79.4	73.3	Decreased	5.0
G335	Electrical equipment, appliance, and component	83.6	79.1	Decreased	1.8
G3361T3	Motor vehicles and parts	77.4	71.2	Decreased	5.7
G3364T9	Aerospace and miscellaneous transportation eq.	73.5	75.8	Increased	4.4
G337	Furniture and related product	78.6	73.0	Decreased	1.2
G339	Miscellaneous	76.8	76.4	Decreased	2.8
G311	Food	83.0	80.7	Decreased	9.0
G312	Beverage and tobacco product	79.1	69.6	Decreased	2.8
G313	Textile mills	83.1	69.6	Decreased	0.3
G314	Textile product mills	83.7	69.7	Decreased	0.3
G315	Apparel	80.5	72.0	Decreased	0.2
G316	Leather and allied product	75.9	60.2	Decreased	0.1
G322	Paper	88.3	83.4	Decreased	2.5
G323	Printing and related support activities	84.3	70.0	Decreased	1.4
G324	Petroleum and coal products	85.5	84.0	Decreased	3.2
G325	Chemical	78.6	73.3	Decreased	12.3
G326	Plastics and rubber products	84.3	77.8	Decreased	3.6
GMFO	Other manufacturing	84.7	69.8	Decreased	2.1
G211	Oil and gas extraction	92.2	94.7	Increased	9.8
N2121	Coal mining	86.1	82.1	Decreased	0.8
G2122	Metal ore mining	79.6	73.6	Decreased	0.6
G2123	Nonmetallic mineral mining and quarrying	83.7	82.1	Decreased	0.9
G213	Support activities for mining	73.2	68.9	Decreased	1.6
G2211	Electric Utilities	88.4	82.0	Decreased	9.0
G2212	Natural gas distribution	80.3	80.1	Decreased	1.4

Source: FRED. Elaborated by the author.

Table 8: Average-to-peak ratio of industrial production by industry and by time period.

Industry code	Industry description	Average 1972-2002	Average 2003-2017	Increased/ Decreased?	Weight (%)
B50001	**Total**	**0.971**	**0.975**	**Increased**	**99.80**
G211111	Crude petroleum and natural gas extraction	0.971	0.963	Decreased	9.25
G211112	Natural gas liquid extraction	0.956	0.944	Decreased	0.54
N2121	Coal mining	0.911	0.942	Increased	0.77
G2122	Metal ore mining	0.918	0.941	Increased	0.59
G2123	Nonmetallic mineral mining and quarrying	0.879	0.835	Decreased	0.88
G213	Support activities for mining	0.900	0.921	Increased	1.63
G22111	Electric power generation	0.887	0.867	Decreased	4.58
G22112	Electric power transmission, control, and distribution	0.877	0.841	Decreased	4.46
G2212	Natural gas distribution	0.611	0.538	Decreased	1.36
G3111	Animal food	0.942	0.945	Increased	0.59
G3112	Grain and oilseed milling	0.949	0.956	Increased	0.75
G3113	Sugar and confectionery product	0.803	0.855	Increased	0.50
G3114	Fruit and vegetable preserving and specialty food	0.822	0.820	Decreased	1.11
N311511	Fluid milk	0.936	0.957	Increased	0.35
N311512	Creamery butter	0.791	0.812	Increased	0.02
N311513	Cheese	0.919	0.966	Increased	0.32
N311514	Dry, condensed, and evaporated dairy product	0.801	0.881	Increased	0.27
N31152	Ice cream and frozen dessert	0.780	0.808	Increased	0.10
G3116	Animal slaughtering and processing	0.932	0.950	Increased	1.96
N3118	Bakeries and tortilla	0.966	0.959	Decreased	1.22
G3119	Other food	0.931	0.958	Increased	1.70
G3121	Beverage	0.913	0.935	Increased	1.85
G3122	Tobacco	0.877	0.881	Increased	0.96
G3131	Fiber, yarn, and thread mills	0.913	0.935	Increased	0.07
G3132	Fabric mills	0.957	0.958	Increased	0.16
G3133	Textile and fabric finishing and fabric coating mills	0.950	0.931	Decreased	0.09
G3141	Textile furnishings mills	0.903	0.915	Increased	0.17
G3149	Other textile product mills	0.960	0.949	Decreased	0.16
G315	Apparel	0.963	0.950	Decreased	0.15
G316	Leather and allied product	0.950	0.948	Decreased	0.06
N3211	Sawmills and wood preservation	0.910	0.928	Increased	0.38
G3212	Veneer, plywood, and engineered wood product	0.925	0.921	Decreased	0.31
G32191	Millwork	0.941	0.946	Increased	0.37
N32192	Wood container and pallet	0.954	0.951	Decreased	0.13
G32199	All other wood product	0.902	0.916	Increased	0.23
N32211	Pulp mills	0.945	0.958	Increased	0.08
G32212	Paper mills	0.949	0.964	Increased	0.60

