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Investment, Autonomous Demand and Long Run Capacity Utilization: An Empirical Test for the Euro Area

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Working Paper, No. 116/2019

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Abstract

In recent years, the role attached to the autonomous components of aggregate demand has attracted rising attention, as testified by the development of the Sraffian Supermultiplier model (SSM) and the attempts to include autonomous demand in the Neo-Kaleckian model. This paper reviews and empirically tests the validity and the policy conclusions of the two models in the Euro Area. First, we theoretically assess whether the SSM may constitute a complex variant of the Neo-Kaleckian model. In this sense, it is shown that results compatible with the SSM can be obtained by implementing a set of mechanisms in a modified Neo-Kaleckian model, leading to the convergence towards a desired rate of utilization. Furthermore, the chief difference between the models is recognized to be the role attached to the rate of capacity utilization in the long run. Second, the paper empirically tests the main implications of the models in the Euro Area, based on Eurostat data. In particular, the discussion outlines the short and long-run relation between autonomous demand and output, by testing both the cointegration and the direction of causality between the two with a VECM model. Moreover, the role accounted by both theories to the actual rate of capacity utilization and its discrepancies from the normal rate is empirically assessed, through a time-series estimation of the Sraffian and Neo-Kaleckian investment functions. While confirming the theoretical relation between autonomous demand and output in the long run, the results show that the dynamics of the rate of capacity utilization still plays a key role in the short-run adjustment mechanism – despite its stationary behaviour in the long term. Therefore, admitting that Keynesian results may hold even after the traverse, our work suggests to be Kaleckian in the short run and Sraffian in the long run.

JEL classification: B51; E11; E12; O41; O47; O52
Keywords: distribution, effective demand, Eurozone, growth, Neo-Kaleckian, Sraffian, Supermultiplier

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Acknowledgments: I would like to thank Eckhard Hein and Marc Lavoie for their support and guidance, as well as Maria Cristina Barbieri Góes and Vinicius Diniz Moraes for helpful comments on an earlier draft. All remaining errors are, of course, my own.

1 Introduction

In the aftermath of the crisis of 2007 – 2008 the debate on stagnation and the mild recovery of the European economies gained the center of academic and non-academic discussion. Within the political sphere, the diagnosis has been attached to austerity measures, the reduction of labor costs and flexibilization of labor markets. Regarding European economies, both the policy mix advocated by the European Commission - based on the strengthening of the Stability and Growth Pact through the Fiscal Compact - as well as the demands of the Troika have proven to be unsuccessful in establishing a strong recovery. Likewise, it seems legitimate to search for alternative theories encompassing short-run dynamics, distribution and long term growth.

The failure of the Great Moderation in both its theoretical background and policy implication, pushed economic theory to rethink the link between demand, distribution and growth. An attempt in this sense has been provided for long by heterodox schools of thought, above all Post-Keynesian. In line with this tradition, the paper focuses on two specific models, namely the Sraffian Supermultiplier and the Neo-Kaleckian models. Whilst this latter is well-established in the Post-Keynesian school, the former approach has recently attracted rising attention, highlighting the role of autonomous components of demand in shaping the long-run growth path of the economy.

Therefore, in line with the research initiated by Garegnani (1962), this paper reviews the attempts to conjugate the Keynesian-Kaleckian principle of effective demand in the long run with the Neo-Ricardian approach to growth and distribution (Sraffa, 1960). Departing from the pioneering work of Serrano (1995a; 1995b), we analyze the role played by autonomous non-capacity creating components of demand both in the short and in the long run.

In this regard, the first research goal is to theoretically assess whether the Sraffian Supermultiplier model could constitute a variant of the Neo-Kaleckian model (Lavoie, 2016, 2017) or if it is rather a completely different one superseding the Neo-Kaleckian, as argued by Cesaratto (2017). In accordance with Lavoie (2016), it is assumed that we can obtain results very similar to those put forward by Sraffian authors by incorporating a set of mechanisms in a modified Neo-Kaleckian model with autonomous expenditure components.

The second research goal is an empirical assessment of key implications of the models in the Euro Area, following the methodology introduced by Girardi and Pariboni (2015, 2016). The empirical investigation moves along two lines. First, it seeks to assess whether autonomous demand and output are correlated in the long run and if a causal relation between the variables can be identified regarding the short-run adjustment process. In line with the Supermultiplier theory, it is assumed that causality runs from autonomous demand to output both in the short and in the long run. Second, we investigate the nature of the long-run rate of capacity utilization, further estimating the effect of changes in the variable on investment dynamics, making use of Sraffians and Neo-Kaleckian specifications of the investment function. In doing so, the actual rate of capacity utilization is expected to be a stationary variable in the long run, in line with the Sraffian-Classical framework.

The methodology is based both on a review of the existing literature and on data analysis. More specifically, the time-series for the variables of interest will be constructed by making use of the Eurostat database.

The paper is divided as follows. Section (2) presents the literature review and the critical discussion of the Sraffian Supermultiplier and Neo-Kaleckian models. Section (3) describes the adopted methodology, as well as discussing the stylized facts on autonomous demand, output and long-run capacity utilization. Section (4) presents the details regarding the econometric tests, model estimation and their respective results. More specifically, it deals with the cointegration test between autonomous demand and output, the VECM estimation, impulse response analysis, as well as estimating the long-run stationarity of the rate of capacity utilization and the Sraffian and Kaleckian investment functions. Section (5) comments on the theoretical framework in light of the preceding empirical analysis. Section (6) concludes, summarizing the findings.

2 Reconsidering Demand-led Growth: A Critical Comparison of the Sraffian Supermultiplier and the Neo-Kaleckian Model

This Section presents the literature review on the Sraffian Supermultiplier (2.1) and the modified Neo-Kaleckian model with autonomous expenditures (2.2). Lastly, Subsection (2.3) discusses the compatibility of the two models.

2.1 The Sraffian Supermultiplier Model

The Supermultiplier Model constitutes a macroeconomic way of conjugating the Keynesian-Kaleckian principle of effective demand in the long run with the Neo-Ricardian approach to growth and distribution (Sraffa, 1960), in line with the research started by Garegnani (1962) and then developed by Serrano (1995a, 1995b). In particular, the model puts emphasis on the role of autonomous demand growth in shaping the dynamics of output in the long run, where autonomous components of demand are generally defined as "those expenditures that are neither financed by contractual wage income nor can create capacity" (Serrano, 1995b, p.8). A more precise definition will be provided later.

In line with Serrano (1995b) we can list some of the main properties of the model:

- Keynesian Hypothesis in the long run (Garegnani, 1992), i.e. the realized level of investment generates a corresponding amount of savings not only in the short and long run, but also in "the long period, in which productive capacity changes" (*ibid.*, p.47);

- Autonomous demand generates induced consumption via the multiplier and induced (capacity-creating) investment through the accelerator process. The multiplier-accelerator process of consumption and investment determines the long-run trends of capital accumulation;

- Long-run convergence of the rate of capacity utilization to its normal value, in line with what Serrano (1995b, p.8) calls "long-period effective demand".

Following the notation of Girardi and Pariboni (2016), we can define some baseline equations of the simple Sraffian Supermultiplier model as follows:

$$Y = C + I + G + (X - M) \tag{1}$$

$$C = C_0 + C_y = C_0 + c(1-t)Y \tag{2}$$

$$M = mY \tag{3}$$

$$I = hY \tag{4}$$

Equation (1) constitutes the output equation of an open economy with government activity and income taxes. Total consumption (Equation 2) is defined as the sum of induced consumption out of disposable income and autonomous consumption C_0. Furthermore, both import and investment are assumed to be a linear function of income in each time period (Equations 3, 4). Regarding investment, this constitutes the simplest way "to reflect the assumption that entrepreneurs invest in order to be able to produce the amount they expect to be demanded." (Girardi and Pariboni, 2016, p.525). Furthermore, the term h, i.e. the investment share, can be defined as "the marginal propensity to invest of firms" (Freitas and Serrano, 2015, p.261).

Having set the baseline of the model, we ought to focus on the definition of what the autonomous components of aggregate demand are and the role they play in shaping the long-run growth path of the economy. In this sense, it is worth recalling the classification adopted by Serrano (1995b) and Cesaratto et al. (2003) of the components of effective demand according to two criteria:

- Capacity creation, i.e. establishing whether or not the dynamics of each component has gross capacity generating effects;
- Dependence on the income level, i.e assessing if a specific component is induced (dependent on actual or expected income levels) or autonomous.

On the basis of this taxonomy, Cesaratto et al. (2003, p.42) define the autonomous, non-capacity creating components of effective demand as the sum of total government spending, total exports, autonomous consumption and autonomous business expenditure. Table (1) summarizes the taxonomy described above.

Table 1: Components of effective demand

	Capacity creating	Non-capacity creating
Autonomous	-	C_0, G, X RD
Induced	I	C_y, M

Source: authors' representation, adapted from Cesaratto et al. (2003)

Consequently, autonomous demand (Z) is defined as the sum of exports (X), public expenditure (G), autonomous business expenditures[1] (RD), credit-financed consumption and consumption financed out of accumulated wealth (C_{0t}):

$$Z = C_0 + G + X + RD \tag{5}$$

After defining the tax-adjusted marginal propensity to save as $s = 1-c(1-t)$ and solving the system of Equations (1-4) for Y, we obtain the level of output as the product of autonomous demand and the otput supermultiplier (SM henceforth):

$$Y = \frac{Z}{s+m-h} = SM \times Z \tag{6}$$

As Girardi and Pariboni (2016) pointed out, Y does not correspond automatically to the level of output realized when the rate of capacity utilization is equal to the normal one, but a continuous tendency of the former to stabilize at its normal level in the long run should be presumed[2].

From Equations (4) and (6) we can derive the growth rate of output and capital accumulation as follows:

$$g^Y = g^Z + \frac{\dot{h}}{s+m-h} \tag{7}$$

$$g^K = \frac{hu}{v} \tag{8}$$

where $v = K/Y^P$. For the sake of simplicity, we do not consider depreciation.

Whenever the economy moves away from the normal rate of capacity utilization, firms will experience a discrepancy with their investment decision, thus facing the choice to adjust their investment shares. The endogenous response of the variable to discrepancies in utilization rates is modeled as follows:

$$\dot{h} = h\gamma(u - u^n) \tag{9}$$

where $\gamma > 0$ is a positive reaction coefficient. Differently than Girardi and Pariboni (2016), this paper does not assume $u^n = 1$, considering it more accurate to set the normal rate of capacity utilization equal to unity ($u_{fc} = 1$) only when full capacity

[1] We use the notation RD to denote autonomous business expenditures since they are considered to be equal to expenditures in research and development of the business sector, as it will be shown in Subsection (3.1).

[2] As argued by (Girardi and Pariboni, 2016, p.527): "the supermultiplier model does not assume that productive capacity is continuously utilized at its normal level. Discrepancies between the actual and the normal degree of capacity utilization are allowed in the out-of-equilibrium dynamics and the reaction of investment to these discrepancies [...] drives the convergence of the economy towards a normal utilization of the productive capacity." For further discussion, see Bortis (1997).

is hit[3].

Furthermore, from Equations (4) and (9), it follows that investment growth depends on output growth and the discrepancies in capacity utilization rates:

$$g^i = g^Y + \beta_1(u - u^n) \tag{10}$$

The rationale behind this specification is provided by Cesaratto et al. (2003, p.42):

> According to the principle of effective demand, income in any period is determined, independently of the level of capacity, by the level of effective demand. [...] [A]mortisation and expansion depend on current effective demand (hence, the degree of utilisation of capacity).

This mechanism draws a significant difference with Neo-Kaleckian contributions, as it will be seen in Section 2.2.

Let us now appreciate the long-run position of the model, characterized by $u = u^n$ and $\dot{h} = \dot{u} = 0$. From this conditions, it follows that all equilibrium growth rates are equalized at a normal level:

$$g^n = g^i = g^Y = g^K = g^Z \tag{11}$$

More specifically, the equality $g^i = g^Y$ is of particular interest, implying that in the long run steady-state g^i will be insensitive to u and investment becomes fully induced. The rationale for this conclusion is provided by by Vianello (1985, p.76):

> [T]his indeterminateness in the degree of utilization of productive capacity is bound to disappear as soon as we move from short-run to long-run analysis. For this necessarily involves a shift of attention from changes in the degree of utilisation of productive capacity to changes in productive capacity itself, on the reasonable supposition that the latter does not tend to remain either systematically under-utilised or systematically over-utilised.

