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THE ROLE OF TECHNOLOGY, DISTRIBUTION AND DEMAND IN THE DEVELOPMENT AND CRISIS OF THE POSTWAR GREEK ECONOMY

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ABSTRACT

In this paper we examine the behavior of the net rate of profit and its constituents in the Greek economy over the 1960-2013 period, and using structural break tests we distinguish the postwar era into four medium run and five short run periods. Then, decomposing the rate of profit into a technology, a distribution and an effective demand component we find that in all three time horizons technological change (rising capitalization of production) appears to be the most important driver of profitability, with distribution also being important during the stagflation crisis of the 1970s. The role of aggregate demand and capacity utilization is limited except for the period of the current crisis when the state and capital in an effort to bring about capital destruction and labor capitulation have adopted drastically restrictive policies which have affected seriously profitability in a negative way.

Keywords: Profitability, Technical change, Effective demand, Income distribution, Greek economy

JEL Classification: B51, E11

Introduction

In earlier works we have investigated the pattern of development of the postwar Greek economy from a classical Marxian perspective (see Maniatis 2005; Maniatis and Passas 2013, 2015, and 2017). These papers focused on capital profitability, its level and fluctuations, using the scheme developed by Shaikh and Tonak (1994) and originating in Shaikh (1978). This scheme provides a thorough correspondence between the categories of orthodox National Accounts and Marxian categories, all expressed in price terms. The construction of Marxian categories in an appropriate way helps in testing the validity of Marx's predictions regarding their long-run pattern and specifically their pattern of development in periods of crisis or in periods of incubation of the conditions of crisis.

Two similar but distinct strands of empirical literature have emerged in the investigation of profitability trends, especially since the stagflation crisis of the late 1960s-1970s. The first is based on the distinction between productive and unproductive labor in estimating the relevant measures and evaluating the fundamental and proximate causes of crisis each time (see Shaikh 1987; Moseley 1988, 1991, 1997; Shaikh and Tonak 1994; Paitaridis and Tsoulfidis 2012). The second strand has been more widely used and it is based on the decomposition of the rate of profit originally presented by Weisskopf (1979) (see also Gordon 1987).

In this paper we combine both approaches in estimating profitability in the postwar Greek economy[1] in order to focus more closely than we did in earlier studies on the role played by cyclical factors, that is, fluctuations in aggregate demand as captured by changes in the rate of capacity utilization.

The first approach provides a different measure of total economic activity in the form of net value added (the sum of variable capital and surplus value) than its mainstream counterpart. Also, changes in distribution are mostly captured by movements in the rate of surplus value (the ratio of surplus value and variable capital) rather than in the profit-wage ratio or in the profit share. In addition, productivity is defined as value added in a Marxian sense over hours worked by productive workers only and not as mainstream value added divided by the hours worked by the entire labor force. Finally, profitability is gauged by the use of two measures. A broad one defined as the maximum possible rate of profit

[1] In a recent unpublished paper, Basu and Das (2015) follow a somewhat similar approach and we mostly apply their method below.

(surplus value before the deduction of costs for unproductive labor and other unproductive activities divided by the stock of fixed capital, a ratio called also the general Marxian rate of profit) and a narrow one, the net rate of profit defined as the ratio of net profits (a subset of surplus value) over the stock of fixed capital. It is the second measure that influences investment and capital accumulation and therefore output growth in the medium and long run. It is obvious also that its movement is bounded from above by the maximum profitability of the system as defined by the general Marxian rate of profit.

The second approach has contributed in turn to the profitability literature by emphasizing the possible effect of changes in effective demand especially regarding particular short term periods. Our previous work on the Greek economy cited above has not examined (for lack of available data on a consistent long run basis) the effect of changes in the capacity utilization (the usual proxy for capturing changes in effective demand). Thus, here we try to take into account the role played by this constituent of profitability especially during the crucial period that precedes the onset of the last two crisis episodes of the postwar Greek economy. In doing so, we construct a time series of potential (capacity) output following the method outlined in Shaikh (2016) and we use it to estimate an adequate (and missing so far) and reliable measure of capacity utilization for the Greek economy.

From a Marxian perspective, the path, the trajectory of the profit rate is fundamental in understanding the performance of the capitalist economies. It is well known that heterodox and especially Marxist traditions of political economy emphasize the importance of profitability for the deeper analysis of the structure, the performance, the health and the prospects of a typical capitalist economy. Profitability drives the capital accumulation process and through the latter and its effect on productivity of labor, it also affects in a significant way output growth on a medium term basis and long-run economic development.

This is obvious in the scatter diagrams and bivariate regressions between the net rate of profit r and the rate of capital accumulation rate I/K and the net rate of profit r and the rate of growth of net value added (dY/Y) depicted in Figure 1 and Figure 2 respectively.

Naturally, the determinants of the changes in the profit rate are of great importance in the efforts to delve deeper in the explanation of the behavior of capitalist economies.

