The Paradox of Investment: A Contribution to the Theory of Demand-Led Economic Growth*

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ABSTRACT

This paper has two purposes. The first is to argue that aggregate investment may be subject to the following paradox. A rise in investment decided by firms to correct overutilization of their production capacity may generate *less capacity than demand* - and hence cause a paradoxical rise in overutilization. This will in turn lead to even more investment, and so on - the result being the self-sustained rises in output that characterize economic expansions.

The second purpose of the paper is to put forward one reason why the above paradox of investment will lose strength as expansions progress, and may eventually disappear leading to their end. That reason may be summarized as follows. As *net* investment increases along expansions, the effect of investment on production capacity rises relative to its effect on demand - and, as a result, the rise in utilization slows down. Moreover, as net investment eventually

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grows to a high level, the effect of investment on capacity may become bigger than its effect on demand. If this happens, utilization will stop rising and start falling, and thus the same may happen with investment and output.

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1.Introduction

Most contemporary heterodox macroeconomics focuses on the determination of output in the short-period or on the determination of the growth rate of output in the long-period (see for example Lavoie 2014, chapters 5 and 6). By contrast, this paper presents a model which attempts to analyze *a sequence of short periods,* by investigating how each short-period position of the economy leads to the next one. Using the same methodology as Garegnani and Trezzini (2010) and Trezzini (2011), we calibrate the model with empirically plausible values for its parameters and provide a numerical example to illustrate how the model may contribute to explain the evolution of aggregate demand and output along time.

The model accounts for the real-word facts that (i) output, capital, investment, etc. evolve over time at distinctly different paces, that (ii) rather than gravitating towards the normal rate, capacity utilization moves up and down over the course of the business cycle, and that (iii) since World War 2 the economy has been relatively stable. The model does this in two ways. The first is to propose that a paradox involving investment may be one engine – among others

- behind the self-sustained rises of output that occur along economic expansions. Specifically, a rise in investment decided by firms to correct overutilization of their production capacity may generate *less capacity than demand* - and hence cause a paradoxical rise in overutilization. This will in turn lead to even more investment, and so on - the result being the self-sustained rises in output that characterize economic expansions.

Secondly, the model puts forward one reason why the above paradox of investment will lose strength as expansions progress and may eventually disappear leading to their end. That reason may be summarized as follows. As *net* investment becomes larger and larger along expansions, the effect of investment on production capacity rises - but there is no reason why the effect of investment on demand should rise too. As a result, the increase in utilization slows down, that is, the paradox of investment loses strength. Moreover, as net investment eventually grows to a high level, the effect of investment on capacity may become bigger than its effect on demand. If this happens, utilization will stop rising and start falling - the paradox of investment will cease to hold - and thus the same may happen with investment and output. In sum, as net investment rises along expansions the intensity of the paradox of investment will decline and may eventually disappear leading to their end.

Our attempt to trace the evolution of the economy along a sequence of several short periods was inspired by Kalecki (1933, 1954), Harrod (1939) and by the Keynesian literature of the business cycle of the 1950s and 1960s (Hicks 1950, 1965). Our model also shares some features with the neo-Kaleckian growth model (see for instance Lavoie 2014, chapter 6), but differs in its *basic structure*. As a consequence of this, instead of generating as the neo-Kaleckian model constant - or possibly ever rising - rates of capacity utilization and capital accumulation, our model generates cyclical fluctuations of these two variables akin to those observed in the real-world. It thus concludes that the economy evolves outside fully-adjusted steady-state positions and without a tendency to converge towards them. However, and in line with some recent literature, the model suggests that such evolution is not necessarily associated with instability (Garegnani and Trezzini 2010; Palumbo 2013; Ryoo and Skott 2017; Skott 2012, 2019; Trezzini 2011, 2015, 2021).

The paper is organized as follows. We start by presenting the model (Section 2) and then use it to lay out the paradox of investment (Section 3). Subsequently, we discuss the extent to which the paradox of investment may be one engine behind economic expansions (Section 4). Afterwards, we explain how the rise in net investment along expansions may act as a check on upward instability (Section 5). We end by comparing our model with other heterodox models - Kalecki's, Harrod's and the neo-Kaleckian growth model (Section 6).

2. The model

The model assumes a closed economy *with* government. It is centered on two ideas. The first is the dual effect of investment on the economy. On the one hand, investment affects demand and output through the multiplier (which acts within a single period, i.e. without lags):

$$Y = \{1/[1- (c_w.(1- \pi) + c_p.\pi).(1- \tau)]\}. (I + C^* + G) \quad (1)$$

Where Y is output, c_w and c_p are the marginal propensities to consume out of wages and out of profits, π is the profit share, τ is the overall tax rate, I is investment, C* is autonomous consumption and G is government expenditure (for simplicity, time subscripts "t" are omitted).[1]

[1] In an economy without government (hence $\tau = 0$) and with no saving out of wages (c_w=1), the multiplier would be reduced to the more familiar $1/(s_p.\pi)$, s_p denoting the marginal propensity to save out of profits.