[3] In other words, this means that the definition of the actual and normal rates of capacity utilization is, respectively $u = Y/Y_{fc}$ and $u^n = Y_n/Y_{fc}$ (Lavoie, 2014; Hein, 2014). Subsequently, also the capital-output ratio is defined with full capacity output at the denominator $v = K/Y_{fc}$. In this sense, this work differs from the long-lasting Sraffian tradition of defining variables weighted on the basis of normal positions (Kurz, 1986), but it reflects also in the notation an increasing awareness within the Sraffian strand that discrepancies between normal positions and full capacity exist both in the short and in the long run.

Summarizing, the Sraffian Supermultiplier constitutes a demand-led model in which demand is not led by investment but by (autonomous) consumption. Therefore, autonomous non-capacity creating components of aggregate demand explain long-run economic growth; economic policies, by acting on them, may thus (permanently) stimulate growth. We will come back on this point in the empirical estimation (Subsection 4.2).

2.2 The Modified Neo-Kaleckian Model

In this Subsection we present a modified version of the Canonical Neo-Kaleckian model (Rowthorn, 1981; Dutt, 1984)[4] that includes non-capacity creating autonomous expenditures, in line with the work of Lavoie (2016). The Subsection focuses on the inclusion of autonomous components in the short-run model, then extending it into a longer run[5], explicitly considering the role of autonomous demand in shaping the growth path of the stylized economy.

The short-run Neo-Kaleckian model with autonomous expenditure can be formalized with the following three-equations system:

$$r = \frac{\pi u}{v} \tag{12}$$

$$g^s = \frac{s_\pi \pi u}{v} - z \quad with \quad z = Z/K \tag{13}$$

$$g^i = \gamma + \gamma_u(u - u^n) \ , \ \ \gamma, \gamma_u > 0 \tag{14}$$

Compared to the canonical Neo-Kaleckian model, the crucial difference of its amended version is the different way saving dynamics are modeled. In line with the argument put forward by Serrano (1995b), the saving function takes now into account the term z, defined as the ratio of capitalists' autonomous expenditure to the capital stock. This allows the average propensity to save to "move endogenously when there are autonomous consumption expenditures, even if both the marginal propensity to save and the profit share are constant" (Lavoie, 2016, p.177).

From Equation (13), we can derive the average propensity to save out of national income:

$$\frac{S}{Y} = s_\pi \pi - \frac{zv}{u} \tag{15}$$

[4] A formal presentation of the model, compatible with the notation used here for its amended version, can be found in Hein and van Treeck (2011).

[5] Coherently with the empirical work presented in the next chapters, the theoretical analysis is here limited to the short and the long run, avoiding the difficulties associated with long-run steady states. For a discussion of the complex variant of the Neo-Kaleckian model encompassing long-run Harrodian mechanisms, see Allain (2015) and Lavoie (2016).

Equating the saving equation (13) and the investment equation (14), we can derive the effective demand curve ED (Lavoie, 2014), also called realization curve (Rowthorn, 1981). Differently than in the canonical model, the ED curve includes now the variable z, positively related to the profit rate r:

$$r = \frac{z + \gamma - \gamma_u u^n + \gamma_u u}{s_p} \tag{16}$$

The main implication for the short-run equilibrium is that, in line with the suggestion of Serrano (1995a), the modified Neo-Kaleckian model leads to an *ex-post* adjustment of saving to investment even in the case of constant propensity to save out of profit, income distribution and - above all - capacity utilization.

From this consideration, it follows that:

> [...] the Keynesian Hypothesis is more general than previously thought, since it does not need to rely on an endogenous rate of utilization in the long run, in contrast to the neo-Kaleckian approach, or on an endogenous profit share, as in the earlier Kaldor-Robinson growth models. (Lavoie, 2016, p.177)

Solving the system of equations (12), (13) and (14), we get to the short-run solution for the equilibrium positions of the rate of capacity utilization, the profit rate and the accumulation rate:

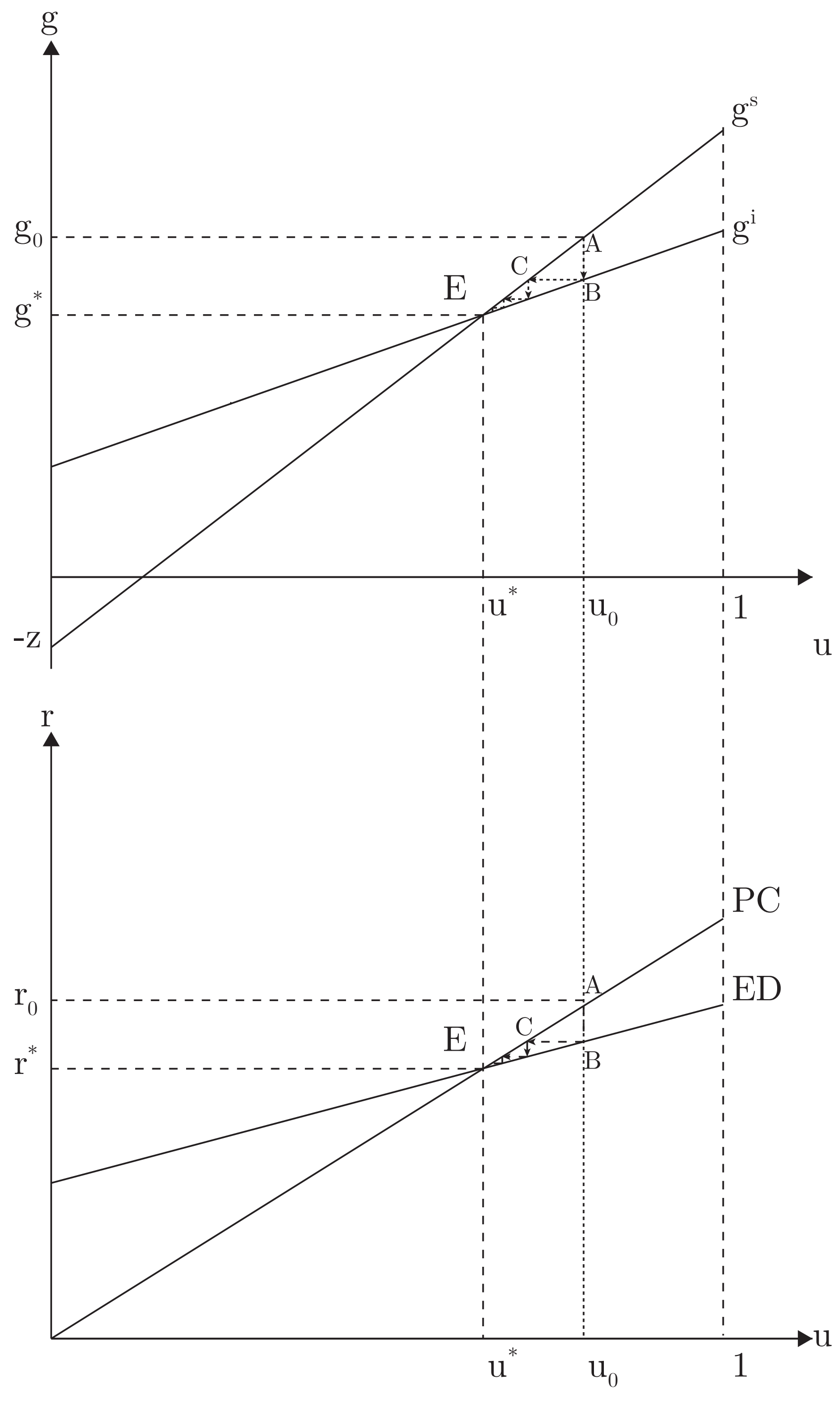
$$u^* = \frac{(\gamma - \gamma_u u^n + z)v}{s_p \pi - v\gamma_u} \tag{17}$$

$$r^* = \frac{\gamma - \gamma_u u^n + z}{s_p - v\gamma_u/\pi} \tag{18}$$

$$g^* = \frac{s_p \pi(\gamma - \gamma_u u^n) + \gamma_u v z}{s_p \pi - v\gamma_u} \tag{19}$$

As in the Canonical Neo-Kaleckian model, we assume Keynesian stability to hold, i.e. savings adjust faster than investment to changes in the rate of utilization ($s_p \pi > \gamma_u$), as graphically illustrated in Figure (1). In the short run, the paradoxes of thrift and of cost still hold, as in canonical model. However, this no longer holds when autonomous demand grows, as it will be shown below.

Figure 1: Stability of the equilibrium in the short run Neo-Kaleckian model with autonomous expenditures



Source: author's representation

In order to move towards long-run analysis, we ought to relax the assumption of a constant autonomous expenditure to capital ratio ($z = \bar{z}$), providing for autonomous expenditures to grow at an exogenous rate g^Z. In other terms, we now let the ratio $z = Z/K$ to move endogenously through time, according to the following growth rate[6]:

$$\hat{z} = \frac{\dot{z}}{z} = \hat{Z} - \hat{K} = \bar{g}^Z - g = (\bar{g}^Z - \gamma) - \gamma_u(u^{**} - u^n) \tag{20}$$

where the rate of growth of autonomous consumption $\bar{g}^Z$ is assumed to be an unexplained constant. Furthermore, it can be shown that z converges to a stable value z^{**} in the long-run, i.e. $\delta\hat{z}/\delta z < 0$ whenever Keynesian stability is assumed.

With $\hat{z} = 0$, the equilibrium position is thus characterized by:

$$u^{**} = u^n + \frac{\bar{g}^Z - \gamma}{\gamma_u} \tag{21}$$

$$z^{**} = \frac{s_p \pi u^{**}}{v} - \bar{g}^Z \tag{22}$$

$$r^{**} = \frac{z^{**} + g^Z}{s_p} \tag{23}$$

The impact effects of the modified model are summarized in Table (2).

Table 2: The impact effects of the modified model in the long-run

	γ	γ_u	s	π	g^Z
u**	-	-	0	0	+
g**	0	0	0	0	+
r**	0	-	-	0	+
z**	0	-	+	+	-

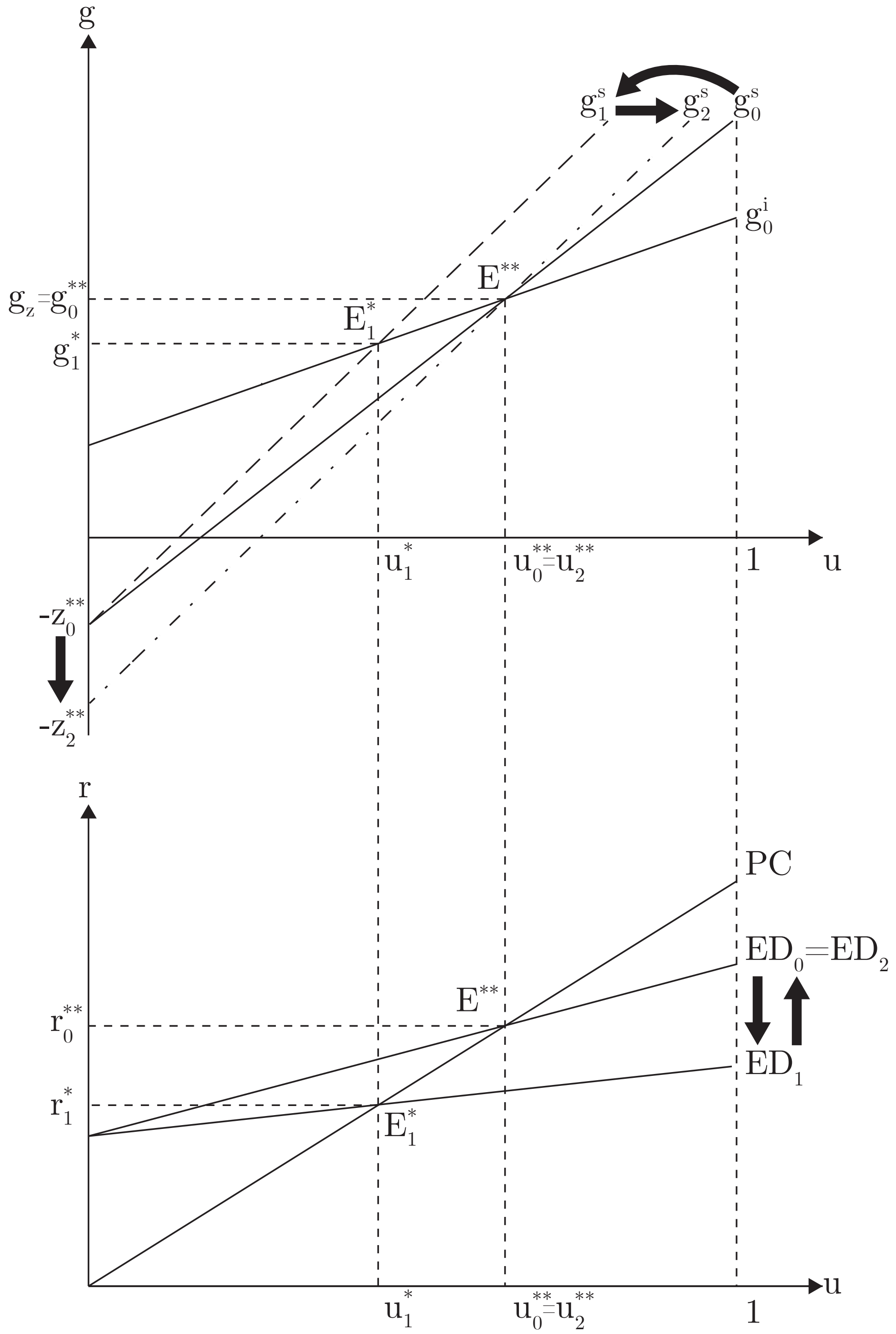
Source: author's representation, adapted from Allain (2015)

As noted by Lavoie (2016), in this modified model the paradoxes of thrift and cost no longer hold in the long-run, since every discrepancy between g^Z and g will be absorbed by endogenous changes of the fraction z. This is shown graphically (Figure 2) by analyzing the impact of an increase in the propensity to save out of profits[7]: the counterclockwise rotation of the curve from g^0_s to g^s_1 will generate a short-run equilibrium E^*_1 that corresponds though to a position in which $\bar{g}^Z > g$. Consequently, z will gradually increase up to its new equilibrium value z^*_2 (Equation 20), leading to a downward shift from g^1_s to g^2_s and bringing back the equilibrium rates of capacity utilization and growth to their initial values g^{**}_0 and u^{**}_0.