N32213	Paperboard mills	0.949	0.970	Increased	0.57
N32221	Paperboard container	0.916	0.940	Increased	0.73
G32222	Paper bag and coated and treated paper	0.954	0.950	Decreased	0.25
G32223A9	Other converted paper products	0.953	0.960	Increased	0.30
G323	Printing and related support activities	0.896	0.973	Increased	1.44
G32411	Petroleum refineries	0.949	0.954	Increased	2.58
N32412A9	Paving, roofing, and other petroleum and coal products	0.915	0.877	Decreased	0.58
G3254	Pharmaceutical and medicine	0.954	0.968	Increased	4.46
G32511A9	Organic chemicals	0.952	0.949	Decreased	2.52
G32512T8	Basic inorganic chemicals	0.937	0.942	Increased	0.71
N325211	Plastics material and resin	0.936	0.952	Increased	0.96
G325212	Synthetic rubber	0.906	0.949	Increased	0.09
N32522	Artificial and synthetic fibers and filaments	0.920	0.925	Increased	0.08
G3253	Pesticide, fertilizer, and other agricultural chemical	0.936	0.930	Decreased	0.56
G3255T9	Paints, soaps and toiletries, and other chemical products	0.944	0.968	Increased	2.92
G3261	Plastics product	0.953	0.975	Increased	3.02
G32621	Tire	0.887	0.905	Increased	0.25
G32622A9	Rubber products ex. tires	0.930	0.959	Increased	0.35
G32711	Pottery, ceramics, and plumbing fixture	0.950	0.938	Decreased	0.05
G32712	Clay building material and refractories	0.928	0.928	Decreased	0.11
G3279	Other nonmetallic mineral product	0.949	0.957	Increased	0.46
G3274	Lime and gypsum product	0.907	0.915	Increased	0.13
G3272	Glass and glass product	0.951	0.963	Increased	0.48
N32731	Cement	0.803	0.827	Increased	0.16
N32732T9	Concrete and product	0.905	0.908	Increased	0.82
G3311A2	Iron and steel products	0.903	0.931	Increased	1.26
G3313	Alumina and aluminum production and processing	0.932	0.933	Increased	0.38
G3314	Nonferrous metal (ex. aluminum) production & processing	0.913	0.942	Increased	0.49
G3315	Foundries	0.944	0.955	Increased	0.50
G332	Fabricated metal product	0.966	0.970	Increased	5.51
G33311	Agricultural implement	0.837	0.881	Increased	0.43
G33312	Construction machinery	0.878	0.864	Decreased	0.44
N33313	Mining and oil and gas field machinery	0.915	0.901	Decreased	0.21
G3332	Industrial machinery	0.931	0.936	Increased	0.53
G3333A9	Commercial & service industry machinery & other general	0.945	0.959	Increased	1.98
G3334	Ventilation, heating, air-conditioning, & refrigeration eq	0.875	0.806	Decreased	0.67
G3335	Metalworking machinery	0.932	0.951	Increased	0.54
G3336	Engine, turbine, and power transmission equipment	0.924	0.914	Decreased	0.57
G3341	Computer and peripheral equipment	0.852	0.899	Increased	0.36
G3342	Communications equipment	0.906	0.907	Increased	0.53
G3343	Audio and video equipment	0.800	0.853	Increased	0.04

G3344	Semiconductor and other electronic component	0.876	0.830	Decreased	1.29
G3345	Navigational, measuring, electromedical, control instrument	0.949	0.963	Increased	2.76
G33521	Small electrical appliance	0.914	0.851	Decreased	0.06
G33522	Major appliance	0.868	0.895	Increased	0.26
G3351	Electric lighting equipment	0.935	0.969	Increased	0.23
G3353	Electrical equipment	0.940	0.959	Increased	0.48
G33591	Battery	0.825	0.928	Increased	0.17
N33592	Communication and energy wire and cable	0.939	0.948	Increased	0.18
G33593T9	Other electrical equipment	0.941	0.954	Increased	0.47
G336111	Automobile	0.825	0.855	Increased	0.62
G336112	Light truck and utility vehicle	0.832	0.845	Increased	1.88
G33612	Heavy duty truck	0.821	0.836	Increased	0.23
G3362	Motor vehicle body and trailer	0.901	0.889	Decreased	0.46
G3363	Motor vehicle parts	0.888	0.899	Increased	2.49
G3364	Aerospace product and parts	0.934	0.951	Increased	3.44
N3365	Railroad rolling stock	0.913	0.901	Decreased	0.10
G3366	Ship and boat building	0.954	0.925	Decreased	0.61
N3369	Other transportation equipment	0.926	0.919	Decreased	0.23
N3371	Household and institutional furniture and kitchen cabinet	0.948	0.961	Increased	0.64
G3372A9	Office and other furniture	0.922	0.906	Decreased	0.56
G339	Miscellaneous	0.960	0.973	Increased	2.79
N1133	Logging	0.888	0.911	Increased	0.16
G51111	Newspaper publishers	0.923	0.934	Increased	0.52
G51112T9	Periodical, book, and other publishers	0.913	0.856	Decreased	1.42