On the other hand, investment increases the production capacity of the economy. The effect of investment on production capacity is equal to net investment times the (potential) productivity of capital. Productive capacity is given by:

$$Y_{FC} = a.K_{-1} + a.(I - \partial.K_{-1}) \qquad (2)$$

Where a is the (potential) productivity of capital, assumed to be constant, K_{-1} is the capital stock and $\partial.K_{-1}$ is capital depreciation (both of the previous period). To make our main thesis clear, we will first assume that net investment increases productive capacity *without lags*. Afterwards, we will explain that if net investment leads to the creation of capacity only after a lag – a more realistic assumption made by Kalecki (1933) - the argument is reinforced.

The second idea on which the model is based is that investment responds with a *lag* to deviations of the actual rate of capacity utilization from a certain desired rate – an investment function common in the heterodox literature (see for instance Skott 2012). Gross investment relative to the capital stock is given by:

$$I/K = \partial + I_A/K + \gamma_u.(u_{-1} - u_n) \qquad (3)$$

Where I_A denotes autonomous investment, and u_{-1} and u_n represent the past and the desired rates of utilization respectively. Autonomous investment is the component of investment unrelated to the rate of utilization (Hicks 1950): investment associated with innovations, housing investment associated with population growth, and investment which is only expected to pay for itself over a long period and is thus linked to the expected long–run growth of sales (e. g. a hydroelectric dam).

The desired rate of utilization, u_n, is the rate firms plan to have on average over time. It is well below 100 percent because firms want to have significant amounts of spare capacity.[2] This happens because of several reasons (Trezzini 2021, pp. 326-7). Firstly, firms know from experience that the demand for their products grows on trend and they want to be able to meet increasing levels of demand. Secondly, because demand fluctuates and its peak levels are uncertain firms may also want to meet unexpected rises in demand. (Note that the ability to meet both expected and unexpected rises in demand may outweigh the consequent costs of spare capacity. Indeed, that ability prevents firms from losing market share to current and new competitors.) Thirdly, *new* firms know that the demand for their products will be limited during an initial period but must build capacity in order to meet demand when this rises later. Fourthly, the indivisibility of capital may force firms to install more capacity than that needed even at demand peaks. Finally, the durability of capital means that it cannot be reduced when demand falls, implying a lower average utilization over time than would otherwise be the case.

The dependence of investment on actual utilization, u, can be justified in two ways. First, if the actual rate of utilization differs from the desired rate, businesses will undertake positive or negative (induced) net investment to adjust their capital stock and thereby bring utilization towards the desired rate. Second, because of fixed costs changes in utilization over the cycle are associated with amplified changes in total profits - and thus with firms' financial capacity to invest. As pointed out by Robinson (1962, p. 86), 'an important part of investment is financed out of retained profits. Moreover, the amount that a company puts up of its own finance influences the amount it can borrow from outside.'

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[2] From January 1967 to May 2021 the average of the total index of capacity utilization in the U.S. was 80.03 percent (see https://fred.stlouisfed.org/series/TCU).

Notice that investment responds to actual utilization only after a *lag*. This happens for two reasons (Sherman 2010, p. 87). Firstly, it takes time for businesses to know that changes in utilization are durable rather than transitory and to ponder whether to advance with investments. Secondly, it may take time for businesses to obtain loans from banks or from bond issues and to acquire government permits for the construction of buildings. As will be seen, it is this lagged effect of utilization on investment in our model that provides the link between the position of the economy in one period and the next, and thereby allows us to trace the evolution of the economy along a sequence of several periods.

We could go further and assume instead, with Trezzini (2021, p. 328), that investment is not likely to respond to *every* past deviation of utilization from the desired level. Indeed, this is a level firms plan to have on *average* over time. Therefore, a given capacity may be considered inappropriate, prompting a reaction of investment, only when a *succession* of past rates of utilization differs on average from the planned average level. If this is true, investment will be less reactive to divergences between the past and the desired rates of utilization than in our case. Having said this, we will nonetheless use the investment function described by equation (3). The reason is that we will use a numerical example to illustrate our argument, and this investment function makes that exercise more tractable.

3. The paradox of investment

Leave aside for the moment autonomous investment, and suppose that in a certain period utilization rises above the desired rate (as a result of say expansionary fiscal and/or monetary policies). When this happens, after a lag firms raise investment above the amount of capital depreciation - equation 3 above - in an attempt to reduce utilization back towards the planned rate. If only a *single* individual firm acted in this way, its productive capacity would rise relative to its output, and therefore the rate of utilization would go down towards the desired level.

But when *most* firms across the economy raise their investments above the amount of capital depreciation, besides increasing the productive capacity of the economy, they unconsciously provoke a macroeconomic effect: they increase aggregate demand and output. As a result, actual utilization does not necessarily fall back towards the planned rate. Instead, if the capacity effect (given by the productivity of capital, see equation 2 above) happens to be smaller than the aggregate demand effect (given by the multiplier, see equation 1 above), actual utilization will paradoxically move further above the desired rate.[3] This may be called the paradox of investment.