Figure 1: Net rate of profit versus rate of capital accumulation, 1960-2013

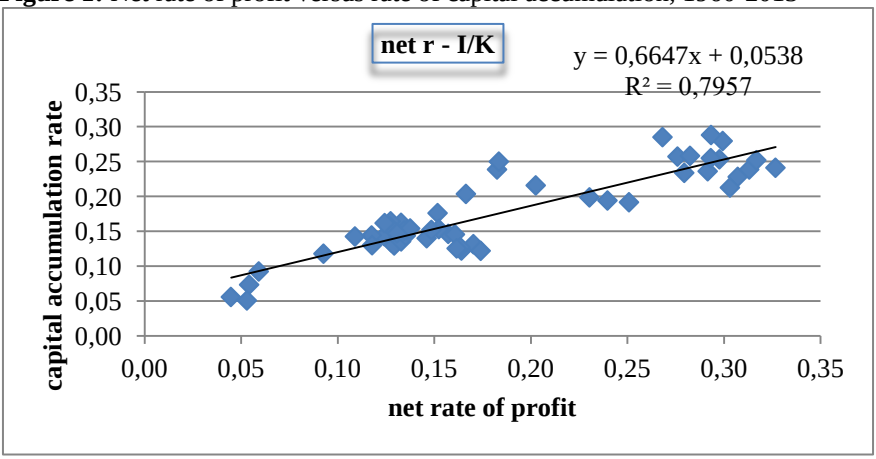
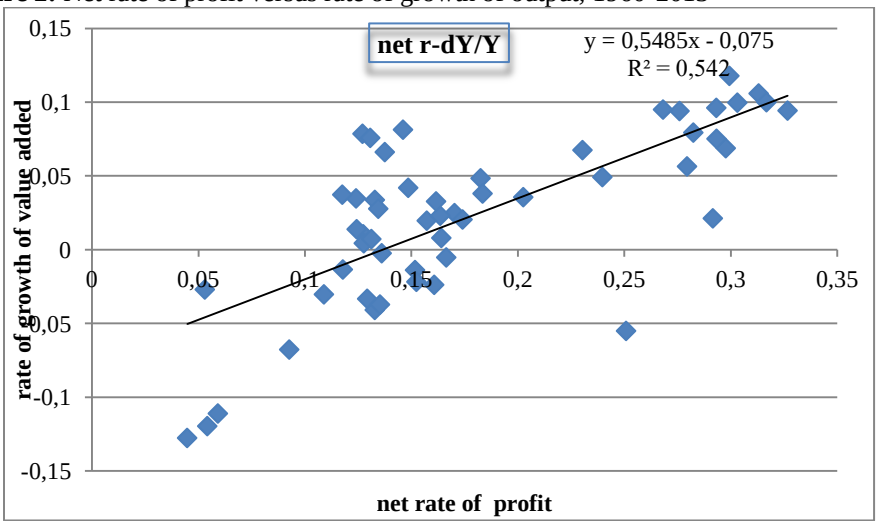


Figure 2: Net rate of profit versus rate of growth of output, 1960-2013



Here, we examine the constituents/drivers of profitability as expressed by the net rate of profit for the entire Greek economy a) over the post war period for which reliable data exist, that is for the 1960-2013 period, b) over the medium run by identifying the different phases of the behavior of profitability and the ups and downs of economic performance and c) during the different short run periods

that can be distinguished in a more precise way by econometric structural break tests.

Thus, our paper can be regarded as a contribution to two distinct sets of literature: the (mostly) Marxist literature on profitability (and its determinants), capital accumulation and economic crisis and the (radical and Marxist) literature on the analysis of the Greek economy especially with regard to the trajectory of growth and distribution that it followed during most of the postwar years. More specifically, this study contributes to the detailed examination of the most concrete profitability measure which is used for decomposition analysis to determine the contribution of each one of the underlying drivers of profitability namely technology, distribution and aggregate demand. A particular addition to the existing literature on the Greek economy is the combination of short run and medium run perspectives in addition to the long-run approach common to all contributions to this literature as well as the use of an objective statistical methodology –that is, techniques to study multiple structural breaks in macroeconomic time series– to identify breaks in the trajectory of the profit rate and different sub-periods of the postwar era. In addition, here the drivers of profitability are examined in detail distinguishing and assessing the impact not only of technology, distribution and effective demand but also the separate effect of changes in real variables and changes in relative prices.

Furthermore, we should note that in the Marxist theoretical tradition, the investigation of the trend, the fluctuations and the determinants of the profit rate is related to the debate on the famous law of the falling rate of profit derived by Marx in Volume III of *Capital*. This law is connected even with the fate of the entire (capitalist) mode of production. In short, we deal here with the analysis of the Greek economy over the most varied time frames, from the shortest period to the very long run.

Profitability trend

Measure of the rate of profit

There exist two measures of profitability in the Marxist literature which analyzes the capital accumulation process and estimates its main determinant, the rate of profit on total invested capital.

The first, R, at a fairly high level of abstraction, divides total surplus value (S) with the total stock of (private nonresidential business) capital (K) and it is the rate of profit for which Marx derives the law of the tendency of the rate of profit

to fall. It is the maximum possible rate of profit in the hypothetical case that there are no costs for unproductive activities (U), that is, no unproductive activities (like circulation, finance, supervision of labor, etc.) and employment of unproductive labor exist. Examples of works that adopt this approach are the studies by Shaikh and Tonak 1994; Moseley 1991; Cronin 2001; Mohun 2005; Maniatis 2005; Maniatis and Passas 2013; Paitaridis and Tsoulfidis 2012. In addition, those studies and almost every other study which concentrates on the course of profitability in advanced capitalist economies (Glyn and Sutcliffe 1972; Body and Crotty 1975; Dumenil and Levy 2011; Bakir and Campbell 2009; Michl 1988; Weisskopf 1979) estimate the (net) rate of profit, r as the ratio of profits (Π) per se (ideally after the deduction of interest, rent and corporate taxes) over the replacement (current) cost stock of capital (K) as defined above. The two measures are obviously related as the general Marxian rate of profit constitutes the upper limit of the net rate of profit and the time trend of the latter depends on the trend of the first and the movement of the ratio U/K over time.

