Interest and Profit: An Empirical Assessment of the Monetary Theory of Distribution for the Euro Area

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Interest and Profit: An Empirical Assessment of the Monetary Theory of Distribution for the Euro Area

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ABSTRACT
Several authors, especially those who share a Classical–Keynesian point of view, argue that the interest rate determines the rate of profit in the long run. Considering the eleven founding economies of the euro area, I find that, adjusted for the rate of growth of gross national income, there is a positive long-term relationship between the real interest rate and the net rate of profit. The results are confirmed even when I estimate a model with nominal interest rates, inflation, and a yield curve. These results imply that the European Central Bank (ECB), when deciding monetary policy, is not neutral in determining income distribution.

The rate of profits, as a ratio, has a significance which is independent of any prices, and can well be 'given' before the prices are fixed. It is accordingly susceptible of being determined from outside the system of production, in particular by the level of the money rate of interest. (Sraffa 1960, p. 33)

1. Introduction

In the Marginalist Theory of value and distribution, the notion of the money rate of interest is largely subordinated to the normal rate of profit.¹ The rate of interest is ultimately determined by productivity and thrift, the long-term real forces that, in the case of Marginalism, explain the course of the normal rate of profit (Pivetti 1991). According to Panico (1988), 'the “natural” interest rate was determined as (i.e., it coincided with)

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¹ By 'normal rate of profit' we simply mean what the theories of distribution endeavour to explain: classical and Marxian expressions such as 'natural rate of profit', 'permanent rate of profit' or 'general rate of profit', and marginalist expressions such as 'natural or real rate of interest' and 'equilibrium or full-employment rate of interest', never refer to actual or effective profits, but to normal profits. The later, reckoned gross of interest, correspond to the rate of return on capital which would be obtained by firms using dominant or generally accessible techniques, and producing output at levels regarded as normal at the time the capacity was installed. As actual profits always deviate from normal profits, economic theory is in substantial agreement in regarding the normal rate of profit as a magnitude which cannot be arrived at statistically and empirically. (Pivetti 1991, p. 20, emphasis added)
the real rate of return, or the general rate of profits, on capital, associated with full employment of labour and capital in long-period equilibrium.\(^2\) In this theoretical approach, the rate of profit determines the rate of interest. However, given the great difficulties of the neoclassical theory (see the Cambridge Capital Controversy), this paper will rest on more consistent theoretical foundations developed from the writings of Piero Sraffa (1960) and Pierangelo Garegnani (1964) in the early sixties: the Surplus approach. According to the English Classical economists, by whom Sraffa was inspired, the rate of profit was determined by taking as given the real wage and production technique. Therefore, the rate of interest or entrepreneurial profit must result as a residual magnitude (Pivetti 1991). However, complementing the Classical authors, Sraffa innovatively tried to develop what later authors Massimo Pivetti and Carlo Panico, among others called ‘the Monetary Theory of value and distribution’. In his book Production of Commodities by Means of Commodities, written in 1960, the author argued:

\[\begin{align*}
&\text{The choice of the wage as the independent variable in the preliminary stages was due to its being there regarded as consisting of specified necessaries determined by physiological or social conditions which are independent of prices or the rate of profits. But as soon as the possibility of variations in the division of the product is admitted, this consideration loses much of its force. And when the wage is to be regarded as ‘given’ in terms of a more or less abstract standard, and does not acquire a definite meaning until the prices of commodities are determined, the position is reversed. The rate of profits, as a ratio, has a significance which is independent of any prices, and can well be ‘given’ before the prices are fixed. It is accordingly susceptible of being determined from outside the system of production, in particular by the level of the money rate of interest. (Sraffa 1960, p. 33, emphasis added)}
\end{align*}\]