[6]Henceforth, the notation with double asterisks is meant to indicate long-run equilibria.

[7]A similar example can be done by analyzing a variation in the profit share, with the only difference being the shift of the PC instead of the ED curve.

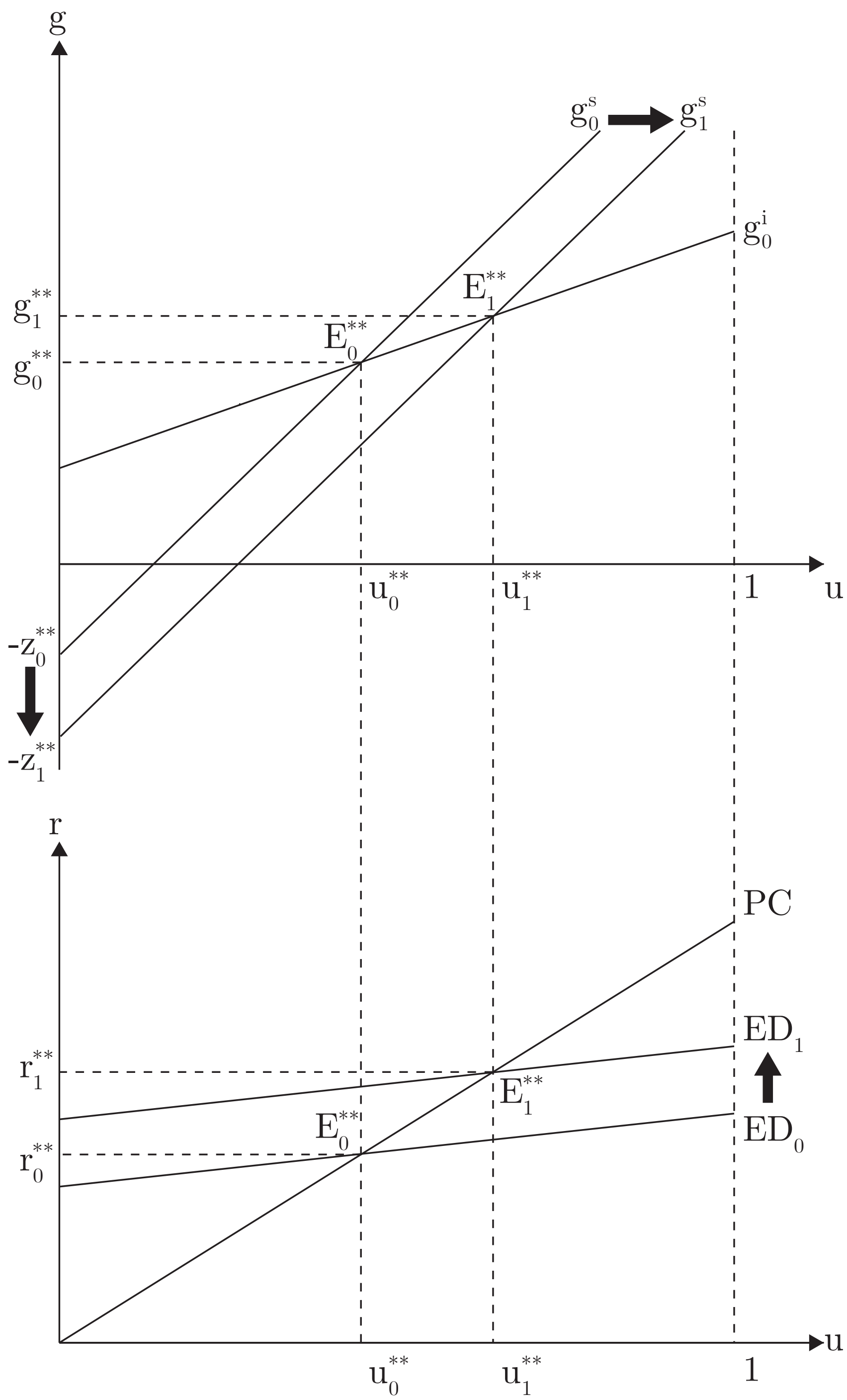
Figure 2: The long-run impact of an increase in the propensity to save in the modified Neo-Kaleckian model



Source: author's representation

Therefore, the only variable which impacts the long-run equilibrium value of u and g is precisely the exogenous growth rate $\bar{g^Z}$, as it is shown in Figure (3). According to Equation (20) when $\bar{g^Z}$ increases, this will trigger an increase in the value of z, until the gap $\bar{g^Z} - g$ is filled and the economy stabilizes at an higher level of economic activity and utilization.

Figure 3: The long-run impact of an increase in the growth rate of autonomous demand in the modified Neo-Kaleckian model



Source: author's representation

It is worth noting that the model presented here does not provide any mechanism that leads to the convergence of the actual rate of capacity utilization to its normal value. As acknowledged by (Lavoie, 2016, p.182), "for $u^{**} = u^n$ to be achieved, the γ parameter in the investment equation would need to be equal to g^Z." If we assume - in line with Sraffian authors - that in equilibrium $\gamma = g^Y = g^Z$, the fully-adjusted position reached by the modified Neo-Kaleckian model (Equation 21) is absolutely compatible with the one of the proponents of the Supermultiplier, without any further mechanism.

2.3 Are the Models Compatible or Mutually Exclusive?

Following the exposition of both models, their theoretical assessment is now in order. The fundamental similarities and differences to be noted consist in the very nature of the models, which are both demand-led; however, while for the Neo-Kaleckian model aggregate demand plays a fundamental role through the investment channel, in the Supermultiplier approach it does so by means of exogenous changes in autonomous expenditures.

Furthermore, two key differences regard the long-run role of capacity utilization and the relation between the investment share, the saving ratio and the trend growth rate of the economy. While not dealing with the latter, it is worth discussing the former difference; in particular, as showed in Subsection (2.2), the Neo-Kaleckian models - both in its conventional form and the modified version presented here - provide for an actual rate of capacity utilization that stays endogenous in the short and long run. On the contrary, the Supermultiplier growth model (Subsection 2.1) accounts for the long-run convergence of the actual rate to its normal value, determined by exogenous factor such as conventions, distribution conflict and influenced by the level of long-period effective demand (Garegnani, 1992). However, Subsection (2.2) showed that the theoretical problem of long-run convergence of the actual rate of capacity utilization to its normal rate is solved in the modified Neo-Kaleckian model by assuming the trend growth rate of sales to be equal to the growth rate of autonomous demand[8]. In this sense, albeit maintaining the chief difference concerning the endogenous/exogenous nature of the normal rate of capacity utilization, the two models are compatible in the way they deal with the fully-adjusted position.

Therefore, the issue of whether the actual rate of capacity utilization has a non-stationary behavior - providing support to Kaleckian ideas - or if it is roughly constant, thus confirming Sraffian-classical insights, becomes an empirical one, as it will be tested in Subsection (4.3).

Overall, amending the Neo-Kaleckian model by introducing autonomous expenditures permits to reconcile key Kaleckian elements with the insights provided by the proponents of the Supermultiplier theory, as argued by Lavoie (2016, 2017).

[8]However, the fully-adjusted position may also be reached through the introduction of the Harrodian reaction function, as presented by Allain (2015) and Lavoie (2016).

Albeit on one hand it is still misleading to argue in favor of the absolute compatibility of the two models[9], on the other, key common points should be outlined. More specifically, for the sake of our empirical analysis, we can argue that both the Supermultiplier and the modified Neo-Kaleckian models provide for a very similar role of autonomous components of aggregate demand, both in equilibrium and in the long-run adjustment process.

Furthermore, it is worth discussing three additional remarks, summarizing the ones put forward by Lavoie (2016).

First, it should be noted that in the modified Neo-Kaleckian model and the Supermultiplier, the wage-led and profit-led narrative as put forward in the Post-Kaleckian growth model (Bhaduri and Marglin, 1990) simply disappears, provided that "the growth rates of capital and of output eventually adjust to the given growth rate of autonomous consumption expenditures" (Lavoie, 2016, p.182).

Second, albeit the paradoxes of thrift and of cost disappear in the modified Neo-Kaleckian model, a reduction of the propensity to save or of the profit share have a positive *level* effect on capital, capacity and output rather than *growth* effects alleged in "the unconvincing [*conventional*] neo-Kaleckian arguments" (Cesaratto, 2015, p.175). In this sense, the modified long-run Neo-Kaleckian model overcomes the pittfalls stressed by Sraffian authors (Serrano, 1995b; Cesaratto, 2015), reconciling Keynesian results and steady-state analysis with autonomous demand growth.

Third, Lavoie (2016) notes that in the modified Neo-Kaleckian framework, positive demand shocks have only short-run impacts on the rate of utilization, which comes back to its previous value in the long run, overall ranging around a certain mean value. If we interpret this mean value as the normal rate of capacity utilization (Skott, 2012; Duménil and Lévy, 2014), "the neo-Kaleckian model modified by the addition of autonomous consumption expenditures allows the model to be reconciled with this apparent empirical behaviour of the rate of capacity utilization." (Lavoie, 2016, p.184) However, contrary to what Lavoie (2016) argues, the issue of convergence remains open, fueled by the Sraffian critiques on the nature of investment in the Neo-Kaleckian model. More specifically, Cesaratto (2015) and Girardi and Pariboni (2018) have recently questioned the validity of the Neo-Kaleckian investment function as such, arguing that its specification violates the Keynesian Hypothesis in a fully-adjusted position, namely investment becomes exogenously determined. In fact, when $u = u^n$, then $g^n = g_i^0 = \gamma = s/v$, i.e. an exogenously determined quantity. The solution would be to impose *ex-ante* the trend growth rate of sales to be equal to output growth, as Sraffians would suggest. However, the idea would need further empirical investigation; we will get to this point in Subsection (4.4).

[9]This is impossible, in our view, in light of the unsolved *utilization controversy* Nikiforos (2013).

Summing up the answer to the first research question, we reject the thesis of mutual exclusivity of the two models (Cesaratto, 2015), recognizing their shared and compatible results regarding the role attached to autonomous non-capacity creating components of aggregate demand. More precisely, both models provide for the possibility that autonomous expenditures have direct and persistent impact on the growth path of the stylized economy, as argued by Lavoie (2016). Nonetheless, we recognize that attempting to subsume the Sraffian Supermultiplier as a complex version of the Neo-Kaleckian model may be incorrect from an epistemological point of view. However, given the purpose of this work - aimed to test the empirical relevance of the two models - we can reasonably accept the starting hypothesis of compatibility between the two models, in agreement with the arguments put forward by Lavoie (2016, 2017).

In Section (4), this allows us to deal with the two models in an coherent way while estimating the impact of Z on economic activity, then stressing the differences as regards the role of capacity utilization.

3 Stylized Facts on Output Growth, Autonomous Demand and Capacity Utilization in the Euro Area

In this Section we deal with the methodology used to construct the time series in Subsection (3.1). The stylized facts on autonomous demand, output and the Supermultiplier are reported in Subsection (3.2), whilst the ones on the rate of capacity utilization are covered in Subsection (3.3).