$$R = \frac{S}{K} \quad (1),$$

$$r = \frac{\Pi}{K} \quad (2),$$

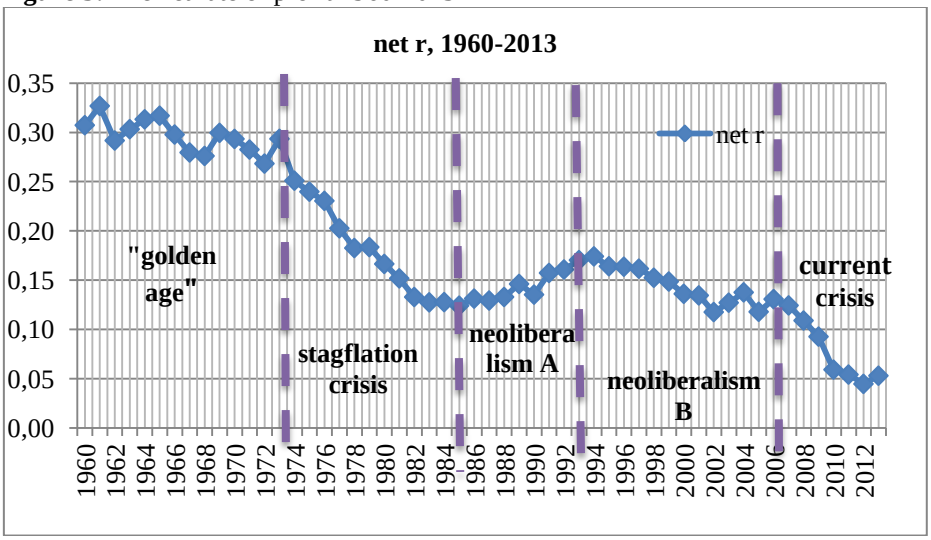
$$r = \frac{S-U}{K} = \frac{S}{K} - \frac{U}{K} = R - \frac{U}{K} \quad (3).$$

The net rate of profit, r belongs to a more concrete level of abstraction than that of the general Marxian measure. It is the more relevant indicator of profitability for capitalists and therefore it is the regulator of investment and capital accumulation as well as a reliable index of the general economic situation and prospects. Here, we concentrate on the net rate of profit and its determinants which according to the important contribution by Weisskopf (1979) can be distinguished into three factors that represent the effect of technological change, distribution and aggregate demand on profitability.

In addition, by applying the econometric method of identifying structural breaks in the trajectory of profitability, we can distinguish a certain number of medium run periods (distinct *phases* of constant or rising and falling profitability) as well as a larger number of short run periods of rising, falling or constant profitability. The overall period is comprised from a number of various medium and short run periods with different characteristics in each successive profitability regime where distribution, technological change and aggregate demand alternate in playing the major role in affecting profitability and in certain cases causing an economic crisis when profitability becomes too low.

The disaggregation of the components of the profit rate goes a step further by distinguishing between the contribution of changes in the real variables and the contribution of price changes in the formation of each nominal variable.
Finally, in this paper, at least for the most detailed analysis we leave almost totally aside the role played by unproductive activities and unproductive labor in trying to conduct our analysis in terms quite similar to those of most recent studies (see Basu and Das 2015; Shaikh 2016).

Figure 3: The net rate of profit 1960-2013



Identifying structural breaks

As expected, the net rate of profit has fluctuated a lot during the 54-year period examined here and shown in Figure 3. Periods of constant or rising and high profitability especially during the first considered decade of the postwar period have given rise to periods of low or falling profitability during most of the second half of the period. Although from plain visual inspection of Figure 3 above it is possible to identify four distinct regimes (those covering the periods of "golden age", stagflation crisis, neoliberalism and finally of the current crisis, as we argue in Maniatis and Passas (2013, 2015), selecting the appropriate turning points could be done in a more precise way. More specifically, following Basu and Das (2015) we use a Bai and Perron (2003) structural break test after

running a regression of the logarithm of the profit rate to a constant and a linear time trend to select the appropriate turning points.

$$\log (r_t) = a + bt + u_t$$

with b being the average exponential growth rate of the rate of profit for the entire period, 1960-2013. In other words, the break points selected in that way account both for changes in the level and for changes in the trend of the profit rate.

Results from the dating of structural breaks are presented in Table 1. In particular, using the Double Maximum (UD, WD) test we find evidence for four structural breaks in the years 1973, 1984, 1993 and 2006 at the 1% significance level. Therefore, those breaks in the exponential growth rate of the rate of profit allow us to exactly define the five short run periods in the following way:

Table 1: Structural Break Tests: Bai - Perron tests

Number of Breaks	F-statistic	Scaled F-statistic	Weighted F-statistic	Critical Value	BIC	Break Dates
1	18.07316	36.14633	36.14633	15.37	-3.285787	1992
2	29.86371	59.72743	75.55643	12.15	-3.861121	1980, 2006
3	32.88068	65.76135	98.41791	10.27	-4.136655	1977, 1991, 2006
4*	99.18053	198.3611	352.4635	8.65	-4.541011	1973, 1984, 1993, 2006
5	69.73559	139.4712	306.2389	7.00	-4.298289	1969, 1977, 1985, 1994, 2006

UDMax statistic*	198.3611	UDMax critical value**	15.41
WDMax statistic*	352.4635	WDMax critical value**	17.01

Table 1a: Short-run periods

Phase	Years
"Golden Age"	1960-1973
Stagflation Crisis	1973-1984
"Recovery phase" of neoliberalism	1984-1993
"Stagnation phase" of neoliberalism	1993-2006
Current crisis	2006-2013

In short, the four structural breaks provided by econometric testing identify five short run periods of analysis, while the medium run perspective, a combination of visual inspection (high and stagnant, falling, then rising and finally sharply falling rate of profit) and structural breaks (1973, 1984, 1993, 2006) indicates the existence of four different medium run periods.

Broad Trends (Long-Run, Medium-Run, Short-Run)

In this section we describe briefly the behavior of the net rate of profit as shown in Figure 3 and analyzed in more detail in Tables 2 and 3 below. We do so by distinguishing among three different time frames, the long run which refers to the overall period examined, the medium run which refers to four different periods of falling and rising (or stagnant) profitability and the short run which covers five periods of alternate regimes in profitability.

Over the whole period, the net rate of profit fell at an average exponential rate of 3.31%. We investigate below the proximate and more fundamental reasons for this secular fall. The four medium run periods are distinguished mainly by the alternating behavior of the rate of profit in addition with the use of the information provided by the structural break tests. During the first period (1960-1973) the rate of profit is more or less constant at a quite high level, hence the characterization of this period as "golden age" (mostly though for capital and much less so for the working class). The next period (1973-1984) is the period of "stagflation crisis" with the rate of profit falling substantially at an average rate of -6.18% per year. Then, comes the (long) period of neoliberalism (1984-2006) during which the rate of profit was rising at a paltry average rate of 0.11% per year. Finally, the episode of the current crisis (2006-2013) follows with the rate of profit falling sharply at an average rate of 9.98% per year.