Is the productivity of capital smaller than the multiplier? (i) Ponder first on the value of the multiplier. If we consider an overall tax rate of 0.4, the stylized facts c_p=0.4, c_w=0.9 and π= 0.4 mentioned by Lavoie (2014, p. 369 and p. 380) point to a multiplier in equation (1) of 1.72. Ninety percent of this value is associated with the initial change in investment expenditure plus the first and second rounds of consumption expenditure that follow it. Therefore, almost all of the effect of the multiplier occurs within a short period of time - probably one quarter, at most one semester. (ii) On the other hand, Lavoie (2014, p. 380) and Sherman (1991, p. 179) mention a productivity of capital of 1/3 per year (1/12 per quarter) as a stylized fact. (iii) Therefore, we can conclude that the productivity of capital, 1/12 per quarter, is smaller than the multiplier effect, 1.55 (= 0.9 * 1.72) exerted over one quarter.

[3] This mechanism can be extended to housing investment. In this case, the story may be told as follows. As the number of unsold houses – the 'amount of spare capacity' – falls below the desired level, building firms increase construction above the replacement level in an attempt to raise the number of houses available for sale to the desired rate. But this increases incomes (firstly in the construction sector) and therefore aggregate demand. If the value of the new houses built – the additional 'capacity' - is lower than the rise in aggregate demand, average utilization across the economy will rise.

In contrast with what may seem at first, and as explained in Section 5, the fact that the productivity of capital is lower than the multiplier does not imply that the paradox of investment always holds. It only implies that it may hold for some time and that, while it does, it is one engine behind economic expansions. The next section discusses this last point.

4. The paradox of investment as one engine that drives expansions

What makes aggregate demand grow along expansions*?* According to mainstream economists, supply creates its own demand. The increases in aggregate demand along expansions are thus explained by the increases in aggregate supply in those periods. Heterodox economists have a different view. They reject Say's Law, and argue that aggregate demand growth is instead determined by the growth of investment expenditure along expansions. While not proved, this view is suggested by the fact, patent in Figure 1, that investment grows more than aggregate demand along expansions (and falls more than aggregate demand in recessions).[4]

But the heterodox view poses another question: what makes firms raise investment year after year over expansions? An answer to this question is outlined next via a numerical example. This should not be interpreted too literally, as some bold assumptions are made and several relevant aspects are left aside.

4.1. A numerical illustration

Leave aside for the moment a possible rising trend in autonomous expenditures. Besides, assume that the amount of capital depreciation is fixed at $100, that the productivity of capital per quarter is 1/10, and that the multiplier is 1.5 (the full operation of which requires one

[4] Note however that some heterodox economists have argued that in the long-run aggregate demand growth is essentially driven by autonomous trend rises in private consumption, housing investment, government expenditure and exports (Girardi and Pariboni 2016). We will return to this issue.

quarter).[5] In this setting, consider a period t when utilization rises above the desired rate. In response to this, in *period t+1* entrepreneurs will raise investment above the amount of capital depreciation, say from \$100 to \$110, in an attempt to drive utilization back to the desired rate. However, this will lead to a bigger increase in demand, \$10*1.5, than in productive capacity, \$10*(1/10), and therefore will end up in a paradoxical rise in utilization further above the desired rate (see Table 1, second row). Output will rise according to demand and profits will rise in an amplified way. To fix ideas:

$\uparrow u_t$ above u_n => $\uparrow I_{t+1}$ above depreciation => $\uparrow \text{demand}_{t+1} > \uparrow \text{capacity}_{t+1}$ =>

=> $\uparrow u_{t+1}$ further above u_n.

<Table 1 around here>

And this process – the paradox of investment - will repeat itself over several periods. Indeed, the mentioned rise in utilization in t+1 will lead to a new increase in investment in t+2, which will again have a bigger effect on demand than on capacity, and thus will lead to a new rise in utilization in t+2. And so on. Along the way profits will rise with utilization and reinforce the upward movement. The paradox of investment may thus be one engine behind the sustained increases in utilization, investment and output observed along expansions (Figures 1 and 2).

<Figures 1 and 2 around here>

4.2. Discussion

The illustration just presented should not be interpreted too literally. First and foremost, the described upward movement should be seen as an *addition* to a long-run process of economic

[5] These last two values are roughly in line with the empirical evidence presented in the preceding section. Note also that, to keep the example simple, we neglect the fact that capital accumulation will imply increasing amounts of capital depreciation, and assume this fixed at \$100.

growth associated with proportional rises in productive capacity and aggregate demand (of the type the super-multiplier model attempts to explain through the idea of a rising trend in autonomous non-capacity creating expenditures; see Girardi and Pariboni 2016; Freitas and Serrano 2015). [6]

Besides, the preceding illustration leaves aside aspects that contribute either to dampen or to reinforce the described upward movement of the economy. On the one hand, and as already pointed out, investment may not react to every divergence of past utilization from the desired level, but rather to an average of successive utilization rates differing from the planned level. This would make the intensity of the paradox of investment weaker than our illustration suggests. On the other hand, there are three aspects that on the contrary reinforce the described upward movement. First, the marginal propensity to consume and therefore the multiplier is especially high during expansions (Trezzini 2011).[7] Second, and unlike we assumed, investment orders do not lead to the creation of capacity instantaneously but only after a lag (Kalecki 1933). If this lag is say one year, the amount of capacity created in a certain quarter of an expansion will not be determined by the amount of that quarter's net investment; instead, it will be determined by the *smaller* amount of net investment of the corresponding quarter of the previous year. As a result, the increase in capacity in each successive quarter of the expansion will be smaller, and thus – for the same rise in aggregate demand – the increase in utilization will be bigger. This being so, the upward movement will be stronger than if net investment led to an instantaneous increase in capacity (as assumed in our illustration). Finally, because net investment rises along the expansion, the capital stock increases by (slightly) larger and larger