Later in the 1960s, when asked why the rate of profit could be taken as an ‘exogenous’ variable, Sraffa replied that in the past entrepreneurs, in deciding how much to invest, were strongly influenced by the general state of economy and how the level of activity evolved in recent periods. At the first sign of a decline in production levels, they decided to stop investing. Now, however we are in 63 or 64 the entrepreneurs expect that the authorities will still be able to adjust the performance of the system back to its normal growth path. Even bankers think in this way. That’s why the interest rate is an indicator of the normal rate of profit. And that’s also why the fluctuations of the past are no more, and economic growth is stable. (Cozzi 1986, p. 208)\(^3\)

Following this point of view, some Sraffian authors such as Panico (1988, 1995) and Pivetti (1991) tried to develop the ‘ Monetary Theory of Distribution’, where the interest rate is an exogenous magnitude given by central banks, and it is indeed a prime determinant of the distribution between profits and wages in the long run.\(^3\) According to Professor Pivetti, the rate of interest is strictly a ‘ monetary phenomenon’ which governs

\[^2\]This quotation has been translated to English by Matías Vernengo http://nakedkeynesianism.blogspot.com.ar/2012/09/sraffa-and-confidence-fairy.html.

\[^3\]Determining what the exogenous variable is it is undoubtedly very complex. As suggested by Panico, Yet, owing to the complexity of the conflicts over distributive shares, it may be impossible to say a priori whether the real wage rate or the rate of profits has to be taken as an independent variable. The specific economic, social and political conditions prevailing over a certain period will determine the outcome of the conflict between workers and capitalists over the social product, and consequently the direction of the causal links between distributive variables. (Panico 1988, p. 6)
distribution by regulating the ratio of prices to money wages (Serrano 1993). Money wages and price changes are a manifestation of class struggle between workers and capitalists. A persistent change in the long-term interest rate causes an alteration in the same direction in the price level and, given the monetary wage, it induces an income distribution shift which affects directly, the normal rate of profit and, inversely, the real wage rate. Pivetti suggests that ‘lasting change in interest rates causes a change in the same direction in the level of prices in relation to the level of money wages, hereby generating changes in income distribution’ (Pivetti 1991, p. 22), such as,

\[ \Delta i \rightarrow \Delta P \rightarrow \nabla \frac{W}{P} \rightarrow \Delta r \]

From this point of view, the price system is established considering that, under a long-term analysis, both prices tend to equate to normal production costs and the rate of profit tends to be equal in each sphere of production as a result of free competition between capitals. Likewise, the normal rate of profit is composed of two elements: the interest rate \(i\) – the ‘pure’ remuneration of capital – and the normal profit of enterprise \(npe\). While the former represents its lower limit, the sectoral ‘risks and trouble’\(^4\) are, at first, independent of the interest rate and are a – supposedly – sufficiently stable magnitude which is independent of the interest rate (Pivetti 1991, p. 24). An algebraic expression can be:

\[ r_j = i + npe_j \]

where \(r_j\) is the normal profit of sector \(j\), \(i\) is the interest rate and \(npe_j\) is the normal profit of enterprise of sector \(j\). Each productive sector has its own normal profit of enterprise which is related to the risks associated to the productive utilization of capital in each sector (Pivetti 1991, p. 24). Within this approach, changes in normal production costs driven by persistent changes in interest rate are independent of capital borrowing. Interest rate is a portion of her profit rate; the selected investment yield has to be equal or higher than the rate of interest, the latter being a ‘floor’\(^5\) to the minimum normal rate of profit on capital (Pivetti 1991). According to Pivetti, the commercial interest rate, partially based on the central bank interest rate decision, constitutes the opportunity-cost of capital,

The notion that lasting changes in interest rates constitute changes in normal costs, does not rest on the assumption that all capital employed in production is borrowed capital. Interest (as economic theory has always looked at it) is the price for the use of capital the ‘pure’ remuneration of capital, whatever the form of its employment, whether financial or real.