Those medium run regimes delineated above almost coincide with the break-up of the entire period into short run periods which is done by following exactly the structural break test of Table 1. It is obvious there, that from a short run perspective the entire period can be considered as the succession of five roughly similar in length periods, the "golden age" (13 years), the "stagflation crisis" (9 years), the "recovery phase" of neoliberalism (9 years) with the rate of profit rising substantially at an average rate of 2.9% per year, the "stagnant phase" of neoliberalism (13 years) with the rate of profit falling at an average rate of 1.48% per year and finally the period of the current crisis which had lasted for seven years at the end of the period examined here.

In order to analyze these divergent trends in profitability, we will use an analytical framework organized around profit rate decomposition, following a recent contribution by Basu and Das (2015).

Profit rate decomposition

In this section we focus on the fundamental drivers of profitability over two different time frames. The first is related to a long and medium run perspective where we abstract from considerations of aggregate demand and we focus on the separate effects of technological change and distribution (in a broad sense) on the rate of profit. This approach examines both long run capitalist development and also episodes of crises. The second is related to a short run perspective first developed in Weisskopf (1979) and Gordon (1987), where in this more detailed analysis we also take into account the effect of aggregate demand on the rate of profit.

Decomposition of the rate of profit from a short run and a medium run perspective

Following the common practice in the related literature we proceed to the decomposition of the net profit rate into the profit share $\left(\frac{\Pi}{Y}\right)$ and the output-capital ratio $\left(\frac{Y}{K}\right)$. Such a decomposition of the profit rate allows for the distinct treatment of distribution effects (as captured by variations in the profit share) and the effect of technological factors (as captured by changes in the output-capital ratio). As we discuss in more detail below, variations in the class struggle between labor and capital are more appropriately captured by the development of the rate of surplus value (s' = S/V) where S = surplus value, V = variable capital.

If we denote as U = costs for unproductive labor (wages) plus other costs of unproductive activities ($U = U_W + U_C$) then $Y = \Pi+U+V$, and $S = \Pi+U$. Here, we disregard the part of U that does not represent wages of unproductive labor (i.e. U_C) and we define net output ($Y = \Pi + W$) as the sum of profits (Π) and total wages ($W = V + U_W$). Obviously, a rise in U_W/Y will lower the profit share (Π/Y) without at the same time productive labor necessarily gaining in the direct distribution battle with capital at the point of production.[2]

In any case, below we can see the decomposition of the profit rate over a medium term horizon, used mostly in the literature that does not distinguish between productive and unproductive labor:

$$r = \frac{\Pi}{K} = \frac{\Pi}{Y} * \frac{Y}{K} \quad (4).$$

[2] See Maniatis and Passas (2013).

Since all variables in Equation (4) are given in nominal prices, it is possible to further decompose them by separating real variables per unit of labor from their corresponding price indices.[3] Thus,

$$\frac{\Pi}{Y} = \frac{Y-W}{Y} = 1 - \frac{W}{Y} = 1 - \left(\frac{w_r * P_w}{y_r * P_y}\right) = 1 - \left(\frac{w_r}{y_r} * \lambda_{wy}\right) \text{ (5).}$$

With w_r being the real wage rate[4], W = total wages, L = employment of (total) labor, P_w = consumer price index = CPI, and w_r = W / (L * P_w), y_r = real labor productivity, Y = net output, y_r = Y / (L * P_y), P_y = price index of net output = GDP deflator, and λ_{wy}= P_w/P_y the ratio of the CPI to GDP deflator.

Distinguishing the real wage w_r from the real product wage w_p = w_r * λ_{wy} = W/ (L*P_y), we note that the former expresses the purchasing power of the nominal wage and therefore the development of the standard of living of workers while (changes in) the latter express in a more direct way the development of distribution since the comparison of the rates of growth of the real productivity and the real product wage determine the direction of change of the profit share.
In similar fashion, technical change is analyzed further, by decomposing the output-capital ratio,

$$\frac{Y}{K} = \frac{Y_r * P_y}{K_r * P_k} = \frac{y_r}{k_r} * \frac{1}{\lambda_{ky}} \text{ (6).}$$

With $y_r = \frac{Y_r}{L}$ real labor productivity, $k_r = \frac{K_r}{L}$ real capital stock per unit of labor, and λ_{ky} the ratio of Gross Fixed Capital Formation (GFCF) deflator to the GDP deflator (P_k/P_y). It is obvious from equation (6) that with λ_{ky} constant, when the real capital stock per unit labor (mechanization of production) grows more than the real productivity of (total) labor then the output-capital ratio falls (i.e. capitalization of production occurs).

It is possible to further expand Equation (4) in order to capture the effects of variations in aggregate demand and capacity utilization that are considered to be significant by this part of the literature that focuses more on the short-run developments

[3] Capital letters indicate nominal variables and small letters indicate variables per unit of labor, except for deflators.
[4] Wages include the wage equivalent of the self-employed persons.

$$r = \frac{\Pi}{Y} * \frac{Y}{Y_n} * \frac{Y_n}{K} \text{ (7)},$$

with Y_n denoting full capacity output, $\frac{Y_n}{K}$ indicating the capacity-capital ratio, and $\frac{Y}{Y_n}$ the capacity utilization rate.

As before, it is possible to express Equation (7) in a way that distinguishes between real variables per unit of labor and price indices, in the following way:

$$\frac{Y_n}{K} = \frac{y_{nr} * P_y}{k_r * P_k} = \frac{y_{nr}}{k_r} * \frac{1}{\lambda_{ky}} \text{ (8)},$$

with $y_{nr} = \frac{Y_{nr}}{L}$ real capacity output per unit of labor or real capacity productivity, $k_r = \frac{K_r}{L}$ real capital stock per unit of labor, and λ_{ky} the ratio of Gross Fixed Capital Formation (GFCF) deflator to the GDP deflator (P_k/P_y).