3.1 Methodology and Construction of the Time Series

The construction of the time series of autonomous demand is based on Equation (24), recalled below:

$$Z = C_0 + G + X + RD \tag{24}$$

The quarterly data was retrieved from Eurostat Database[10]. More precisely, the time series is constructed as follows:

- C_{0t}: in line with the empirical work of Girardi and Pariboni (2016), consumer credit has been excluded from the analysis, on the basis of its partly induced nature. Therefore, we consider autonomous consumption to be equal to residential expenditures (dwellings);

[10] For more details, see Appendix A.

- G: differently than both previous theoretical and empirical work, e.g Cesaratto et al. (2003), we do not consider total government expenditure to be autonomous on the level of income. More specifically, gross fixed capital formation of the public sector is excluded from G, due to its presumed induced nature. Hence, this work considers only final consumption expenditure of general government as autonomous[11];

- X: the total level of exports of goods and services, depending *ceteris paribus* "on foreign demand (i.e. exports are financed by exogenous purchasing power)" (Cesaratto et al., 2003, p.42);

- RD: autonomous business expenditure is assumed to be equal to intramural R&D expenditure of the business sector, thus excluding other managerial expenditures. Intramural R&D is defined in the Frascati Manual (OECD, 2015, p.30) as "all current expenditures (including labour and other costs) plus gross fixed capital expenditures (such as for land, buildings, machinery and equipment) for R&D performed within a statistical unit during a specific reference period, whatever the source of funds."

Furthermore, the output is calculated at market prices. Investment is obtained by subtracting residential expenditure from gross fixed capital formation (Girardi and Pariboni, 2015, 2016), the rationale being that residential expenditures has already been considered in the construction of Z. All variables mentioned above are seasonally and calendar adjusted and taken in chain linked volumes (2010 million euro), thus already deflated. All data are aggregated for the Euro Area (EU19), divided in quarters from 1995Q1 to 2017Q4.

Regarding the construction of the time series of the actual rate of capacity utilization, we make use of quarterly survey data for the Euro Area from 1980Q1 to 2018Q1, based on interviews to about 137.000 firms. The methodology is criticized by (Shaikh and Moudud, 2004, p.4), according to whom:

> the difficulty with such surveys is that they do not specify any explicit definition of what is meant by capacity. Thus the respondents are free to choose between various measures of capacity, and the analysts who use this data are free to interpret them in manners consistent with their own theoretical premises.

The criticism, albeit well-founded, has scarce empirical relevance in our case, since our time series is far from the "operative premise [...] that the economic system

[11] Nonetheless we acknowledge that, even with this correction, considering the institutional context of the Eurozone, public consumption expenditure may still be depending on income, further considering the conditions attached to the Stability and Growth Pact and to the Fiscal Compact.

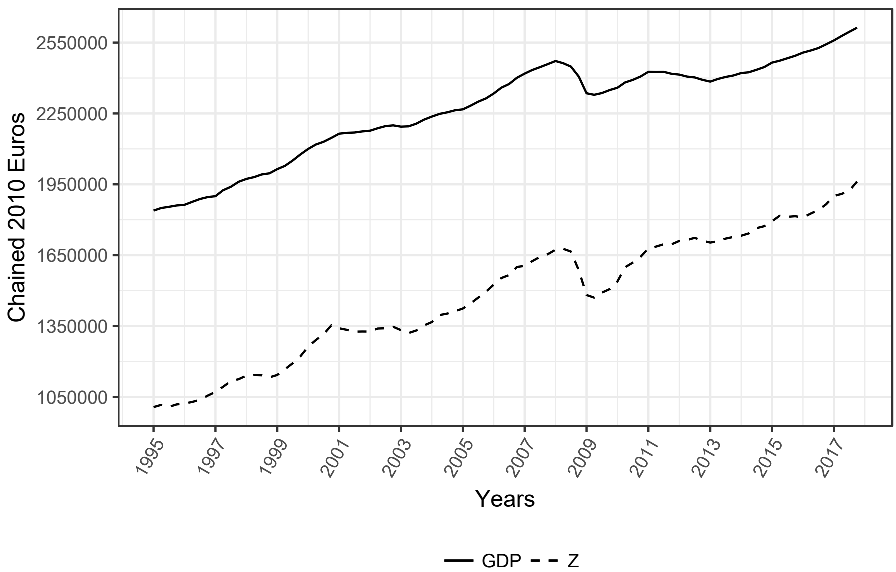
generally operates at, or near, full capacity." (*ibid.*). Furthermore, the choice of making use of survey data allows us to escape to compute actual and normal rates on the basis of full capacity indexes, as it has been done - erroneously in our view - by Schoder (2014)[12].

The estimation strategy as regards the time series of the normal rate of capacity utilization will be discussed in Subsection (4.3).

3.2 Autonomous Demand, Output Growth and the Supermultiplier

Coming to the discussion of the stylized relation between autonomous demand (Z) and GDP it is possible to observe (Figure 4) that the variables not only show a common trend, but they seem to move in step in the considered time frame. Therefore, the stylized facts on Z and GDP for the Euro Area are similar to those for the US, where "Z and output appear to follow a parallel growth path." (Girardi and Pariboni, 2016, p.530). Moreover, the observation of quarterly percentage changes (Figure 5) for both variables is also consistent with the idea that "[i]n the short run, their rates of growth are strongly correlated" (*ibid.*), with a higher variability in the growth rate of Z.

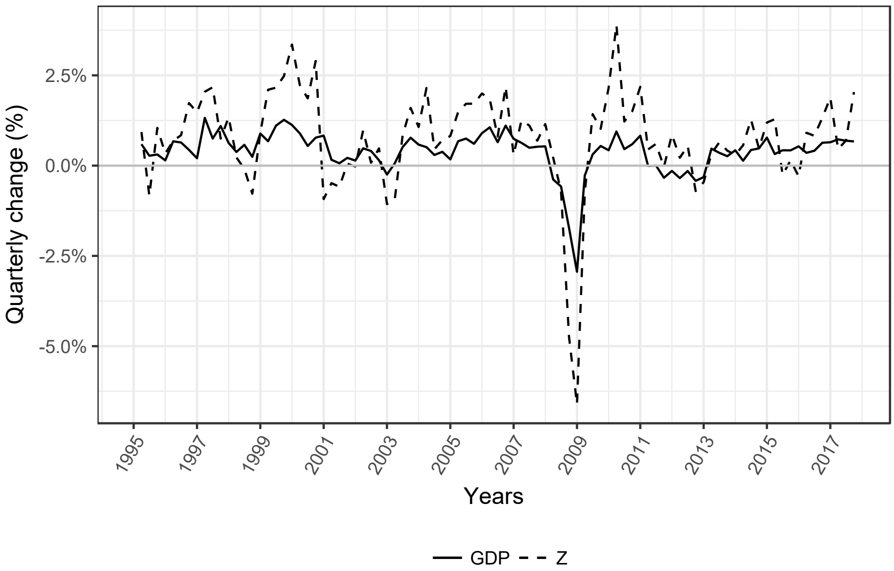
Figure 4: The dynamics of autonomous demand and GDP in the Euro Area, Chained 2010 Euros, (quarterly data, 1995-2018)



Source: authors' representation, based on Eurostat (See Appendix A)

[12] This choice, indeed, would require "theoretical faith not only in the much criticized notion of an aggregate production function [...] but also in the existence of a natural rate of unemployment. (Shaikh and Moudud, 2004, p.5)".

Figure 5: The dynamics of autonomous demand and GDP in the Euro Area, percentage change (%), (quarterly data, 1995-2018)

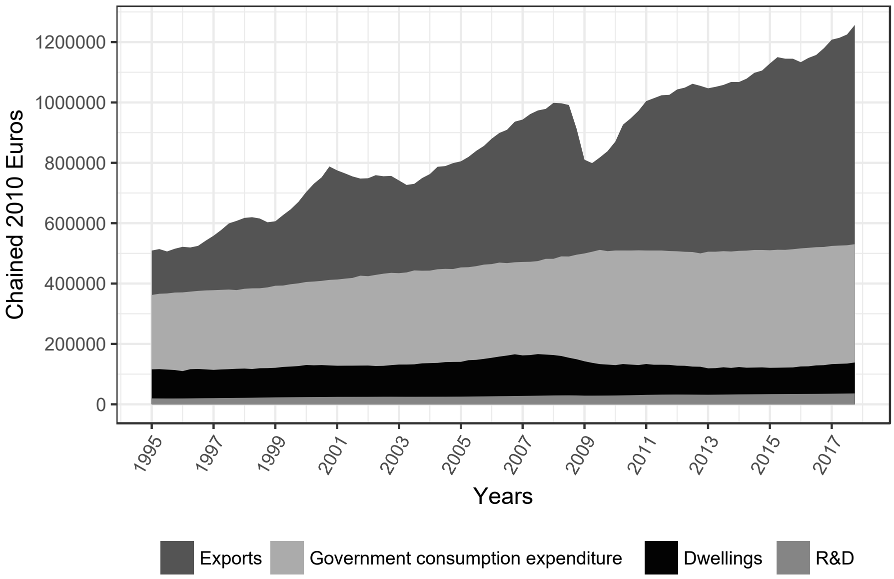


Source: authors' representation, based on Eurostat (See Appendix A)

A quick comment on the dynamics of the variables in the crisis years is now in order. Accordingly, this behavior appears inconsistent with the underlaying theory, with Z seeming to be driven from rather than to drive GDP growth.

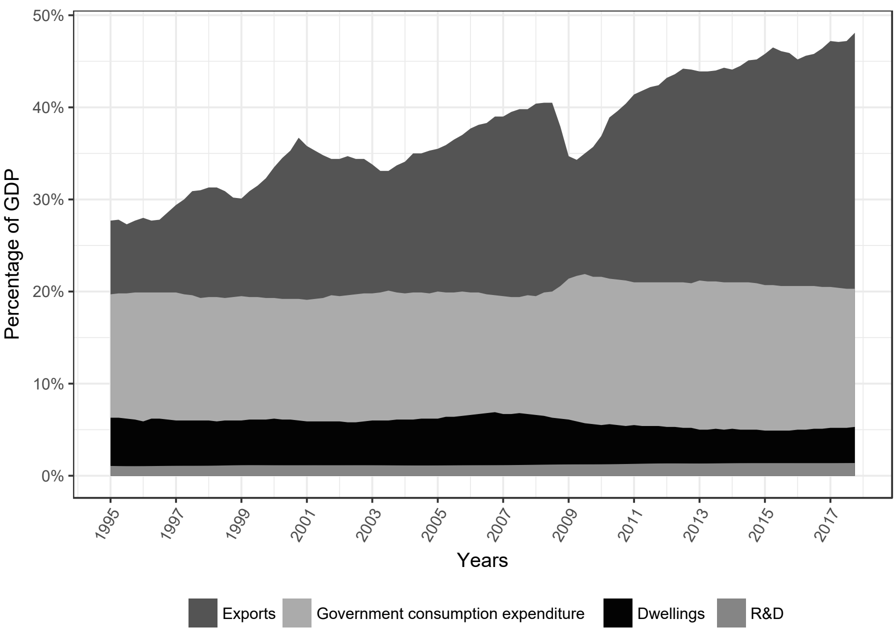
The *conundrum* is explained by the decomposition of autonomous demand (Figure 6 and 7). In the Eurozone, both in levels and percentages of GDP, dwellings and R&D expenditures remained roughly constant, whereas government consumption expenditure mildly rose, particularly in absolute terms. Contrarily, exports of good and services developed in step with output, crashing in 2008 as a consequence of the fall in global demand, but recovering and steadily increasing its share following the turmoil of 2008-2010. Overall, is mainly the external sector that explains the trend in Z and its relation with GDP. Therefore, the stylized results are still consistent with the theoretical implications discussed in Section (2), given that exports are autonomous just from the point of view of the considered economy - the Euro Area - but are still dependent on the level of demand abroad.