\(^4\)To quote from Ricardo’s work:

I have already said, that long before this state of prices was become permanent, there would be no motive for accumulation; for no one accumulates but with a view to make his accumulation productive, and it is only when so employed that it operates on profits. Without a motive there could be no accumulation, and consequently such a state of prices never could take place. The farmer and manufacturer can no more live without profit, than the labourer without wages. Their motive for accumulation will diminish with every diminution of profit, and will cease altogether when their profits are so low as not to afford them an adequate compensation for their trouble, and the risk which they must necessarily encounter in employing their capital productively. (Ricardo 1821, emphasis added)

\(^5\)… for the long-term interest rate and the normal remuneration of “risk and trouble” establish, in each sphere of production, the minimum or “necessary” level below which the profit rate cannot go, over the long run, however intense one may suppose the forces of competition to be’. (Pivetti 1991, p. 29).
If production is carried on with the firm’s own capital, interest constitutes its opportunity-cost, and as such will enter into that normal cost which in the long run tends to be equates with the unit price. (Pivetti 1991, p. 23)

Pivetti has certainly produced by far the best rationale and developed the most original, interesting and well-developed argument in favour of what he calls the ‘Monetary Theory of Distribution’ (Serrano 1993). However, one of the critiques, developed by Serrano in Pivetti’s book review, has emphasized that the relation between money wages and prices can be governed by the rate of interest only if ‘relative prices do not change’ (Serrano 1993, p. 123). An approximation to this condition of lower relative price variability, low inflation and wage stagnation seems to have occurred in central countries within the period from the ‘Great Moderation’ to the present day. This particular context, coupled with the exchange rate peg in some European countries for more than twenty years, will allow me to analyse the relationship between interest and profit empirically.

This paper is organized into four sections. After reconstructing the different positions on the relationship between interest and profit among Classical–Keynesian scholars, an original empirical contribution will be proposed by analysing the interest rate level as one of the main determinants of the profit rate at an aggregate level for eleven European countries. A causality test is also performed. Anticipating some results, I find a long-term relationship between interest and profit. Some conclusions will close the paper.

2. Interest and Profit Through Classical–Keynesian Lenses: Former and Recent Views

Along the same lines as the Classical–Keynesian standpoint, only a few articles have been written about the determination of the profit rate by central banks through their monetary policy. To date, the determination of the main financial variable, i.e., the interest rate, has been presented from two different points of view. Following Sraffa (1960) and Gar-egnani (1964), in this section a brief formalization of the impact of the interest rate on profits will be provided. On the one hand, some authors claim that the financial sector is a basic one. Carlo Panico (1988) is the most important author supporting this position. For simplicity, the following assumptions are made here: (i) there is single production — neither fixed capital nor joint production; (ii) there are two commodities — one industrial commodity (I) and one financial commodity (b), which are produced by means of different techniques (lI;lB); (iii) the latter is an input of the former; (iv) two social classes defined by their role in the production process — workers and capitalists; (v) wages are paid post factum. Algebraically, we have:

\[ p_I = (1 + u)A_I p + w l_I + q i^b \]

where \( p_I \) is the industrial commodity price, \( u \) is the normal rate of profits, \( A_I \) is the industrial sector input matrix, \( p \) is the price vector, \( w \) is the nominal wage rate, \( l_I \) is the quantity of labour per unit of output, \( q \) is the credit input vector per unit of gross output valued at going prices, that is the ratio of loans to gross receipts in that industry, \( i^b \) is the rate of interest in loans. Furthermore, the financial commodity price (commercial banks’
interest rate) is,

\[ i^b = (1 + u)A^T_b p + wl_b + i^{BC} \]

where \( i^b \) is the financial commodity price, \( u \) is the normal rate of profit, \( A^T_b \) is the banking sector’s input matrix, \( p \) is the price vector, \( w \) is the nominal wage rate, \( l_b \) is the quantity of labour per unit of output, \( i^{BC} \) is the exogenous rate of interest given by the central bank. Finally,

\[ p_I = (1 + u)\tilde{A}_I p + w\tilde{l}_I + q i^b \]

where

\[ A = A_I + A^T_b q \]

\[ \tilde{l} = l_I + l_b q \]

As the interest rate is exogenously administered by the central bank, changes in the basic interest rate generate changes in the interest rate offered by commercial banks to the industrial sector in the following fashion:

\[ \frac{\partial i^b}{\partial i^{BC}} = 1 > 0 \]