Therefore, our expression for the *medium run* becomes

$$r = \left[1 - \left(\frac{w_r}{y_r} * \lambda_{wy}\right)\right] * \left(\frac{y_r}{k_r} * \frac{1}{\lambda_{ky}}\right) \text{ (9)}.$$

And for the *short run:*

$$r = \left[1 - \left(\frac{w_r}{y_r} * \lambda_{wy}\right)\right] * \frac{Y}{Y_n} * \left(\frac{y_{nr}}{k_r} * \frac{1}{\lambda_{ky}}\right) \text{ (10)}.$$

It is now possible to transform expressions (9) and (10) into growth accounting form where variables appear as rates of change over time. To do so in an efficient way we multiply the wage share with a positive multiplier $-\xi$ that translates the growth rate of the wage share to the growth rate of the profit share, such a multiplier has the property $\xi = \frac{W}{\Pi}$.

Thus, for the medium run

$$\Delta \ln(r) = \left[\frac{W}{\Pi} * \left(\Delta \ln(y_r) - \Delta \ln(w_r) - \Delta \ln\left(\lambda_{wy}\right)\right)\right] + [(\Delta \ln(y_r) - \Delta \ln kr - \Delta \ln \lambda ky] \text{ (11)}.$$

And for the short run

$$\Delta \ln(r) = \left[\frac{W}{\Pi} * \left(\Delta \ln(y_r) - \Delta \ln(w_r) - \Delta \ln(\lambda_{wy})\right)\right] + \Delta \ln\left(\frac{Y}{Y_n}\right) + \left(\Delta \ln(y_{nr}) - \Delta \ln kr - \Delta \ln \lambda ky\right) (12).$$

Having obtained growth accounting expressions (11) and (12) for the medium run and the short run respectively, it is now possible to estimate the contribution of each profitability component to the formation of the profit rate especially before and during the crisis episodes of the postwar Greek economy.

Results

The Long Run Story

Table 2: Medium term decomposition of the profit rate and contributions (average annual growth rate, % per year)

Medium Term	r	Π/Y	Y/K	W/Π	y_r	w_r	λ_{wy}	y_r	k_r	λ_{ky}
	(1) = (2+3)	(2) = (4) * (5-6-7)	(3)= (8-9-10)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1960-1973	-0.35	0.64	-0.99	117.98	9.00	9.48	-1.07	9.00	7.93	2.06
1973-1984	-6.18	-2.98	-3.21	159.56	0.51	3.07	-0.70	0.51	1.87	1.85
1984-2006	0.11	0.46	-0.35	170.89	1.42	1.25	-0.06	1.42	2.93	-1.16
2006-2013	-9.98	-2.82	-7.16	279.83	-2.08	-1.86	0.93	-2.08	5.82	-0.75
1960-2013	-3.31	-1.09	-2.22	172.03	2.40	3.16	-0.16	2.40	4.08	0.55

As far as the long run story is concerned, we see in the last row of Table 2 that the net rate of profit fell at an average annual rate of 3.31% for the entire period. The major contributor to this fall was the nature of technological change (Marx-biased) as the output-capital ratio fell by 2.22% per year (accounting for almost 66% of the entire fall in the rate of profit). Changes in distribution contributed the other third of the fall in profitability since the profit share (the index of changes in distribution subject to the reservations about the role played by unproductive labor mentioned above[5]) fell at an average rate of 1.09% for the

[5] As a matter of fact for the entire period the ratio of unproductive labor compensation to productive labor compensation rose from 0.82 to 1.29 and the ratio of unproductive labor wages to net output

entire period. In short, over the long run the Greek economy did not exhibit much of technological dynamism while the share of profits fell in similar fashion with what happened in the postwar history of other advanced capitalist economies.

More specifically, as far as the profit share is concerned, columns 4 through 7 in the last row of Table 2 show that the real wage (for total labor) complemented by the wage equivalent of self-employed people rose substantially at an average annual rate of 3.16% while the real product wage grew by 3% per year, both surpassing the average annual rate of growth of (total labor) productivity of 2.40%. On the other hand, columns 3, and 8-10 indicate that significant capital deepening occurred, since the real capital-labor ratio, k_r increased at an average annual rate of 4.08%. This substantial mechanization of production nevertheless increased real productivity by an average annual rate of 2.40% which combined with an increase in the relative price of capital goods by an average rate of 0.55% resulted in a decrease in the output-capital ratio (Y/K) by 2.2% on average. At first sight, the decisive contribution of the capitalization of production to the secular fall in the rate of profit seems to provide support for the secular version of the Marxian law of the falling rate of profit. However, over the entire period wild swings in profitability and its constituent factors have occurred, both over a medium term horizon and in shorter term periods. Thus, we turn to the analysis of profitability over the four different phases of the postwar Greek economic development.

The Medium Run

In earlier works (Maniatis and Passas 2013, 2015), we have also divided the postwar period of the Greek economy into four sub-periods based mainly on visual inspection of the trajectory of profitability and the well-known correlation between profitability, capital accumulation and growth. Here, we combine visual inspection and structural break analysis for distinguishing and discussing in detail these different medium-term periods as accurately as possible. In section 2.3 above we saw those four periods and the rows of Table 2 present the overall movement in profitability and the specific way the rate of profit was formed by separate developments in technological change and distribution.

A first point has to do with the fact that in the same way with the overall period, technological change was more important than distribution in driving the rate of profit in three of the four medium-run periods except for the period of

rose from 0.24 to 0.42. This rise in unproductive costs was accompanied by a rise in the rate of surplus value indicating a distributive victory of capital over productive labor.

neoliberalism (1984-2006). During the "golden age" period of capital accumulation (1960-1973), a period of exceptional growth due to the *high* rate of profit (as shown in Figure 3 above, and despite a slightly negative trend) the output-capital ratio exhibited a falling trend while distribution in the form of the profit share (and much more so in the more appropriate form of the rate of surplus value as shown in Maniatis and Passas 2013) developed in favor of capital. This is the scenario described by Marx as the content of the law of the tendency of the rate of profit to fall regarding the typical development of distribution and technical change in preparing the ground for the beginning of a crisis of overaccumulation of capital. The crisis period per se (i.e. the "stagflation crisis" of 1973-1984) was also characterized by a fall in the output-capital ratio but now the fall in profitability (at an annual average rate of 6.18%) was intensified by the successful labor struggles after the fall of the military dictatorship which lowered both the profit share and the rate of surplus value.