[6] Our model can thus be seen as a complement to the super-multiplier model: this focus on the long-run trend of the economy while we try to account for the medium-term fluctuations around that trend.
[7] For the period 1960-2011 in the U.S., Trezzini (2011, p. 583) calculated an elasticity of consumption with respect to net disposable income equal to 1.73 on average during economic expansions, and always lower than 0.4 during recessions.

amounts and the same happens with depreciation. Consequently, the *rises* in depreciation allowances, gross investment, aggregate demand and utilization will *increase* (slightly) quarter after quarter. Therefore, the upward movement will be stronger than under the assumption of fixed amounts of depreciation.

5. The rise in net investment as a check on upward instability

5.1. How the expansion may lose strength

In the real-world utilization rates do not rise through the roof. In the US expansions, they have risen up to only 85-90 percent (Figure 2). So, what may eventually tame the upward movement previously described?

A possible answer results from the following idea. While the *growth* in aggregate demand depends on the *growth* of investment, the *growth* in production capacity depends on the *level* – not on the growth - of net investment. This being so, as investment grows period after period along an expansion, through the multiplier the successive increases in investment continue to generate successive increases in demand and output of roughly the same size. But, because they are associated with higher and higher *levels* of net investment (Figure 3), they generate larger and larger increases in production capacity.[8] As a result, the increases in utilization – which depend positively on the increases in output but negatively on the increases in production capacity - become smaller and smaller. This means that the paradox of investment progressively loses strength.

[8] For instance, and as shown in the row of Table 1 related to t = 1, the $10 increase in gross investment earlier in the expansion from $100 - the replacement level - to $110 led to a net investment of $10 and to an increase in capacity of $10*(1/10). But, as shown in the row related to t = 10 of that table, the same $10 increase in gross investment later in the boom, from $190 to $200, translates into a bigger net investment, $100, and into a bigger increase in capacity, $100*(1/10).

<Figure 3 around here>

Although progressively smaller, the rises in utilization still continue to lead to increases in investment – equation (3) above - but at slower and slower rates. Therefore, the expansion loses strength.

5.2. A possible explanation for some crises

Once net investment has grown to a high level, a subsequent increase in investment may eventually start to generate a smaller increase in demand than in capacity. Specifically, and as shown in the row of Table 1 related to t = 16, at a late stage of the expansion the same $10 increase in gross investment, from $250 to $260, will still imply an increase in demand of $10*1.5 - but a bigger increase in capacity, $160*(1/10).[9] Consequently, the paradox of investment ceases to hold: utilization falls. This in turn may lead to a decline in investment and thus in output. In sum, once net investment has grown to a high level:

$\uparrow I_t \Rightarrow \uparrow demand_t < \uparrow capacity_t \Rightarrow \downarrow u_t \Rightarrow \downarrow I_{t+1} \Rightarrow \downarrow output_{t+1}$

This idea that declines in utilization in the last stage of the expansion may trigger the declines in investment that initiate economic recessions is in line with what has happened in most post-1966 US economic cycles (Figures 1 and 2).

It should however be acknowledged that the decline in utilization at the end of expansions may be just one of the factors contributing to the observed crises. In fact, and firstly, some economic crises – including the most acute ones – may be the mere result of financial crises, whose origins and contours have been explained by Minsky (1982, pp. 65-8). And secondly, the decline in investment that leads to some crises may also be caused by a ‘profit

[9] Given the assumed replacement level of investment of $100, a gross investment of $260 corresponds to a net investment of $160 and thus raises capacity by $160*(1/10).

squeeze' triggered by the rising costs in raw-materials that typically occur in the last third of expansions (Sherman 2010, p. 141).

5.3. A comment on economic recessions and subsequent recoveries

As mentioned, the decline in utilization at the end of the boom may lead to a reduction in investment and thus in output. If this happens, profits will decline. On the other hand, net investment will fall but to a level that is positive (Figure 3). Therefore, capacity will keep on rising, at a time when output will be declining. As a result, there will be *a new* decline in utilization which will produce a further decline in investment. And so on.

Now, since World War 2 economic recessions have been relatively short-lived, lasting about 1-1.5 years. This means that the above-mentioned cumulative downward process has been halted by other factors soon after it started. These factors may include the fact that consumption resists declines in income (Trezzini 2011), the rising trend in autonomous investment (Hicks 1950) and the rising autonomous trend in private consumption and government expenditure (Girardi and Pariboni 2016).