Source: FRED. Elaborated by the author.

Table 9: Accumulated production growth by industry and by time period.

Industry code	Industry description	Accumulated growth (%) 1972-2002	Accumulated growth (%) 2002-2017	Weight (%) 2002	Weight (%) 2017
B50001	**Total**	**116.0**	**11.9**	**100.00**	**100.00**
G211111	Crude petroleum and natural gas extraction	-27.4	62.8	3.81	9.25
G211112	Natural gas liquid extraction	14.3	90.9	0.31	0.54
N2121	Coal mining	58.3	-32.1	0.64	0.77
G2122	Metal ore mining	34.1	0.9	0.21	0.59
G2123	Nonmetallic mineral mining and quarrying	32.5	-5.8	0.66	0.88
G213	Support activities for mining	-11.8	-17.8	0.76	1.63
G22111	Electric power generation	177.7	1.0	4.23	4.58
G22112	Electric power transmission, control, and distribution	128.6	15.4	4.18	4.46
G2212	Natural gas distribution	-9.2	1.7	1.25	1.36
G3111	Animal food	147.0	31.3	0.44	0.59
G3112	Grain and oilseed milling	101.5	11.1	0.74	0.75
G3113	Sugar and confectionery product	45.2	-1.4	0.56	0.50
G3114	Fruit and vegetable preserving and specialty food	58.5	6.0	1.24	1.11
N311511	Fluid milk	3.0	-10.0	0.35	0.35
N311512	Creamery butter	-13.3	80.2	0.01	0.02
N311513	Cheese	143.6	55.5	0.21	0.32
N311514	Dry, condensed, and evaporated dairy product	35.6	64.6	0.18	0.27
N31152	Ice cream and frozen dessert	90.8	-29.6	0.18	0.10
G3116	Animal slaughtering and processing	117.8	16.9	1.70	1.96
N3118	Bakeries and tortilla	18.3	-4.3	1.34	1.22
G3119	Other food	117.1	39.6	1.40	1.70
G3121	Beverage	62.3	42.3	1.37	1.85
G3122	Tobacco	-32.7	-39.6	1.40	0.96
G3131	Fiber, yarn, and thread mills	40.1	-45.1	0.15	0.07
G3132	Fabric mills	-4.3	-53.2	0.44	0.16
G3133	Textile and fabric finishing and fabric coating mills	-9.4	-54.2	0.22	0.09
G3141	Textile furnishings mills	73.1	-53.8	0.35	0.17
G3149	Other textile product mills	25.1	-13.7	0.21	0.16
G315	Apparel	-36.0	-79.1	0.84	0.15
G316	Leather and allied product	-71.5	-33.9	0.12	0.06
N3211	Sawmills and wood preservation	26.7	-0.6	0.32	0.38
G3212	Veneer, plywood, and engineered wood product	74.3	-18.6	0.34	0.31
G32191	Millwork	57.5	-12.3	0.40	0.37
N32192	Wood container and pallet	95.0	49.8	0.10	0.13
G32199	All other wood product	-17.1	-20.7	0.32	0.23
N32211	Pulp mills	123.4	-5.4	0.07	0.08
G32212	Paper mills	56.6	-30.8	1.06	0.60
N32213	Paperboard mills	33.6	-1.6	0.45	0.57