The profitability ("stagflation") crisis was reversed by the advent of the neoliberal period and the attack on labor, especially during the first period of neoliberalism (see below). However, the output-capital ratio continued to fall (the massive destruction of capital required for a substantial recovery of profitability was not politically feasible at the time) as the growth in the real capital-labor ratio, k_r exceeded by so much the growth in real labor productivity, y_r so as to offset the fall in the relative price of capital goods, λ_{ky}. Hence, despite the reversal in the fall of the profit share, the rate of profit recorded an incomplete (compared to that required for robust growth) insufficient at best, recovery.

Our structural breaks test indicates that the neoliberal regime was already exhausted by 2006-7, when a clear fall in profitability was manifested at first, and the mass of real profits remained stagnant (both in 2007 and 2008, this being the clear sign of the start of a crisis of capital overaccumulation, see Maniatis and Passas 2017). The rate of profit fell dramatically at an average rate of 9.98%, mostly because of the great fall in the output-capital ratio (by an average annual rate of 7.16%). Despite the significant fall in the real wage by an average annual rate of 1.86%, profits fell even more, reducing the profit share and contributing another 2.82% to the fall in the rate of profit.

Finally, it should be noted that the medium run analysis reveals that in all four periods the increases in real productivity achieved by capital deepening were not sufficient (during the "golden age" because of changes in relative prices, λ_{ky}, in the next three simply because $y_r < k_r$) to increase the "productivity of capital", namely to prevent a rise in the capital-output ratio which is the sufficient

condition for the falling tendency in the rate of profit to appear at some point in time (Shaikh 1987). Foley and Michl (1999) call this pattern of increasing labor productivity but decreasing output-capital ratio, "Marx-biased technical change". In general, after the "golden age" period, the Greek economy did not experience any period of notable technological dynamism, certainly not productivity-wise and even more so regarding *the output-capital ratio which fell in all medium run periods*. As far as distribution is concerned, we observe that two periods witnessed a rise in the profit share and two periods a fall. It should be noted that the only period where labor clearly gained in the distributive struggle with capital was the years 1973-1984 (actually after 1974 and the fall of the military dictatorship) when the real wage rose much more than real productivity, whereas in the other period that the profit share fell (during the current crisis) this fall was mostly caused by a fall in labor productivity while at the same time the real wage also fell substantially, albeit less than labor productivity.

The short-run

We turn next to the decomposition analysis of the five short run profitability periods identified by the structural breaks test of Table 1 which mostly coincide with the medium run periodization, except for the break-up of the neoliberal period into a "recovery phase" of neoliberalism (it could be called "true" neoliberalism) and a "stagnant phase" of neoliberalism.

Table 3: Short Term decomposition of the profit rate and contributions (average annual growth rate, % per year)

Short Term	r	Π/Y	Y/Y_n	Y_n/K	W/Π	y_r	w_r	λ_{wy}	y_{nr}	k_r	λ_{ky}
	(1)=(2)+(3)+(4)	(2)=(5)*(6-7-8)	(3)	(4)=(9-10-11)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1960-1973	-0.35	0.64	2.80	-3.79	117.98	9.00	9.48	-1.07	6.20	7.93	2.06
1973-1984	-6.18	-2.98	-1.15	-2.06	159.56	0.51	3.07	-0.70	1.66	1.87	1.85
1984-1993	2.90	3.07	0.34	-0.51	178.36	0.63	-1.06	-0.12	0.29	1.87	-1.08
1993-2006	-1.48	-0.94	0.69	-1.22	162.85	2.02	2.60	-0.01	1.33	3.82	-1.27
2006-2013	-9.98	-2.82	-6.69	-0.47	279.83	-2.08	-1.86	0.93	4.60	5.82	-0.75
1960-2013	-3.31	-1.09	-0.51	-1.71	172.03	2.40	3.16	-0.16	2.91	4.08	0.55

Considering the separate contributions of a) technical change, b) aggregate demand and capacity utilization, and c) distribution, allows for a finer analysis and characterization of the five different short run periods and especially those that preceded the onset of each of the two major crisis episodes of the postwar history of the Greek economy.

In Table 3 we observe that the capacity-capital ratio Yn/K fell significantly (by 3.79% at an average annual rate) during the "golden age" period. This fall combined with the rise in the profit share that we already discussed above, and the positive effect of aggregate demand and capacity utilization (2.8% at an average annual rate) form exactly the scenario of the typical development which is the content of the law of the falling rate of profit due to the increasing organic composition of capital (or capitalization of production).

The short run analysis of the period of "stagflation crisis" provides the further piece of information that the fall (3.21% p.a.) in output-capital ratio we saw above is decomposed into a 2.06% fall in the capacity-capital ratio and a 1.15% fall in the capacity utilization rate, an expected fall in a period of crisis, but a mild fall nevertheless.

The main contribution of the use of structural breaks test is the division of the long neoliberal period into two separate phases. The first one (1984-1993) is characterized by the well-known features of neoliberalism: falling real wages (1.06% p.a.), very small improvements in productivity (0.29% p.a in the capacity real productivity y_{nr}, 0.34% p.a. in the rate of capacity utilization and 0.63% p.a. in the real productivity of labor, y_r) which resulted in a significant increase in the profit share while the recovery in the profit rate peaked in the last year of this period. Capital accumulation (mechanization), productivity and the capacity capital-output ratio continued to increase in the absence of serious capital devaluation or capital destruction. This is all that neoliberalism offered to the recovery of profitability as the distributive gains of capital started to erode in the next phase of "stagnant neoliberalism" (1993-2006). Capital deepening (increasing k_r by 3.82% p.a.) brought about smaller increases in productivity (1.33% p.a. in y_{nr}, and 2.02% p.a. in y_r, aided by an increase of 0.69% p.a. in the capacity utilization rate) and as a result despite a fall in the relative price of capital goods λ_{ky} by 1.27% p.a. the capacity-capital ratio fell more than before at an average annual rate of 1.22%. Thus, the current crisis was *preceded* by a period of substantial capital accumulation and *capitalization of production*, with conditions of aggregate demand being positive for profitability. However, the restrictive policies that have been adopted since the beginning of the overaccumulation crisis in an effort to drastically restore capital profitability by both capital destruction and labor defeat have turned the crisis into a Great Depression with both profit share and capacity-capital falling and aggregate demand contributing the most *during* the crisis years to the fall in profitability.[6]