A recovery may be subsequently triggered as follows. Once *induced* gross investment has fallen to low levels, it cannot fall much further. Therefore, the effect of its decline on aggregate demand begins to be more than offset by the rising trend of autonomous expenditures and/or by expansionary fiscal and monetary policies. In turn, this leads to an increase in utilization and in induced investment, and thereby to a new economic expansion.[10] Note finally that another factor may have also been behind the revivals of investment that have initiated economic expansions: the positive effect on profits of the sharp decline in the cost of raw-

[10] For example, the Obama fiscal stimulus package of 2009-10 may have been the trigger that started the recovery from the Great Recession of 2008-9.

materials relative to consumer prices that typically occurred in the post-1970 recessions (Sherman, 2010, p. 114).

6. Comparison of our dynamics with that of other heterodox models

6.1. Comparison with Kalecki

Like our model, Kalecki's models of the cycle also rely on the interaction between the demand and capacity effects of investment. But instead of stressing that these two effects have different *magnitudes*, Kalecki (1933, pp. 9-11) underscores the different *lags* with which they operate. Kalecki starts by pointing out that investment orders generate, after a lag, production of investment goods and, via the multiplier, of consumption goods; and that after an *additional* lag, investment goods are delivered and production capacity increases.

In this setting, a cycle devoid of trends is explained as follows. After a recession, investment orders rise and lead to an increase in output. But, because of the second lag, the delivery of investment goods remains for a while lower than the amount of depreciation, and thus production capacity declines. For these two reasons – rising output and declining capacity – utilization rises, and this motivates another increase in investment orders. And so on.

However, after some time the delivery of investment goods starts to exceed the amount of depreciation and, consequently, production capacity starts to increase. Initially, this increase in capacity is still lower than the rise in output, and thus merely restrains the rises in utilization and in investment. But, at a later stage, the increase in production capacity starts to exceed the rise in output - utilization begins to decline. This then causes a reduction in investment orders and, after a lag, in output. (Kalecki's explanation of the self-sustained nature of recessions and subsequent recoveries is exactly symmetric).

In turn, Kalecki (1954, pp. 130-33) provided another explanation for the upper turning-point of the cycle. In an expansion, the rise in investment eventually comes to a halt due to shortages of equipment or labor. Consequently, aggregate demand and output become *stagnant*. But after years of expansion net investment is positive at a high level and thus production capacity is rising. Therefore, utilization falls, and this soon leads to a decline in investment and output.

6.2. Comparison with Harrod

Harrod's explanation of the upward movement of economic activity may be summarized as follows (Harrod 1939; Caldentey 2019, pp. 176-7 and 186-7). Starting with utilization at the desired level, if demand and output grow at a rate *requiring an addition* to the capital stock above the *actual addition* being carried out (i.e., when actual growth, G, exceeds the warranted rate, G_w), utilization will rise above that rate. This is seen by entrepreneurs as a consequence of the fact that net investment, determined by the accelerator principle, underestimated the growth in demand. Expectations about demand growth will therefore be revised up. In turn, the higher expectations of demand growth coupled with the rise in utilization above the desired rate will lead to an increase in investment. As a result, 'G, instead of returning to G_w, will move farther from it in an upward direction, and the farther it diverges, the greater the stimulus to expansion will be.' (Harrod 1939, p. 22).

In this paper's model, investment also increases as a result of a rise in utilization. And that increase in investment may also generate a paradoxical further rise in utilization. But the similarities stop here, and there are some important differences relative to Harrod. First, while in Harrod investment is mainly determined by expected demand growth, in our model it is critically dependent on the rate of capacity utilization. Secondly, the rise in investment in our model generates a rise in output – not a rise in the *growth rate* of output. Thirdly, unlike Harrod's our model makes explicit that the rise in utilization will happen if (because of the existing *level* of net investment, the potential productivity of capital and the multiplier) the effect of an increase in investment on capacity is smaller than its effect on demand. Finally, and again unlike Harrod's, our model indicates that the rise in utilization will not happen if net investment has reached a high level making the former effect bigger than the latter.

6.3. Comparison with the neo-Kaleckian growth model

Assuming a closed economy without government, no autonomous consumption and no saving out of wages, the canonical version of the neo-Kaleckian growth model consists of three equations (Hein et. al. 2012, p. 141; Lavoie 2014, p. 361):

$$I = S \quad (4)$$

$$g^s = S/K = s_p.\pi.u.a \quad (5)$$

$$g^i = I/K = \gamma + \gamma_u.(u-u_n) \quad (6)$$

Equation (4) defines the equilibrium in the goods market. Equation (5) is the 'saving function' whose variables and parameters have the meaning already explained in this paper. It is important to understand that, for a given level of investment, equations (4) and (5) would be equivalent to equation (1) of the multiplier of our model, if this had also assumed an economy without government, no autonomous consumption and no saving out of wages. That is to say, equations (4) and (5) are equivalent to $Y = [1/(s_p.\pi)].I$. Indeed, the profit rate P/K is equal to $(P/Y).(Y/Y_{FC}).(Y_{FC}/K)$; that is $P/K = \pi.u.a$. This being so, equation (5) can be re-written as $S/K = s_p.P/K$. In turn, under S = I and considering that $P = \pi.Y$, this equation is equivalent to $I/K = s_p.\pi.Y/K$, therefore to $I = s_p.\pi.Y$ and finally to $Y = [1/(s_p.\pi)].I$.