Figure 6: The components of autonomous demand in the Euro Area, Chained 2010 Euros, (quarterly data, 1995-2018)



Source: authors' representation, based on Eurostat (See Appendix A)

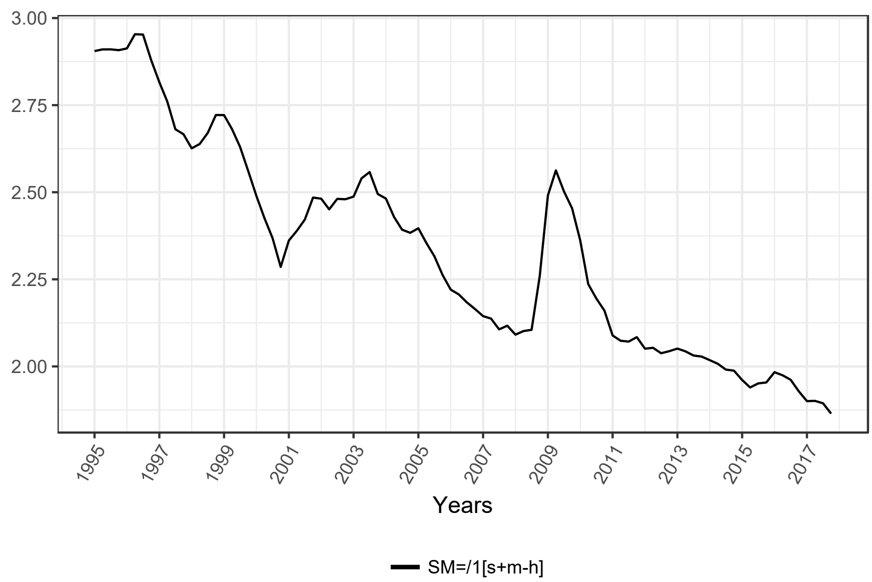
Figure 7: The components of autonomous demand in the Euro Area as percentage of GDP, (quarterly data, 1995-2018)



Source: authors' representation, based on Eurostat (See Appendix A)

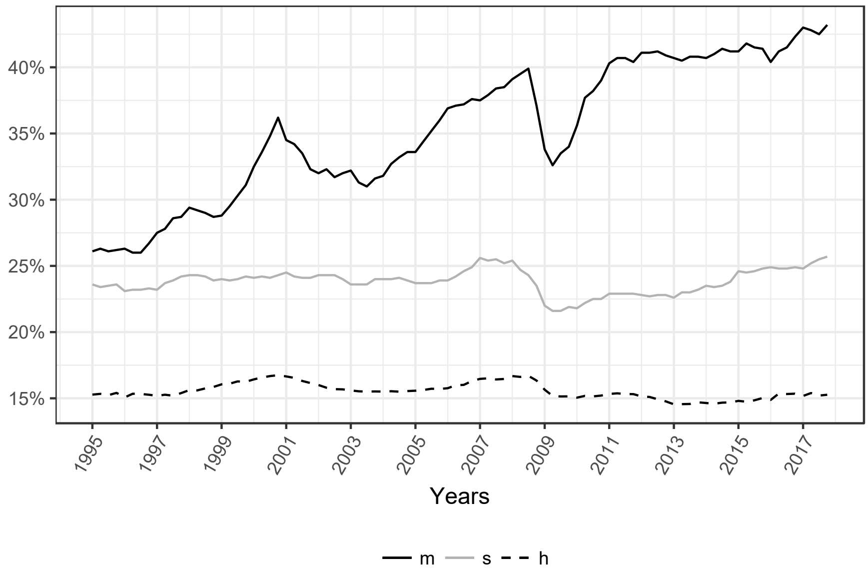
Moving to the dynamics of the Supermultiplier (Figure 8) it is recognizable as a steadily decreasing trend, with two interruptions: in 2000, as a consequence of the introduction of the Euro and in 2008, following the explosion of the Global Financial Crisis. While in the former case the rise of the Supermultiplier was mainly caused by the fall in the propensity to import, in the second it was associated with a crash of all the relevant variables (Figure 9). Overall, the trend dynamics of the Supermultiplier is mainly explained by the external sector, i.e. by the steadily increasing trend in the propensity to import. Furthermore, it is worth stressing that - in line with what was observed for the US economy by Girardi and Pariboni (2016) - also in the Euro Area the Supermultiplier showed a decreasing trend over the last two decades. However, while this trend is relatively mild in the US, it is much more significant in the Eurozone. Moreover, while the empirical analysis of Girardi and Pariboni (2016) shows that the Supermultiplier came back to its pre-crisis values (*circa* 2.6) in the US, in the case of the Eurozone the downward trend continued steadily until today, driven by rises both in the propensity to save and to import, while the investment share remained stagnant. in light of Equation (6), this downward trend - as compared to the dynamics of autonomous demand - supports the secular stagnation hypothesis (Summers, 2014) in a Sraffian fashion.

Figure 8: The Supermultiplier in the Euro Area, (quarterly data, 1995-2018)



Source: authors' representation, based on Eurostat (See Appendix A)

Figure 9: The components of the Supermultiplier in the Euro Area, percentage change (%), (quarterly data, 1995-2018)



Source: authors' representation, based on Eurostat (See Appendix A)

Aiming to summarize the historical dynamics of the described variables, an analysis based on average growth rates is in order. Accordingly, Table (3) shows the annual growth rates of output, autonomous demand and the Supermultiplier. Furthermore, it shows the contributions of each component to the growth of Z and SM. The results are shown both for the entire time frame 1995-2017 and further decomposed in three specific intervals: the years prior to the introduction of the Euro (1995-1999), the pre-crisis years (1999-2008) and its aftermath (2008-2017). First, the results show an overall slowing down in the pace of both output and autonomous demand growth, whose main driver has been exports (with an increasing role especially in post-crisis years). Second, we can acknowledge as the argument put forward by (Girardi and Pariboni, 2016, p.532) is sound also for the case of the Eurozone:

> If we interpret this as an alternative form of 'growth accounting' — based on effective demand instead of factors' supply — we can infer from this exercise that long-run changes in output are mainly accounted for by the growth of demand, while changes in the supermultiplier have been relatively less important

Table 3: Average annual growth of GDP, autonomous demand (Z) and Supermultiplier (SM)

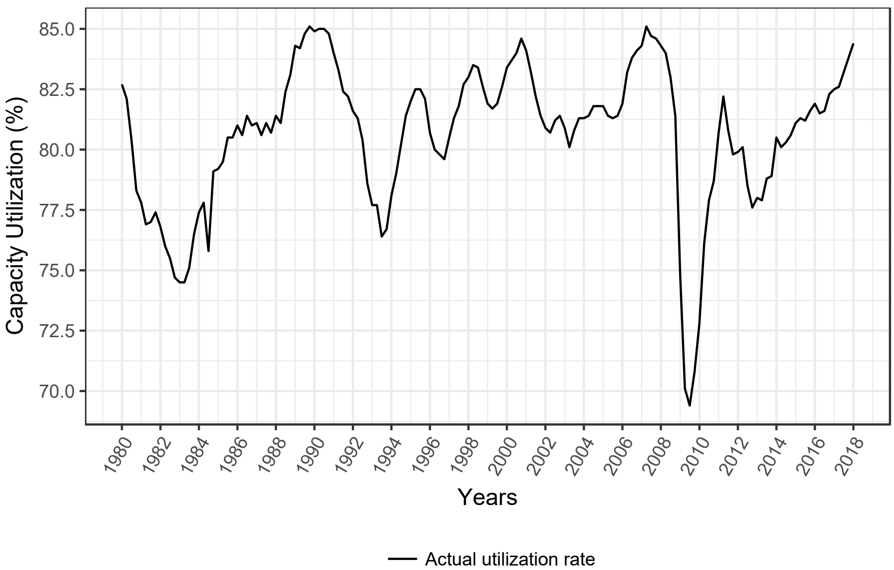
			Contributions to Z growth					Contributions to SM growth		
	GDP	**Z**	*G*	*X*	C_0	*RD*	**SM**	*s*	*m*	*h*
1995-2017	**1,55%**	**3,10%**	0,53%	2,43%	0,09%	0,05%	**-1,69%**	-0,11%	-1,66%	0,08%
1995-1999	**2,49%**	**3,97%**	0,68%	3,00%	0,20%	0,09%	**-1,88%**	-0,32%	-2,51%	0,94%
1999-2008	**2,04%**	**3,88%**	0,74%	2,82%	0,27%	0,05%	**-2,28%**	-0,10%	-2,24%	0,05%
2008-2017	**0,64%**	**1,93%**	0,25%	1,78%	-0,15%	0,04%	**-1,01%**	-0,04%	-0,69%	-0,27%

Note: Contributions may not sum to the aggregate growth rate because of rounding and approximation.
Source: author's calculation, various sources (see Appendix A)

3.3 The Alleged Stationarity of the Long-run Rate of Capacity Utilization

Coming to the discussion of the main difference between the Supermultiplier and the Neo-Kaleckian models, an empirical analysis of the actual rate of capacity utilization is now in order. The dynamics of the time series are shown in Figure (10).

Figure 10: Rate of Capacity Utilization in the Euro Area (quarterly data, 1980-2018)



Source: authors' representation, based on Eurostat (See Appendix A)

The rate oscillates between 69.4% and 85.1%, thus confirming "that there is excess capacity over the long run, as Kaleckians claim." (Lavoie et al., 2004, p.134). However, the time series appears to be fluctuating around a mean value of roughly 80%, without any particular trend[13]. At a first sight, the plausible stationarity of u in a medium to long-run analysis appears at odds with the endogeneity assumption of Kaleckian authors. In other words, as stressed by (Skott, 2012, p.127):

> The stylized facts on utilization and growth do not appear to have the characteristics implied by the Kaleckian assumptions. In order for the Kaleckian model to generate long-run variations in u that are of the same order of magnitude or smaller than those in accumulation, one would need a strong positive correlation between the shocks to investment and to saving.

However, the mere observation of the stylized behavior of capacity utilization may be misleading, failing to analyze stochastic components unobservable in the graphical representation. Therefore, the presence of unit roots in the time series will be subject to further analysis in Subsection (4.3).

[13]In particular, on the basis of the Neo-Kaleckian framework and of Post-Keynesian insights on finance-dominated capitalism (Hein, 2012) we should expect a downward trend of u.

4 The Dynamics of Autonomous Demand, Investment Share and Output in the Euro Area

In this Section we present the results of our empirical estimation. More specifically, Subsection (4.1) discusses the order of cointegration of the time series of autonomous demand and output, while Subsection (4.2) assesses the short and long- run effects of the former on the latter. Furthermore, Subsection (4.3) is devoted to the assessment of the stationarity of the actual rate of capacity utilization and the estimation of the normal rate, aimed to the estimation of the investment functions of the two models in Subsection (4.4).

4.1 Cointegration Test Between Autonomous Demand and Economic Growth

The first important task before estimating the effects of Z on GDP is to test the stationarity of the variables. In order to do so, we use the Augmented Dickey-Fuller (1979) test - ADF henceforth -, which investigates the presence of unit-root in the time series, under the null hypothesis of unit-root. In other words, if the null hypothesis cannot be rejected the variable is non-stationary. The ADF test is developed in two separate parts; the first assesses the stationarity of the series and the second analyses its order of integration. The two variables are taken in natural logarithms.

As expected from the graphical analysis of the stylized facts (Subsection 3.2), the two time series are stationary when taken in the first difference (i.e. the growth rate), but not in levels. The stationarity of the variables in first differences is tested by using the full specification with trend and drift (Pfaff, 2008), thus testing both whether the process is stationary in mean and/or around a trend. Furthermore, the (non)stationarity of the variables in levels is assessed by making use of a model without nor trend nor drift. The results are reported in Table (4). Recalling that the null hypothesis is rejected when $|t| > c$, the results show that at a significance level of 0.05 both processes are integrated of order one - $I(1)$.

Table 4: Augmented Dickey-Fuller Unit Root Test

	Test	Test Type	Test Stat.	Critical Values			
					1pct	5pct	10 pct
Level	GDP	None	2.35	tau1	-2.62	-1.95	-1.61
	Z	None	2.27	tau1	-2.62	-1.95	-1.61
First Difference	diff(GDP)	Trend	-4.02	tau3	-4.04	-3.45	-3.15
			5.39	phi2	6.50	4.88	4.16
			8.09	phi3	8.73	6.49	5.47
	diff(Z)	Trend	-4.87	tau3	-4.04	-3.45	-3.15
			7.92	phi2	6.50	4.88	4.16
			11.86	phi3	8.73	6.49	5.47

Source: author's representation, various sources (see Appendix A)

Two processes with the same order of integration can show cause-effect relations if they are cointegrated, namely if they present similar behavior across time, that tends to converge in the long term. This is important because "in the presence of cointegrated variables, it is possible to model the long-run model and the short-run dynamics simultaneously" (Enders, 2014, p.343). Therefore, we proceed to the cointegration test following the Johansen (1991) procedure. More specifically, we make use of both the maximum *eigenvalue* and the *trace* tests for the cointegrating rank[14]. It is worth stressing as the *eigen* test is usually preferred (Enders, 2014, p.380). The optimal number of lags is determined by making use of the Akaike Information Criterion (AIC), which provides a measure of the quality of the estimates given both the goodness-of-fit and the complexity of the model[15].