[6] Weisskopf notes that "Whatever the initial source of decline in the rate of profit, that decline will sooner or later induce a fall in the rate of investment which in turn is likely to lead to a decline in the

Finally, looking at the postwar period depicted in the last row of Table 3, we conclude first that technological change in the form of changes in the capacity-capital ratio was the most important contributor to the secular fall in profitability (causing more than 50% of the total fall) and second that technological dynamism or real technological change which as Basu and Das (2015) note, is expressed by changes in the real capacity-capital ratio (i.e. yn_r - k_r which was consistently negative) was absent in the Greek economy in all five short run periods.

Conclusions

Over the entire 54-year period examined here the rate of profit in the Greek economy has exhibited a clear negative trend falling at an average annual rate of 3.31%.

It can be argued that Marx-biased technical change as expressed by an average annual falling output-capital ratio of 2.22% per annum (despite the rise in labor productivity) was the primary reason for this secular fall while distribution, expressed here (in a way that disregards unproductive labor) by the profit share also contributed to the reduction in profitability falling by an average annual rate of 1.09%.

In the same way with a recent contribution by Basu and Das (2015), we used a methodology of dating structural breaks in addition to visual inspection for the identification of turning points in the net rate of profit over both a medium run and a short run time framework.

Over the medium run, we distinguished two periods of rapid growth ("golden age") and stagnation or slow growth ("neoliberalism") respectively. Both of those periods of relative capitalist prosperity ended because of capital overaccumulation in the form of increasing capital-output ratio despite increases in the productivity of labor brought about from increasing mechanization of production. Developments in distribution favorable for capital during both periods did not prevent the gestation of the conditions for the onset of the crisis. The other two medium run periods were periods of crisis ("stagflation" in the 1970s and 1980s, and the current crisis) with profitability falling sharply, developments in distribution squeezing the profit share, but output-capital continuing its downward trend indicating that the destruction of capital required

rate of capacity utilization. Such a lagged decline in φ should not of course, be identified with the initial source of the decline in ρ." Weisskopf (1979, 342).

for a sufficient recovery of profitability did not (in the "stagflation" crisis) and has not (in the current crisis) taken place.

The short run analysis which extends the number of sub-periods and includes the effect of changes in aggregate demand and in the capacity utilization rate on profitability does not alter in a substantial way the above mentioned conclusions. For the entire period, just like the output-capital ratio was the most important driver of profitability, now the fall in capacity-capital ratio contributes more than half of the overall fall in profitability. In addition, the fall in the capacity-capital-output ratio before the two crisis episodes appears to be the most important factor in driving profitability. Also, what stands out is the great fall in aggregate demand during the current crisis, in contrast to what happened during the "stagflation" crisis when the response of the state was more in the Keynesian direction of stimulating aggregate demand, moderating in this way the fall in profitability. This is the case where the difference between Keynesian and neoliberal remedies to crisis is more obvious. However, both responses appear to be inadequate as the system suffers from a deep structural crisis originating in the production sphere rendering policies at the circulation (Keynesian) and distribution (neoliberal) levels useless for coping successfully with this crisis. In general, it could be argued with respect to the evaluation of the crisis episodes of the postwar Greek economy and especially the current one, that except for the accuracy allowed by the finer formulations adopted here, the picture which emerges, is that of a systemic structural crisis which is the outcome of the typical development of an advanced capitalist economy, a conclusion similar to those reached in our earlier studies on this subject.

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Appendix: Data sources and estimation methods

In this appendix we describe the data that we used for our calculations, their sources and the methods that we employed to construct them, as well as the estimation processes used to obtain our results.

a) Data sources

Output was calculated as total GDP less net taxes on production and imports (taxes minus subsidies), less consumption of fixed capital, less gross value added in the sectors of agriculture, public administration, and real estate. Therefore our measure of output is net of depreciation. Moreover, it is a measure of output for the business sector of the economy and it also excludes fictitious elements such as imputed rents. Our main source of data was EUROSTAT for the period 1995-2014, and national accounts data published by ELSTAT[7] for the period 1958-1994. We note that due to the different vintages of accounting systems used by ELSTAT over the years it was necessary to link different vintages of data to avoid breaks in the series. The link years were 1988 and 1995, and the linking process was straightforward as we applied the growth rates of the earlier series to our last valid data point when using the newest vintage of national accounts data. Finally, we estimated the deviation between the measure of GDP reported by ELSTAT in the earlier vintages of national accounts data and that reported by AMECO for the same period[8]. Ideally, this deviation should have been stable reflecting only step changes caused by changing the vintage of the accounting system. While this was the case for the period after 1974 we found an increasing deviation for the years before 1974 that in turn made necessary a final adjustment. Thus, we recalculated our measure of output by adjusting for the growth profile of GDP as reported by AMECO. This had the effect of lowering our estimates of output for the 1960-1974 period.

Data on the compensation of employees for the period 1995-2014 were obtained by EUROSTAT. We exclude from the total compensation of employees that of employees in the sectors of agriculture and public administration. For the years prior to 1995 we used national accounts data on the compensation of employees obtained by ELSTAT. We linked the two series, as before, by applying the growth rate of the earlier series to the level of the last valid data point of the latest series.

[7] The Greek Statistical Authority.

[8] We could not simply use AMECO's data since they lack the necessary detail at the sectoral level that is necessary to focus on the business sector of the economy. This was also the case for the OECD Statistics as a data source.