Equation (6) is the investment function where γ represents entrepreneurs' expectations about the trend growth of sales. It corresponds to equation (3) of our model, with three differences: actual utilization appears without a lag, the constant term does not include the rate of capital depreciation and besides includes a slightly different notion of autonomous investment.

Finally, it should be noted that the neo-Kaleckian model does not include an equation corresponding to equation (2) of our model – an equation according to which investment increases the productive capacity of the economy. As a result, the dynamics associated with the neo-Kaleckian model is different from the dynamics of our model, which is based on the dual effect of investment – on demand and on productive capacity.

The dynamics associated with the neo-Kaleckian model can be explained as follows. Equations (4) to (6) jointly determine the equilibrium values of utilization and investment (relative to the capital stock), u* and g*. This is illustrated in Figure 4 where a g^i curve (equation 6) represents the effect of utilization on investment, and a g^s curve (equations 4 and 5) represents the effect of investment via the multiplier on output and thus on utilization. A g^i curve should thus be read counter-clockwise while a g^s curve should be read clockwise. It is assumed that at time t = 0 the g^i_0 curve intersects by coincidence the g^s_0 curve at point 0 where the rate of utilization is equal to the desired rate, $u^*_0 = u_n$, and the level of investment relative to capital is equal to the assessed trend growth of sales, $g^*_0 = \gamma_0$.

<Figure 4 around here>

Now, if afterwards there is (say) a decrease in the marginal propensity to save, the saving function rotates rightwards and intercepts the investment function at a new equilibrium – point 1 - with utilization above the desired rate, $u^*_1 > u_n$, and investment relative to capital higher than the *assessed* trend growth of sales, $g^*_1 > \gamma_0$. The economic mechanism that moves the economy to this new equilibrium, usually left implicit in the literature, is the following one. The decline in the marginal propensity to save raises the magnitude of the multiplier and therefore leads to an *additional* increase in output (relative to the initial steady-state growth), and thus to a rise in utilization. In turn, by equation (6) this leads to an increase in investment above the initial steady-state level, which through the multiplier leads to a further rise in utilization. And so on, until the interaction between the rises in utilization and in investment - represented by the successive arrows that start from point 0 - eventually stops at point 1.

One result of this new equilibrium is that the growth rate of the economy, g^*_1, is now durably higher than the *assessed* trend growth of sales, γ_0. It is thus reasonable to assume that sooner or later entrepreneurs will revise up this assessment. In terms of equation (6), this means that the parameter γ will rise to $\gamma_1 = g^*_1$. In Figure 4, this implies that the investment function shifts upward and intercepts the saving function at a second new equilibrium – point 2 – where utilization is at u^*_2, further above u_n, and investment relative to capital is at g^*_2, above the *already* upwardly revised trend growth of sales (γ_1). The economic mechanism driving this movement of the economy is the following one. Starting at point 1, the rise in γ leads to an increase in investment which, by the multiplier, leads to a rise in utilization, which in turn leads to a further increase in investment. And so on, until the interaction between the rises in investment and in utilization - represented by the successive arrows that start from point 1 - eventually stops at point 2.

Now, in this new equilibrium the growth rate of the economy is again durably higher than the already upwardly revised assessed trend growth of sales; that is, $g^*_2 > \gamma_1$. There will thus be a new rise in γ leading to a second upward shift of the investment function, and to a third upward interaction between investment and utilization moving the economy to point 3. And so on.

In sum, in the neo-Kaleckian growth model the economy *may* experience ever-rising rates of utilization and levels of investment relative to capital - Harrodian instability – a result that would be inconsistent with the behaviour of these variables in the real-world.

What has been explained leads us to three conclusions. The first is that in the neo-Kaleckian model increases in investment lead to rises in utilization as a result of the multiplier – not as a result of the fact that they have a bigger effect on demand than on productive capacity as in our model. Secondly, in the neo-Kaleckian model utilization tends to remain stable for durable periods of time – each of the equilibrium positions 1, 2, 3, etc. - whereas in our model the dual effect of investment on demand and capacity keeps utilization in a state of permanent cyclical change. And thirdly, in the neo-Kaleckian model utilization may eventually increase without limit, whereas in our model the rise in *net* investment contains and may reverse the upward movements of utilization. It is thus clear that the dynamics associated with the neo-Kaleckian model is distinct from the dynamics envisaged by our model.

7. Conclusion

By marrying the dual effect of investment with a heterodox investment function, this paper attempted to explain how successive short-period positions of the economy lead to one another. In doing so, the paper made two points. The first is that the growth of aggregate demand along expansions may be partly driven by the paradox of investment. The second point is that, as net investment rises along expansions, the intensity of the paradox of investment declines and may eventually disappear leading to their end. In short, the paper argued that the paradox of investment, and its recurrent disappearance and reemergence, may be one relevant driver of economic activity.

It is however important to end with some qualifications. First, the paper's model would be more realistic if it considered that the effect of investment on capacity operates with a lag, and that investment may not respond to a single but only to a succession of past deviations of utilization from the desired rate. On the other hand, a more complete account of the evolution of economic activity should add other aspects. These include the long-term rising trend of the economy, the fact that the marginal propensity to consume is higher in expansions than in recessions, and the fact that some economic crises are caused by financial factors or by a profit squeeze.