In turn, changes in the interest rate impact on prices through the following channel:

\[ \frac{\partial p_I}{\partial i^{BC}} = q > 0 \]

Of course, this is a simplification. Panico’s work goes much deeper and also includes other factors that affect this interest–profit relationship. For example, referring to Marx, Panico says:

In his writings it is evident that variations in the conditions of demand for and supply of money are only the way through which a change in the interest rate asserts itself, and that the average interest rate depends upon the factors causing change in the structure of the money market, and in the position of different groups of lenders and borrowers in it. (Panico 1988, pp. 182–183)

This is just a small example of the complexity of this subject. Panico also refers to many competitive mechanisms operating in the financial markets. These mechanisms include all the elements affecting the shape of the so-called ‘yield curve’. Here I can include the institutional organization of the different credit and financial markets, the role of the central bank as a stabilizer of those markets, and its influence on the ‘degree of liquidity’ of the assets as perceived by financial operators. The analysis also considers the mechanisms operating in the sphere of production, such as the risks associated to the productive utilization of capital in each sector or the existence of entry barriers in specific industries. In fact, in the last chapter of his thesis, Panico introduces a more complex model which includes variables such as the amount of loans the industrial sector has borrowed from the banking sector, the amount of deposits per unit of output of each industry, the rate of interest on deposits, the total amount of deposits and the total amount of bank loans. The general idea of the model is to reflect the impact of ‘liquidity’ that is
affected by the monetary authority. Illiquidity is presented in the model through parameters. When these parameters increase due to, for example, persistent restrictive monetary policy, the whole structure of interest rates, the rate of profits and the prices of commodities increase too. In this more complex model, a rise in the rates of loans will have the immediate effect of favouring bankers at the expense of industrialists, so there will be an internal conflict between capitalists (financial and industrial).

On the other hand, some authors argue that the rate of interest is an opportunity cost for entrepreneurs. Massimo Pivetti (1985) is the most important author supporting the idea that \( u \) depends on \( i^{BC} \) and that, subsequently, changes in the interest rate\(^6\) impact on the level of prices and on the profit rate because \( u = f(i^{BC}) \), where \( f'(i^{BC}) > 0 \). The price equation can be expressed as:

\[
p_t = (1 + u(i^{BC}))Ap + wl
\]

In turn, changes in the interest rate impact on the level of prices through the following channel:\(^7\)

\[
\frac{\partial p_t}{\partial i^{BC}} = Ap \frac{\partial u}{\partial i^{BC}} > 0
\]

### 2.1. Other Contributions

Until now I have introduced Panico and Pivetti’s vision on the connection between interest and profit, following Piero Sraffa (1960). Some recent attempts have attempted to analyse the relationship between interest and profit in more depth within the Modern Classical theory of value and distribution. Franke (1988) introduces different remunerations for capitalists and financiers, demonstrating a conflict within the capitalist class. He also includes the firms’ ratio of indebtedness and how this varies with the relative returns of real and financial capital.\(^8\) Ciccarone (1998) attempts to formalize a Monetary Theory of Distribution without the notion of opportunity cost, making a considerable step forward towards a formalization of the banking sector (Dvoskin and Feldman 2021, p. 268). In his model, the banking industry can exogenously fix the banking spread.\(^9\) Park (2002) attempts to introduce endogenous currency into a Sraffian–Keynesian growth model with some insights from the Monetary Theory of Distribution.

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\(^6\)Actually, the real interest rate impacts on the rate of profit. As Ciccone (1990) points out, ‘The fundamental issue, as I understand it, concerns what, in Pivetti’s analysis, the monetary authority have as a target. What they are assumed to control, through the nominal interest rate, is precisely the real rate of interest’.