Table 5: Johansen Test for cointegration, GDP and Z

Character	Test	Hypothesis	Statistics	10%	5%	1%
Trend	Trace	$r = 0$	24.61	22.76	25.32	30.45
		$r \leq 1$	4.96	10.49	12.25	16.26
	Eigen	$r = 0$	19.65	16.85	18.96	23.65
		$r \leq 1$	4.96	10.49	12.25	16.26

Source: author's representation, various sources (see Appendix A)

[14] For an in-depth discussion of the differences and properties of the two tests, see Lütkepohl et al. (2001).

[15] For an overview of the other main criteria for lag selection, see Lütkepohl (1985).

Table (5) reports the results of the Johansen cointegration test. It shows that the statistics pass the critical values at the 5% level as regards the maximum eigenvalue test - the preferred one - and at the 10% as regards the trace test. In both cases, we fail to reject the null hypothesis of $r \leq 1$, thus implying that we have one cointegration relationship.

The result is particularly relevant as compared to previous attempts to find cointegration between the variables, in particular the one of Girardi and Pariboni (2015), who have been unable to find cointegration for specific European countries[16]. Contrarily, in our case the analysis of the Eurozone as a whole shows that the variables appear to be correlated across time, thus confirming the insights of Serrano (1995a,b).

The cointegration considers the properties in the long-run model, not dealing explicitly with short-run dynamics. For this purpose, a VECM model have been developed and presented in Subsection (4.2).

4.2 Impacts of Autonomous Demand on GDP in the Short and Long run

Cointegrated time series can be represented in a bivariate VECM, which allows to estimate simultaneously the long-run relation and the short-run adjustment process. Furthermore, the VECM could help assessing the direction of causality between the two series, without the need to run Granger (1969) causality test[17].

Since the observation of the predicted error corrections shows a clear trend, this non-stationary behavior justifies the estimation of a VECM model with an unrestricted constant and a restricted trend[18], i.e case IV specification.

We assume a long-run relation of the type:

$$GDP_t = c + \mu + \theta Z_t \tag{25}$$

with c indicating the constant, μ the trend and θ the parameter yielding the

[16] A possible explanation could be that the analysis for member countries of the European Union and even more of the Euro Area fails to properly take into account the process of European integration. In particular, in the considered time frame the strong trend in the import share may undermine the cointegrating relation. A solution to the problem is provided by Girardi and Pariboni (2015) themselves, who suggest to include the Supermultiplier in the cointegration equation.

[17] In particular, the test is extensively criticized in the literature due to the fact that it finds 'predictive causality', which might reflect mere correlations in the case of non-stationary series that are cointegrated, as in our case. Lavoie (2012), for instance, expresses concerns about the usefulness of such test, also by making reference to Rowley and Jain (1986) that have called the Granger-Sims causality tests 'soft econometrics', questioning the true validity of the casual relation between the variables.

[18] The restriction is meant to include the trend only in the cointegrating relation, not in the α and γ coefficients.

long-run relation between the variables.

The short-run adjustment process is modeled according to the following VECM:

$$\Delta GDP_t = \alpha_0 + \alpha_1(GDP_{t-1} - \theta Z_{t-1} - c - \mu) + \alpha_2 \Delta GDP_{t-1} + \alpha_3 \Delta Z_{t-1} + e_{1t} \quad (26)$$

$$\Delta Z_t = \gamma_0 + \gamma_1(GDP_{t-1} - \theta Z_{t-1} - c - \mu) + \alpha_2 \Delta GDP_{t-1} + \alpha_3 \Delta Z_{t-1} + e_{1t} \quad (27)$$

As usual, GDP and Z indicate the natural logarithms.

In line with Girardi and Pariboni (2016), the predictions of the Supermultiplier model are listed below:

a. $\epsilon_t = GDP_t - \theta Z_t$ is a stationary series

b. $\theta = 1$

c. $\alpha_1 < 0$

d. $\gamma_1 = 0$

e. $\alpha_3 > 0$

Condition (a) simply assures that Z and GDP share a common long-run trend. The condition has already been verified in Subsection (4.1) with the Johansen procedure. Condition (b) is of key relevance, ensuring that "Z and GDP move in step in the long run" (Girardi and Pariboni, 2016, p.534). Conditions (c), (d) and (e) concern the short-run adjustment process. More precisely, conditions (c) and (d) state that the cointegrating relation affects the short-run adjustment in output rather than on autonomous demand, thus implying that the causality runs from Z to GDP. Lastly, condition (e) postulates a short-run multiplier effect of autonomous demand at time $t-1$ on GDP at time t.

The results of the VECM estimation are reported in Table (6).

Table 6: Vector Error Correction Model Estimation, restricted trend

	Long-run cointegrating equation			Short-run equation for ΔGDP_t		Short-run equation for ΔZ_t
θ	0.94***	**Constant**	α_0	0.00	γ_0	-0.00
	(10.59)			(1.27)		(-0.14)
c	1.44	**Error Correction Term**	α_1	0.07**	γ_1	0.27***
	-			(2.97)		(4.53)
μ	-0.00***	**Lagged Differences**	α_2	0.57***	γ_2	0.79*
	(-4.96)			(3.94)		(2.24)
			α_3	0.072	γ_3	0.40**
				(1.21)		(2.74)
			R^2	0.65	R^2	0.60

Note: All variables in natural logarithms; t statistics in parentheses; Estimation of the VECM (1995:Q1 –2017:Q4); $*\ p < 0.10$, $**\ p < 0.05$, $***\ p < 0.01$.
Source: author's representation, various sources (see Appendix A)

First, it should be noted that the VECM model estimates a long-run coefficient very close to 1 (0.94), thus confirming that the two variables move in step in the long run, in line with the argument of Sraffian authors[19]. However, the short-run adjustment process and the relation of causality seem to be very different from the ones advocated by the proponents of the Supermultiplier model. More specifically, the results suggest that both error correction terms are positive and significantly different than zero, implying that long-run changes in the series are positively related with short-run dynamics in both output and autonomous demand, with a stronger positive effect on ΔZ_t. This result is at odds s with Sraffian insights, which predict that movements in autonomous demand would lead to short-run adjustments in output that - through further movements in the investment share - are expected to bring the system to a new long-run growth path. Moreover, the short-run multiplier effect (α_3), albeit positive, is very small and not significant.

Therefore, looking at Table (6), it would be tempting to argue that the estimated

[19]Furthermore, it is worth noting that the result is really close both in the coefficient and in the significance level to the one provided by Girardi and Pariboni (2016) for the US for the period 1960Q1-2014Q1, i.e. 0.93 with a $t - stat = 13.8$.

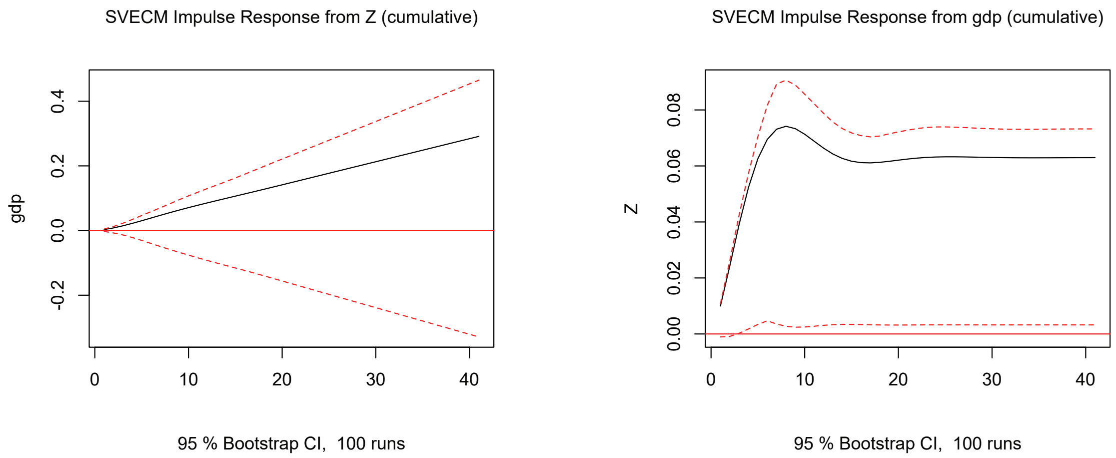
short-run adjustment process conflicts with the one put forward by Sraffian authors and, more specifically, that the causal relation runs from GDP to Z rather than *vice versa*. However, few points should be recalled: first, the higher R^2 of the model for Equation (26) contradicts this alleged causality. Second, it should be noted that the estimated short-run adjustment process comprises a huge shock as the downward swing following the 2008 crisis. In a longer time frame, as the one of Girardi and Pariboni (2016), the impact of the crisis on the estimated coefficients would be milder, allowing to get a more reliable estimation. Further research, aimed to extend the length of the time series, is thus required. Third, the estimation may be biased by the international business cycle synchronization (Baxter and Kouparitsas, 2005); a solution could be to re-estimate the model by separating the autonomously growing part of export from the stationary component, function of the real exchange rate, as proposed by Nah and Lavoie (2017). Furthermore, in line with Verdoorn (1949) and Dixon and Thirlwall (1975), if we assume that output growth stimulates productivity and thus external competitiveness, exports - and therefore Z - become potentially influenced by GDP growth. In other terms, coping with these last two points - disregarded in the previous analysis and in the literature - would probably lead to estimations of α_1 and γ_1 more in line with the theoretical framework.

To denote more precisely the impact on one variable on the other, we make use of orthogonalized impulse-response functions (OIRFs). The OIRFs were applied in a structural vector correction (SVEC) instead of the VECM presented above. This is because for the modeling of SVEC "interest centers on the common trends, in which the long-run effects of shocks are captured" (Pfaff, 2008, p.146). Therefore, in order to calculate the OIRFs, we apply the Choleski decomposition[20]. Figure (11) shows the OIRFs of cumulative effect of Z on GDP and *vice versa*.

[20] In order to do so, it has been followed the formula to identify the imposed number of restrictions presented by Enders (2014), i.e. $(n^2 - n)/2$ with n being the number of variables considered. As pointed out by Enders (2014, p.315-316): “the Choleski decomposition requires all elements above the principal diagonal to be zero”.

Figure 11: Orthogonalized impulse response functions (OIRFs) and bootstrapped 95% confidence intervals

(a) Z ---> GDP (b) GDP ---> Z



Source: authors' representation, various sources (see Appendix A)

Figure (11a) allow us to assess how discretionary choices made by individuals and institutions regarding government spending, residential expenditures and foreign citizens' spending affect the growth path of the considered economy in the long run. Figure (11b) describes the feedback mechanism between a positive shock in output on autonomous demand, relying on the theoretical consideration that "Z does not fall from the sky: it is socially and historically determined; [...] economic growth certainly plays a major role" (Girardi and Pariboni, 2016, p.535). This visual analysis partially reconciles the empirical and theoretical frameworks, illustrating a permanent positive effect of autonomous demand on output growth[21]. At the same time, a positive shock in GDP has a positive but not permanently increasing impact on Z. Comparing the two impulse-responses it is clear that, notwithstanding the shape of the curves, the magnitude of the effect of an autonomous demand shock on output is much bigger than the opposite, providing support to the idea that (autonomous) "demand does indeed drive growth all the way" (Taylor et al., 2017, p.20).

[21] However, it should be noted that the strict positive effect is not statistically significant.

4.3 The Stationarity of the Rate of the Rate of Capacity Utilization and the Normal Rate

Having estimated the relation between autonomous demand and output, we are now interested in analyzing the degree to which investment dynamics in the Eurozone provide support to Neo-Kaleckian or Sraffian arguments. A necessary step in order to estimate the investment functions of the two theoretical specifications requires the computation of the normal rate of capacity utilization. This operation involves facing a key theoretical difference regarding the way the two models deal with this rate, that is:

- Endogenous in the Kaleckian tradition, i.e. "it can depend on the path taken during the traverse (Lavoie, 1996, p.144). Furthermore, some post-Keynesians-Kaleckians question the existence of a unique normal rate, identifying it with a range rather than a precise value[22]. However, for the sake of the empirical estimation, the latter argument is disregarded in the following analysis, focused on how to endogenously calculate a point estimate of u^n;
- Exogenous in the Sraffian tradition, i.e. the actual rate converges to a given normal rate, determined by distribution, class conflict and, more generally, historical conditions of accumulation[23].

The second argument is supported *sic et simpliciter* by setting the normal rate equal to the mean value of the time series, i.e. $\bar{u^n} = 81.04$ for the time frame considered in Subsection (4.4) (1995Q1-2017Q4). The rationale for this choice is that, in line with the theory, the normal rate should have remained (roughly) constant in our medium to long-run analysis.