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Table 1: The paradox of investment followed by the upper turning-point

t	Gross I	ΔGross I => ΔAD	Net I => ΔCapacity	ΔAD-ΔCapacity => Δutilization
1	$110	$10 => $10*1.5	$10 => $10*(1/10)	$15 - $1 => ↑ utilization
…	…	…	…	…
10	$200	$10 => $10*1.5	$100 => 100*(1/10)	$15 - $10 => ↑ utilization
…	…	…	…	…
16	$260	$10 => $10*1.5	$160 => 160*(1/10)	$15 - $16 => ↓ utilization

Note: multiplier = 1.5; potential productivity of capital = (1/10); depreciation fixed at $100.

Figure 1. Share of private investment in GDP over US cycles, 1947-2019

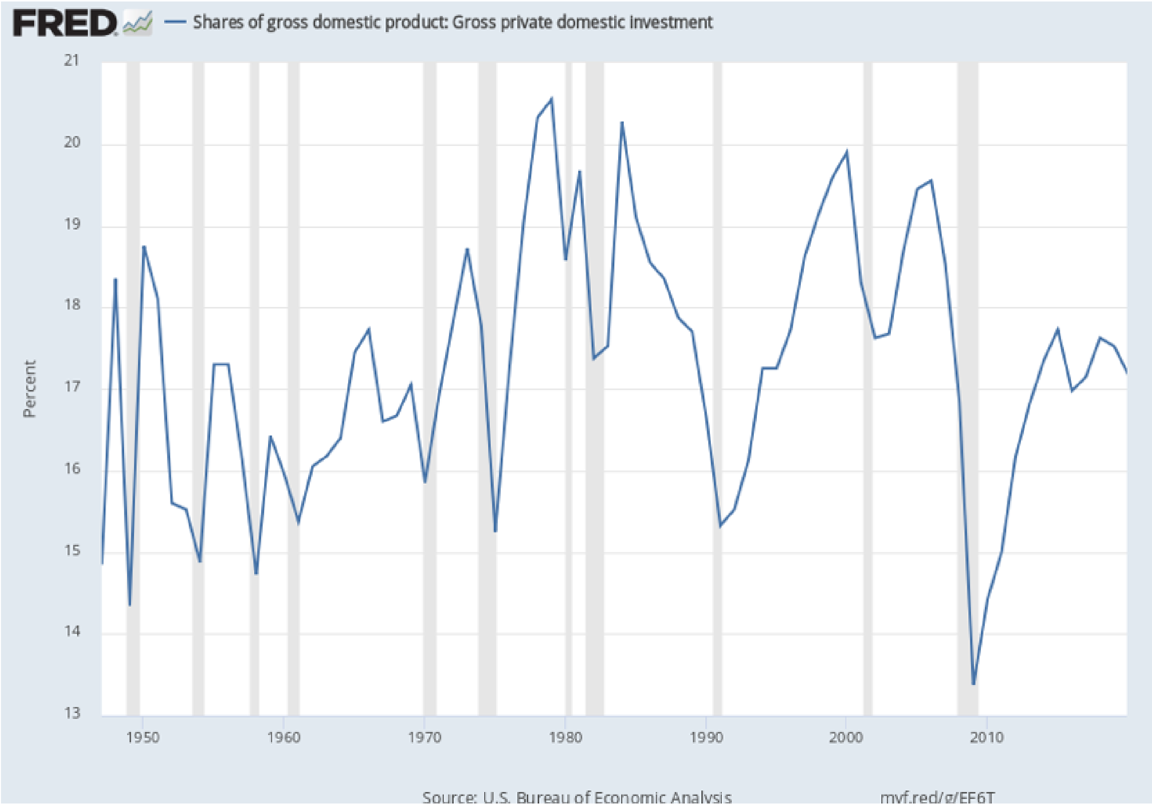

Figure 2. Capacity utilization over US cycles, 1967-2020

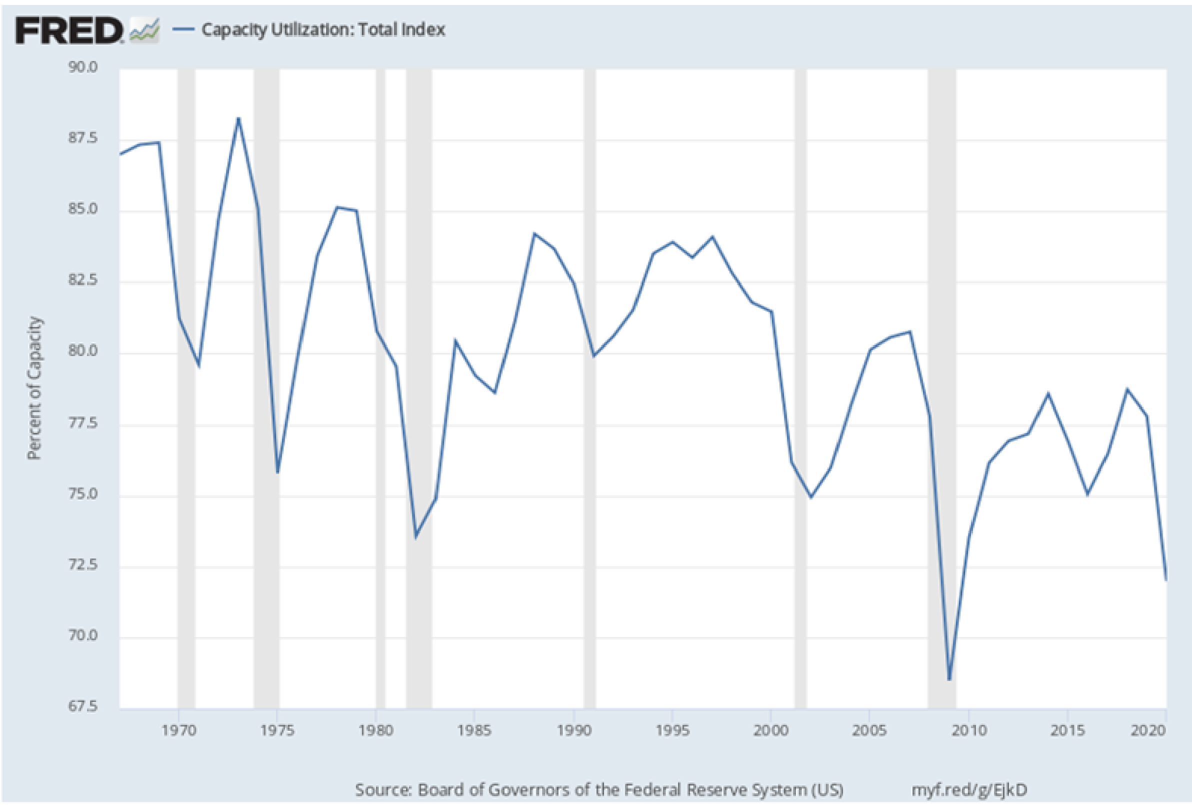

Figure 3. Net private investment over US economic cycles, 1967-2019

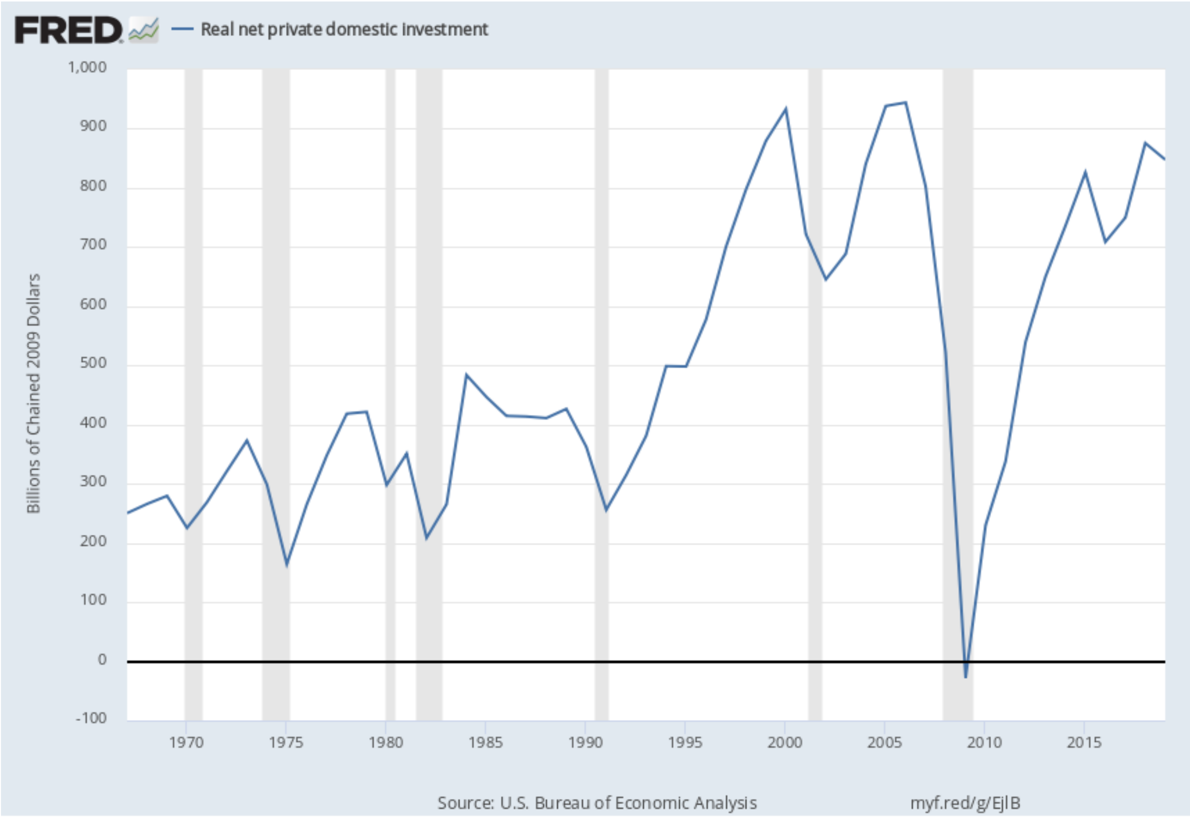

Figure 4: The dynamics associated with the neo-Kaleckian growth model