N32221	Paperboard container	23.7	-3.7	0.73	0.73
G32222	Paper bag and coated and treated paper	32.8	-23.9	0.35	0.25
G32223A9	Other converted paper products	141.4	-14.2	0.49	0.30
G323	Printing and related support activities	105.5	-27.4	2.46	1.44
G32411	Petroleum refineries	33.7	15.2	1.18	2.58
N32412A9	Paving, roofing, and other petroleum and coal products	41.1	-1.9	0.36	0.58
G3254	Pharmaceutical and medicine	286.9	-14.0	4.36	4.46
G32511A9	Organic chemicals	41.9	34.4	1.15	2.52
G32512T8	Basic inorganic chemicals	22.0	-32.5	0.76	0.71
N325211	Plastics material and resin	139.2	-1.8	0.69	0.96
G325212	Synthetic rubber	33.3	-26.4	0.11	0.09
N32522	Artificial and synthetic fibers and filaments	11.6	-33.1	0.15	0.08
G3253	Pesticide, fertilizer, and other agricultural chemical	51.4	28.6	0.39	0.56
G3255T9	Paints, soaps and toiletries, and other chemical products	88.0	-5.2	3.10	2.92
G3261	Plastics product	319.1	-1.9	3.14	3.02
G32621	Tire	6.3	-20.8	0.32	0.25
G32622A9	Rubber products ex. tires	60.4	-9.3	0.39	0.35
G32711	Pottery, ceramics, and plumbing fixture	-8.2	-49.7	0.09	0.05
G32712	Clay building material and refractories	-12.3	-17.9	0.13	0.11
G3279	Other nonmetallic mineral product	71.1	18.0	0.39	0.46
G3274	Lime and gypsum product	45.3	-4.6	0.10	0.13
G3272	Glass and glass product	29.8	-6.3	0.54	0.48
N32731	Cement	4.9	-23.0	0.19	0.16
N32732T9	Concrete and product	53.1	-15.4	0.83	0.82
G3311A2	Iron and steel products	-21.6	0.1	1.02	1.26
G3313	Alumina and aluminum production and processing	0.5	6.8	0.39	0.38
G3314	Nonferrous metal (ex. aluminum) production & processing	-26.7	14.2	0.33	0.49
G3315	Foundries	-10.9	-19.1	0.64	0.50
G332	Fabricated metal product	45.5	-2.9	5.77	5.51
G33311	Agricultural implement	2.8	24.2	0.40	0.43
G33312	Construction machinery	3.4	35.4	0.31	0.44
N33313	Mining and oil and gas field machinery	-18.7	53.6	0.15	0.21
G3332	Industrial machinery	28.6	-13.5	0.75	0.53
G3333A9	Commercial & service industry machinery & other general	153.2	19.2	1.70	1.98
G3334	Ventilation, heating, air-conditioning, & refrigeration eq	28.2	-2.7	0.69	0.67
G3335	Metalworking machinery	3.4	1.6	0.66	0.54
G3336	Engine, turbine, and power transmission equipment	13.9	-12.4	0.72	0.57
G3341	Computer and peripheral equipment	130918.3	172.1	1.42	0.36
G3342	Communications equipment	2676.3	106.4	1.34	0.53
G3343	Audio and video equipment	146.7	-61.1	0.14	0.04

G3344	Semiconductor and other electronic component	30528.9	843.3	2.84	1.29
G3345	Navigational, measuring, electromedical, control instrument	401.4	36.7	2.36	2.76
G33521	Small electrical appliance	16.6	-24.8	0.11	0.06
G33522	Major appliance	78.6	-9.7	0.31	0.26
G3351	Electric lighting equipment	10.4	-12.6	0.30	0.23
G3353	Electrical equipment	10.0	-22.5	0.69	0.48
G33591	Battery	111.1	30.6	0.14	0.17
N33592	Communication and energy wire and cable	91.4	-20.9	0.19	0.18
G33593T9	Other electrical equipment	77.0	10.5	0.47	0.47
G336111	Automobile	-6.5	6.9	1.20	0.62
G336112	Light truck and utility vehicle	2387.0	23.4	2.27	1.88
G33612	Heavy duty truck	139.7	31.6	0.13	0.23
G3362	Motor vehicle body and trailer	6.6	29.8	0.37	0.46
G3363	Motor vehicle parts	132.7	17.7	3.61	2.49
G3364	Aerospace product and parts	48.5	36.2	2.67	3.44
N3365	Railroad rolling stock	-41.6	37.2	0.16	0.10
G3366	Ship and boat building	19.6	13.5	0.51	0.61
N3369	Other transportation equipment	133.7	47.0	0.24	0.23
N3371	Household and institutional furniture and kitchen cabinet	68.8	-33.6	1.06	0.64
G3372A9	Office and other furniture	110.8	-17.5	0.75	0.56
G339	Miscellaneous	142.3	2.0	3.24	2.79
N1133	Logging	44.1	-11.2	0.21	0.16
G51111	Newspaper publishers	-17.5	-63.8	1.55	0.52
G51112T9	Periodical, book, and other publishers	126.7	-49.8	2.90	1.42

Source: FRED. Elaborated by the author.

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