Contrarily, the Kaleckian argument requires further empirical considerations, requiring the discussion of how the normal rate is endogeneized. A common way to deal with the issue consists in computing the normal rate by applying the Hodrick-Prescott filter to the time series of u_t (Lavoie et al., 2004; Setterfield, 2017). More specifically, several Kaleckian authors argued in favor of this solution, based on the fact that "[t]his procedure allows us to identify an estimate of the permanent component in the series u_t" (Lavoie et al., 2004, p.139), identifying it with u^n. However, the methodology based on the Hodrick-Prescott filter suffers of a severe drawback, recently stressed by (Botte, 2017, p.2):

[22] For a discussion of the issue, see (Hein, 2014, Subsection 11.4).

[23] For the sake of precision, the consensus on this assumption is not unanimous within Sraffian economists. In particular, the authors belonging to what Cesaratto (2015) calls the first Sraffian position will tend to refuse the strict exogeneity of u. See, for example, Ciccone (1986) and Kurz (1990).

> The normal capacity utilization rate [...] estimated with the Hodrick-Prescott filter, takes into account values of the actual utilization rate that had not occurred yet. Researchers have access to these values because they analyze the data after the fact, but firms do not know the future when they make decisions.

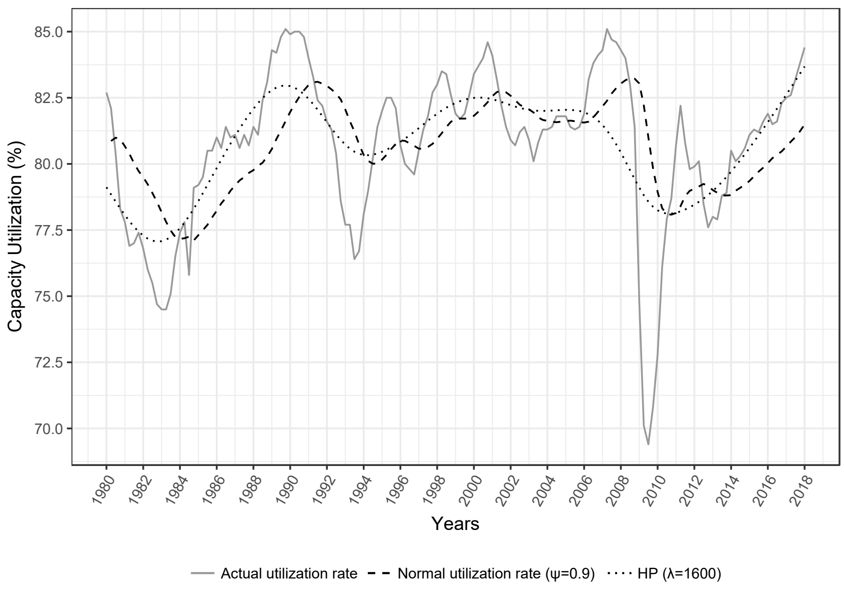
Therefore, Botte (2017) proposes to calculate the endogenous normal rate according to the following adaptive rule *à la* Simon (1976):

$$u_t^n = \psi u_{t-1}^n + (1-\psi)u_{t-1} \tag{28}$$

A major issue consists in attributing precise values to the parameters ψ_i. Following (Botte, 2017, p.3), we assume $\psi = 0.9$, such that firms revise u_t^n "each quarter by computing a mean of the previous rate of normal capacity utilization with 90% weight and the rate they faced during the previous period with 10% weight."

Figure (12) compares the normal rate estimated with Equation (28) and the (deprecated) Hodrick-Prescott filter with the actual utilization rate.

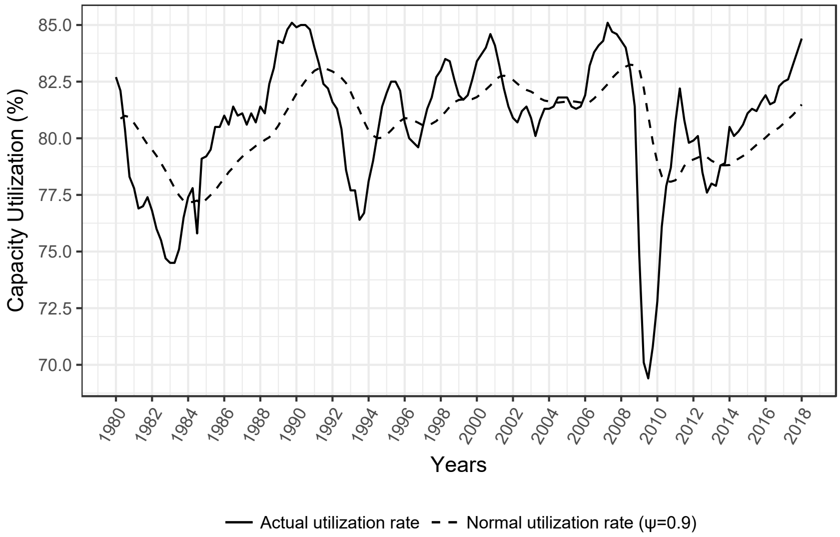
Figure 12: Normal and Actual Rate of Capacity Utilization in the Euro Area, different estimates, (quarterly data 1980-2018)



Source: authors' representation, based on Eurostat (See Appendix A)

The rule proposed by Botte (2017) appears to be much more precise, especially at the upper extreme of the time series. Moreover, it results theoretically to be more appropriate "to describe the behavior of firms immersed in a radically uncertain environment" (*ibid,* p.3), as well as more in line with the idea of hysteresis in the normal rate (Lavoie, 1996). Therefore, we stick to this measure as estimate of the endogenous u^n from now on (Figure 13).

Figure 13: Normal and Actual Rate of Capacity Utilization in the Euro Area (quarterly data 1980-2018)



Source: authors' representation, based on Eurostat (See Appendix A)

Having estimated the endogenous u_t^n, we can perform the ADF test for u_t, u_t^n and the difference $u_t - u_t^n$. Table (7) reports the results of the test; u_t and u_t^n are in natural logarithms and the difference $u_t - u_t^n$ refers to $ln(u_t) - ln(u_t^n)$, i.e. the percent deviation. The test rejects the null hypothesis of unit root even at the 1% level for all variables.

Table 7: Augmented Dickey-Fuller Unit Root Test, u_t and u_t^n

	Test	Test Type	Test Stat.	Critical Values			
					1pct	5pct	10 pct
Level	u_t	Trend	-4.43	tau3	-4.04	-3.45	-3.15
			6.63	phi2	6.50	4.88	4.16
			9.94	phi3	8.73	6.49	5.47
	u_t^n	Trend	-4.44	tau3	-4.04	-3.45	-3.15
			6.69	phi2	6.50	4.88	4.16
			10.03	phi3	8.73	6.49	5.47
	$u_t - u_t^n$	Trend	-4.90	tau3	-4.04	-3.45	-3.15
			8.05	phi2	6.50	4.88	4.16
			12.08	phi3	8.73	6.49	5.47

Source: author's representation, various sources (see Appendix A)

The result is strongly at odds with the Neo-Kaleckian assumption of long run non-stationarity of the variables, providing support to the argument that the discrepancy in capacity utilization rates cannot be the only explanatory variable of investment dynamics in a long-run time frame. This argument will be the focus of next Subsection.

4.4 A Time-series Estimation of the Sraffian and Neo-Kaleckian Investment Functions

In order to test the different specifications of the investment functions, we first need to test the stationarity of the variables. We have just done that for $(u_t - u_t^n)$; Table (8) reports the results for investment, recalling at the same time the already performed ADF test for output (Table 4).

As expected, investment is stationary only in the first difference, but not in level. Therefore, with g_t^i and g_t^Y we refer henceforth to the differences in the logarithms of investment and output, i.e. the respective growth rates.

Table 8: Augmented Dickey-Fuller Unit Root Test, *GDP* and *I*

	Test	Test Type	Test Stat.	Critical Values			
					1pct	5pct	10 pct
Level	GDP	None	2.35	tau1	-2.62	-1.95	-1.61
	I	None	2.03	tau1	-2.62	-1.95	-1.61
First Difference	diff(GDP)	Trend	-4.02	tau3	-4.04	-3.45	-3.15
			5.39	phi2	6.50	4.88	4.16
			8.09	phi3	8.73	6.49	5.47
	diff(I)	Trend	-4.02	tau3	-4.04	-3.45	-3.15
			5.39	phi2	6.50	4.88	4.16
			8.08	phi3	8.73	6.49	5.47

Source: author's representation, various sources (see Appendix A)

We shall now proceed to the estimation of the different specifications by including one lag for the discrepancies in the utilization rate, in line with the estimation strategy of Lavoie et al. (2004). The estimations make use of an endogenous normal rate, calculated according to Equation (28) and a fixed normal rate ($\bar{u^n} = 81.04$), as commented in Subsection (4.3). In all cases, the dependent variable corresponds to the percentage change of nonresidential gross fixed capital formation, i.e. $g_t^i =$

$ln(I_t) - ln(I_{t-1})$. The results are corrected for the autocorrelation of the residuals in order to get more robust estimates.

Table (9) reports the results obtained with an endogenous normal rate. Starting with the Neo-Kaleckian specification (column 1), notwithstanding the stationarity of the series $(u_t - u_t^n)$, its coefficients in the estimated regression are significant both at time t (positive) and $t - 1$ (negative). The constant, albeit very small, is significantly different from 0 at the 5% level. Column (2) reports the results of what we called here the Conventional Sraffian investment function (Equation 10). However, the results obtained are highly incompatible with the theoretical background, with output growth having multiplying effects on g_i. For this reason, a new specification is introduced, considering not output growth g_t^Y, but rather the *differentials* in the growth rates $g_t^Y - g_{t-1}^Y$. The results - reported in column (3) - appear much more in line with the theory, with the key difference that it is not output growth, but growth differential that fully induces investment, as suggested by the coefficient of $g_t^Y - g_{t-1}^Y$, which is equal to 1.159 and significant at the 1% level.

Furthermore, it can be stressed that the results of column (1) and (3) are absolutely compatible as regards the estimated role of deviations in capacity utilization from its normal value. Therefore, the results support the idea that it is possible to reconcile Neo-Kaleckian and Sraffian insights on investment dynamics by slightly modifying the Sraffian formalization of investment growth.

Table 9: The estimation of the investment functions with an endogenous normal rate

	(1)	(2)	(3)
	Neo-Kaleckian	**Conventional Sraffian**	**Modified Sraffian**
	g_t^i	g_t^i	g_t^i
$u_t - u_t^n$	0.495***	0.144*	0.516***
	(6.46)	(2.53)	(6.04)
$u_{t-1} - u_{t-1}^n$	-0.385***	-0.0640	-0.327***
	(-5.01)	(-1.19)	(-3.80)
g_t^Y		1.454***	
		(11.77)	
g_t^Y - g_{t-1}^Y			1.159***
			(5.05)
constant	0.00322**		
	(2.78)		
N	88	89	89

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: author's representation, various sources (see Appendix A)

It could be argued that the implausible results obtained in column (2) above are caused by the endogenization of u^n, i.e. by the introduction of Kaleckian elements in a Sraffian framework. Therefore, we re-estimate the three specifications with the fixed normal rate $u^n = 81.04$ (Table 10), obtaining results that mirror the ones presented above, both in the value of the estimates and in the statistical significance.

Table 10: The estimation of the investment functions with a fixed normal rate

	(1)	**(2)**	(3)
	Neo-Kaleckian	**Conventional Sraffian**	**Modified Sraffian**
	g_t^i	g_t^i	g_t^i
$u_t - u_t^n$	0.563***	0.179**	0.572***
	(7.29)	(2.97)	(6.70)
$u_{t-1} - u_{t-1}^n$	-0.468***	-0.122*	-0.430***
	(-6.04)	(-2.09)	(-5.04)
g_t^Y		1.435***	
		(11.17)	
g_t^Y - g_{t-1}^Y			1.173***
			(5.10)
constant	0.00437***		
	(3.76)		
N	90	89	89

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: author's representation, various sources (see Appendix A)

It is worth stressing that in Table (9) and (10) the value of the coefficient of $(u_{t-1} - u_{t-1}^n)$ is always negative and almost always significant[24]. This result may be linked with the indivisibility character of investment: if investment dynamics respond to the current divergence from the normal rate of capacity utilization, the response for past deviations has to be negative, since the adjustment occurs period-to-period. Therefore, what is relevant for our analysis is the overall impact of discrepancies in the utilization rate for time $(t-1)$ and t. We can verify this by testing the sum of the coefficients of $(u_t - u_t^n)$ and $(u_{t-1} - u_{t-1}^n)$. For all specifications the

[24]The only exception is the coefficient of the first lagged variable in the Conventional Sraffian specification with an endogenous u^n.

results (Table 11) are significantly differ than zero, both with an endogenous and with a fixed normal rate. Consequently, we can conclude that positive discrepancies in capacity utilization in a 2-lags framework, i.e. in the short run, have always an overall positive impact on accumulation.