The wage equivalent of the self-employed was obtained by multiplying the average compensation of employees to the number of self-employed persons in each sector. Thus, it was necessary to obtain reliable data on the number of employees and the self-employed in each sector of the economy. For this purpose we used data on total employment and employees by sector from the EUKLEMS database for the period 1970-2007 and we extended those both backwards and forwards using higher level data from the Annual Labor Force Survey (ALFS) obtained by the OECD.[9] Our method was to apply the growth rate of employment in agriculture, industry and services as found in the ALFS data to our last valid data points of employment by relevant sector. Therefore it was possible to calculate the number of self-employed persons (including employers) residually.

Finally, our estimate of the capital stock in the Greek economy was calculated excluding dwellings and the sectors of agriculture and public administration. Data came from three data sources. For the period 1960-1989 we used data from Skountzos and Matthaios (1991), for the period 1990-1994 we used data obtained from ELSTAT and for the 1995-2013 period we used data obtained by EUROSTAT. We linked the three databases as previously by applying the growth rates of earlier periods to the levels of the latest period available.

b) Measuring capacity utilization

Having obtained estimates of output and capital stock we utilized the methodology for the estimation of capacity utilization found in Shaikh (2016). The fundamental intuition behind this method is that *"economic capacity is that aspect of output which is cointegrated with the capital stock over the long run, subject to a trend in the capital-capacity ratio due to technical change"* (Shaikh 2016, 825).

From the decomposition of the profit rate into profit share (σ_ρ), capacity-capital ratio(R_n), and capacity utilization rate (u_k)

$$r = \frac{\pi}{Y} * \frac{Y_n}{K} * \frac{Y}{Y_n}$$

$$= \sigma_\rho * R_n * u_k.$$

We used the expression

[9] This survey provides long run data on employment for three broad sectors: agriculture, industry and services.

$$\frac{Y}{K} = R_n * u_k.$$

Taking logs and manipulating algebraically we get

$$\ln Y = \ln K + \ln R_n + \ln u_k.$$

Now since in the long run normal capacity is unity, thus $\ln u_k = 0$.

And since we can assume that the capacity-capital ratio can be considered to be a function of autonomous technical change (modeled as a time trend) and of embodied technical change (modeled as the capital stock)

$$\ln R_n = a + b * t + c' * \ln K + \varepsilon.$$

Then it is possible to write the following relationship

$$\ln Y = a + b * t + (1 + c') * \ln K + u.$$

Estimating this relationship and obtaining the coefficients using an ARDL model, one is able to calculate Y_n, the latter being the estimated long-run value of output, and thus identical to capacity output. Therefore, having an estimate of capacity output and data on output from given sources, it is possible to calculate the capacity utilization rate.

We proceed by empirically estimating the following relationship and obtaining the long run coefficients

$\ln Y_t = a + b * t + c * \ln K_t + dm + u_t$ (A1).

With Y_t being output, *t* a time trend (capturing autonomous technical change), *c* a constant, *K* the capital stock (capturing embodied technical change), *dm* some time-dummies[10], and *u* the residuals of the regression. The period of estimation is 1960-2013, and since our unit root tests indicate that our variables are stationary in levels without a trend, but non-stationary in levels when including a trend we turn to the ARDL method. Therefore Equation A1 above can be rewritten as

$\ln Y_t = a + b * t + \sum \gamma_i * Y_{t-i} + \sum c_j * \ln K_{t-j} + \sum d_h * dm_h + u_t$ (A2).

[10] We include time dummies for the years 1962, 1974, and 2010-2013.

We employ the Schwartz information criterion to select the optimal lag length, out of a maximum of 12 lags, and thus we select an ARDL (2, 0) that we present in columns 2 and 3 of Table A1 below. As it is obvious, the second lag of the dependent variable is not significant, therefore we reduce by one lag to ARDL(1,0) the model that we report in columns 4 and 5 of Table A1. Finally, since our trend is also found to be marginally significant we re-estimate our model without a trend and we report our findings in columns 6 and 7 of Table A1. The main problem with Model 3 is that the capital stock variable has now become marginally insignificant at the 5% level of confidence. Thus, we proceed to the bounds test for Models 2 and 3. For Model 2 the F-Statistic is higher than the critical values of the I(1) bound at the 10% (Table A2). For model 3 the F-Statistic is higher than the critical values of the I(1) bound at the 1% (Table A3). We also note that we do not find serial correlation in the residuals using Breusch-Godfrey Lagrange multiplier test and by inspecting Q-statistics. Therefore, we decided to choose model 3 as our preferred model and conclude that a long run relationship exists between the variables with a high level of confidence. Obtaining the long run coefficients of this relationship allows us to estimate the long run values of output, i.e. capacity output (Y_n), and thus to calculate the capacity utilization rate (Y/Y_n) (see Figure A1).

Table A1: ARDL regressions

	Model 1		**Model 2**		**Model 3**	
1	2	3	4	5	6	7
Variable	Coefficient	Prob.*	Coefficient	Prob.*	Coefficient	Prob.*
LOG(YR(-1))	1.0219	0.0000	0.8123	0.0000	0.8518	0.0000
LOG(YR(-2))	-0.2103	0.0817				
LOG(KR)	0.1877	0.0085	0.1933	0.0079	0.0662	0.0563
DM1	-0.1023	0.0063	-0.0925	0.0126	-0.1011	0.0081
DM2	-0.1203	0.0013	-0.1152	0.0022	-0.0891	0.0124
DM6	-0.1373	0.0000	-0.1605	0.0000	-0.1478	0.0000
C	-0.0233	0.9067	-0.0371	0.8488	0.3495	0.0000
TREND	-0.0032	0.0733	-0.0036	0.0443		

Table A2: ARDL bounds Test (Model 2)

Test Statistic	Value	k
F-statistic	6.698631	1
Critical Value Bounds		
Significance	I(0) Bound	I(1) Bound
10%	5.59	6.26
5%	6.56	7.3
2.5%	7.46	8.27
1%	8.74	9.63

Table A3: ARDL bounds Test (Model 3)

Test Statistic	Value	k
F-statistic	20.31251	1
Critical Value Bounds		
Significance	I(0) Bound	I(1) Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84

Figure A1: Capacity utilization rate