Table 11: Test for the sum of the coefficients of $(u_t - u_t^n)$ and $(u_{t-1} - u_{t-1}^n)$

Endogenous Normal Rate						
	Coef.	**Std. Err.**	**t**	**P>t**	**[95% Conf.**	**Interval]**
Neo-Kaleckian	.1098102	.0391839	2.80	0.006	.031902	.1877184
Conventional Sraffian	.0799465	.0206534	3.87	0.000	.0388889	.1210041
Modified Sraffian	.1893222	.0457854	4.13	0.000	.0983037	.2803407

Exogenous Normal Rate						
	Coef.	**Std. Err.**	**t**	**P>t**	**[95% Conf.**	**Interval]**
Neo-Kaleckian	.0951717	.0317456	3.00	0.004	.0320738	.1582696
Conventional Sraffian	.0573533	.0191535	2.99	0.004	.0192774	.0954292
Modified Sraffian	.1414497	.0405529	3.49	0.001	.0608332	.2220662

Source: author's representation, various sources (see Appendix A)

Concluding, the analysis suggests that economic growth alone is not able to fully explain investment dynamics - as claimed by the advocates of the Supermultiplier model - hence requiring to pay more attention to the behavior both in *level* and in *growth rates* of productive capacity. Moreover, the analysis leaves space for further research, aimed to verify two major factors left aside from this work, i.e. the role accounted to distribution (Bhaduri and Marglin, 1990) or profitability (Shaikh, 2016).

5 Assessing the Models in Light of the Empirical Evidences in the Euro Area

This paper started and was motivated by the intention of testing some major implications of the Supermultiplier and of Neo-Kaleckian models for the Euro Area, focusing in particular on the role of autonomous non-capacity creating components of demand.

Before moving to the *proprius* assessment, a methodological consideration is in order. Macroeconomists tend to be attracted by econometrics as cats by catnip. Often, this fascination leads researchers and experts of all kinds to disregard that the "economic environment is not homogeneous over a period of time (perhaps because non-statistical factors are relevant)" (Keynes, 1939, p.560) and thus empirical tests are imperfect tools *ex definitione*. Besides ontological reasons, adding the contingent problems of imprecision in the measures, breaks, aggregations biases and so forth should lead one to be careful not only with the procedures, but of the interpretation of the results as well. However, abandoning empirical investigation to find refuge in *loci amoeni* of abstraction, castles of equations and unproven theories would be even a greater error. Overall, empirical estimation is needed at least to prove the hypothesized causal nexus, providing evidence of the kind of relation predicted by the theory. It is this spirit that should guide our assessment.

In this sense, the analysis has proven that autonomous demand and output are correlated and, more precisely, they move in step in the long run. However, the verified long-run relation between Z and GDP in the conflicts with the unexpected results regarding the short-run adjustment mechanism. Accordingly, it has been found that, though correlation holds in the short run, both variables have mutual feedback effects, in a way that does not allow us to determine an unidirectional causality nexus. The issue can be traced back to a theoretical rather empirical motive. As Girardi and Pariboni (2016) propose to reconsider the role of consumer credit in the theoretical framework, our empirical results provide several elements to rethink the way the models deal with exports. Although recognizing that "in the long run, one could argue that there is no truly exogenous variable" (Lavoie, 2016, p.194), our empirical scrutiny leaves enough space to believe that the variable is particularly affected by an endogeneity problem. Therefore, including the totality of exports of goods and services in the time series Z may be erroneous. The issue becomes especially clear in the case of a net exporter as the Eurozone.

Theoretically, the entire issue can be perhaps solved by coming back to its starting point, namely to the work of Nicholas Kaldor, conceived by Serrano (1995b) as a precursor of the Supermultiplier model. In particular, Serrano makes reference to

Kaldor (1983 [2015]), p.34-35) to justify the causality from autonomous demand to output growth:

> [A]n increase in resources [...] will not serve to increase actual production unless the exogenous component of demand is increased at the same time. [...] A capitalist economy [...] is not 'self-adjusting' in the sense that an increase in potential output will automatically induce a corresponding growth of actual output. This will only be the case if exogenous demand expands at the same time to the required degree; and as this cannot be taken for granted.

In addition, (Kaldor, 1970, p.342) defines "autonomous components of demand *[as]* the demand emanating from outside the region". However, from the point of view of the exporter, exports should be regarded not only as dependent on foreign income (its autonomous part), but also on foreign prices[25]. Therefore, it makes sense to exclude from the proxy of Z the stationary component of exports dependent on real exchange rate, as proposed by Nah and Lavoie (2017). This may constitute an important line of research for further analysis.

Furthermore, the results confirm that retaining excess capacity - both in the short and long run - is the way firms deal with fundamental uncertainty in advanced capitalist economies, confirming the insights of Steindl (1952). Nonetheless, the long-run behavior of capacity utilization conflicts with the Neo-Kaleckian assumption of non-stationarity of the rate, providing indirect support to the Sraffian and Classical prediction of convergence to an exogenously given normal rate. While the study of investment dynamics in the long run would require further empirical investigation, we have tested the implications of excess capacity and divergences from the normal rate in a short-run framework. In this sense, the apparent theoretical inconsistency of Neo-Kaleckian models disappears, with the discrepancies of the actual rate to its normal value playing a fundamental role in shaping investment decisions.

Conversely, the Sraffian specification appears to be suffering from a theoretical problem regarding the formalization of fully-induced investment. Contrary to what is expected from the theory, the empirical results find that output growth differentials rather than output growth *per se* are in a one-to-one relation with investment growth. Moreover, positive deviations of u from u^n appear to be playing a very similar role in the modified Sraffian specification and in the Neo-Kaleckian one. Therefore, the results suggest that, in absence of theoretical rethinking of Sraffian investment dynamics, the Neo-Kaleckian specification ought to be preferred, yielding

[25] The point is made clear and formalized in several Kaldorian export-led models, e.g. Setterfield and Cornwall (2002).

a significant short-run relation between nonresidential gross fixed capital formation and the discrepancies in the rate of capacity utilization from its normal rate.

This analysis avoided beginning with a judgement of which of the two models constitutes the "most promising approach to growth and instability in capitalism" (Cesaratto, 2017, p.28). The starting point was to search for compatibilities of the two models rather than to rank them. While Cesaratto (2017, p.2) would argue that it is "a matter of personal taste whether the SM *[Supermultiplier]* is considered a variant [...] or a different model superseding the NK *[Neo-Kaleckian]*" one, a comparison to empirical modeling could allow us to move away from this theoretical *beauty context* by introducing some more objective criteria.

In this sense, the major teaching of our results is that the two models serve two different purposes. Therefore, coming to a reconciliation of Sraffian and Neo-Kaleckian contributions would require the recognition of the mutual strength points and limits. On one hand, the Sraffian Supermultiplier provides a more convincing framework for the long-run relations between the variables in presence of a stationary rate of capacity utilization. On the other, the Neo-Kaleckian framework seems to be a superior tool to model investment dynamics in the short run, though it suffers when dealing with long run steady-states. This point has been recently recognized also by Lavoie (2018, p.9):

> Maybe the mistake was to speak of long-run equilibria; perhaps there would have been no controversy if from the beginning we had called them medium-run equilibria.

Concluding, based on the empirical results, the compatibility of the models consists in the preservation of Keynesian characteristics of the economy before, during and after the traverse. In this sense the empirical analysis seems to justify a 'division of labor', with the Neo-Kaleckian model devoted to the explanation of short-run processes and the Sraffian Supermultiplier destined to link autonomous components of demand, capital accumulation and growth in the long term. This reconciliation of Sraffian and Kaleckian contributions may provide two cornerstones to the Post-Keynesian big tent (Lavoie, 2014), avoiding the dichotomy advocated by Duménil and Lévy (1999).

6 Conclusion

The 2007-2008 crisis gave rise to demand for more satisfactory explanations to the mild economic recovery and long-run potential GDP losses. In this regard, this paper reviewed two models of distribution and growth in the Kaleckian and Sraffian tradition. In particular, the Sraffian Supermultiplier (Serrano, 1995a,b) and the modified Neo-Kaleckian model with autonomous expenditures (Lavoie, 2016) were both argued to be coherent theoretical tools to account for the role of non-capacity creating autonomous components of demand in shaping the long-run growth path of the economy.

At the theoretical level, the thesis of mutual exclusion of the two models (Cesaratto, 2015) has been rejected, recognizing that both of them share compatible results regarding the role attached to autonomous demand, both in equilibrium and in the long-run adjustment process. More precisely, both models provide for the possibility that autonomous expenditures have direct and persistent impact on the growth path of the stylized economy, as argued by Lavoie (2016). Furthermore, we identified the role provided for capacity utilization in the long run as the key difference between the models . However, since they share a common solution to reach the fully-adjusted position, the issue of whether the actual rate of capacity utilization has a stationary behavior or not turned to be an empirical one, as was later tested.

The empirical test has been the subject of the second part of the paper. In particular, we have tested some implications of the Supermultiplier and of the modified Neo-Kaleckian models for the Euro Area, following the methodology introduced by Girardi and Pariboni (2015, 2016). An important finding concerned the cointegration between Z and GDP. Contrary to the test of Girardi and Pariboni (2015) - who have been unable to find cointegration for selected European countries - the analysis of the Eurozone as a whole shows that the variables are correlated across time, thus providing support to the insights of Serrano (1995a,b). Furthermore, the VECM estimation confirmed another important aspect of the theory, namely that the two variables move in step in the long run. Nonetheless, not enough support could be found in relation to the short-run adjustment process and the causality nexus advocated by the proponents of the Supermultiplier. In this sense, a reconsideration of the nature of exports may be needed, making a distinction between an autonomous (non-stationary) and a trend component *à la* Kaldor. Lastly, based on a modified SVEC model, the impulse responses have been estimated, accounting for shocks both in autonomous demand and output. Contrarily to the VECM estimation, this analysis partially reconciles the empirical and the theoretical framework, yielding a permanent positive effect of autonomous demand on output growth.

As regards utilization, it has been shown that excess capacity is the way firms deal with fundamental uncertainty in advanced capitalist economies. However, the long-run behavior of capacity utilization has proved to be stationary, thus conflicting with the Neo-Kaleckian arguments. While the study of investment dynamics in the long run goes beyond the scope of the current work, we have tested the implications of excess capacity and divergences from the normal rate in a short-run framework. In this sense, the apparent theoretical inconsistency of Neo-Kaleckian models disappears, with the discrepancies of the actual rate to its normal value playing a fundamental role in shaping investment decisions. Conversely, the Sraffian specification appears to suffer from a theoretical problem regarding its formalization, with with investment fully-induced from growth differentials rather than growth *per se.*

In conclusion, the empirical results suggest a reconciliation of the theories, in a way that maintains the Keynesian characteristics of the economy before, during and after the traverse. A necessary step to achieve this consists in recognizing the mutual strengths and limits of the models. In this sense, the paper has provided support to the thesis that the Neo-Kaleckian model is closer to economic reality when dealing with short-run dynamics, while the Sraffian Supermultiplier provides a more coherent framework to underline the long-run relation between demand and economic growth. Therefore, admitting that Keynesian results may hold even after the traverse, our work suggests to be *Kaleckian in the short run and Sraffian in the long run.*

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A Appendix

- **GDP** – Gross domestic product at market prices, retrieved from Eurostat: https://bit.ly/2kCa5DY
- **Consumption** - Final consumption expenditure, retrieved from Eurostat: https://bit.ly/2I0r2D1
- **Investment** - Gross Fixed Capital Formation, retrieved from Eurostat: https://bit.ly/2kCa5DY
- **Government Expenditure** – Final consumption expenditure of general government, retrieved from Eurostat: https://bit.ly/2kCa5DY
- **Exports** – Exports of goods and services, retrieved from Eurostat: https://bit.ly/2kCa5DY
- **Imports** - Imports of goods and services, retrieved from Eurostat: https://bit.ly/2kCa5DY
- **Residential expenditure** - Gross Fixed Capital Formation by asset type: Dwellings, retrieved from Eurostat: https://bit.ly/2KiHKhL
- **Actual rate of capacity utilization** - Current level of capacity utilization, retrieved from Eurostat: https://bit.ly/2k7XVCE
- **R&D**: Intramural R&D expenditure of the business sector, retrieved from Eurostat: https://bit.ly/2Fg27s6

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Imprint

Editors:
Sigrid Betzelt, Eckhard Hein (lead editor), Martina Metzger, Jennifer Pedussel Wu, Martina Sproll, Christina Teipen, Achim Truger, Markus Wissen, Reingard Zimmer

ISSN 1869-6406

Printed by
HWR Berlin

Berlin, March 2019