\(^7\)This phenomenon is known in the mainstream literature as the ‘Gibson Paradox’ (Sargent 1973). Referring to this, Pivetti stated that:

> There is nothing ‘paradoxical’ in the positive correlation between interest and the price level, when the phenomenon is viewed in the light of Tooke’s theory: given money wages and production techniques, a rising (lowering) of prices as a result of a lasting rising (lowering) of interest rates would merely reflect the adaptation of prices to normal costs, caused by competition. (Pivetti 1998, p. 43)

Kaldor also suggests that ‘There is evidence for believing that interest costs are passed on in higher prices in much the same way as wage costs’ (Kaldor 1982, p. 63). Other authors who contributed to this idea include Tooke, Marx and Keynes (among others; see Panico 1984 and Zolea 2021). For recent empirical evidence on the Gibson Paradox, see Deleidi and Leverero (2021).

\(^8\)See Dvoskin and Feldman (2021, p. 276) for a criticism of Franke’s model.

\(^9\)See Dvoskin and Feldman (2021, p. 268) for a criticism of Ciccarone’s model.
Panico, Pinto and Anyul (2012) introduce the banking sector into a simple model. They assume that workers spend more than they earn in wages and they include an independent variable indicating the ability of banks to give workers access to credit. With these assumptions in mind, they conclude that the income shares of capitalists and workers change when the banking industry expands its activity, even if the rates of wages and profit remain constant. They also show that when the percentage variation of the rate of growth of the loans to workers is higher than the rate of growth of total wages, the profit share rises, and that when the rate of growth of total loans is higher than the percentage variation of the rate of growth of the loans to workers, the share of income of the bankers rises more than that of the other capitalists (Panico, Pinto and Anyul 2012, pp. 1467, 1473). Panico and Pinto (2018) analyse how the size of the banking industry can affect inequality and they argue that the wage share is influenced by the workers’ ability to capture the increases in value added per worker, by the input composition of the productive structure and by the size of the banking industry. In this way, they show that financial innovations affect income distribution.

According to Dvoskin and Feldman (2021), what there is today is a purely monetary, rather than a financial, theory of distribution, a limitation that is particularly relevant considering the growing size of the financial sector in recent decades (Dvoskin and Feldman 2021, p. 262). Because of this, after an interesting revision of the literature, the authors try to analyse many attempts to introduce money and finance into Sraffa’s price system and propose an alternative which includes leverage ratios. Not only are the financial structure of investment and banking spread explicitly considered in the system (Dvoskin and Feldman 2021, pp. 263, 265), but the riskless rate of return on capital is also distinguished from the loan interest rate, and an average leverage ratio that should not be intended as a purely technical parameter is included in their system.

Another noteworthy attempt to include finance in Sraffa’s system is made by Di Bucchianico (2021). According to the author, and in agreement with Pivetti (2013) and Paternesi Meloni and Stirati (2021), the increase in the rate of profit from the 1980s onwards was mainly due to institutional factors that put pressure on real wages (See Table 1 for a summary of these contributions).

As little empirical analysis has been carried out of the relationship between interest and profit, this will be the main focus of this paper. I will try to keep the theoretical structure at the most abstract level possible, because, as I have said, this should represent one first approximation of the empirical determination between interest and profit rates. Future work may incorporate notions of liquidity and risk, even at the sectoral level,

<table>
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in order to bring the abstract theory closer to the concrete reality. After a literature review of the empirical evidence, I will explain why I have chosen countries that initiated the Eurozone in order to size the impact of interest on profit rates.

3. Empirical Evidence: Literature Review

Several papers have attempted to analyse the impact of monetary policy on income distribution. Among other studies, Montecino and Epstein (2015) tried to analyse the impact of unconventional monetary policy and concluded that quantitative easing was modestly dis-equalizing, despite having some positive impacts on employment and mortgage refinancing for the US economy. Using microdata from household surveys for France, Germany, Italy, Spain, the UK and the USA, Domanski, Scatigna, and Zabai (2016) show that while low interest rates and rising bond prices have a negligible impact on wealth inequality, rising equity prices are a key driver of inequality. Mumtaz and Theophilopoulou (2017) find that contractionary policy has a larger negative effect on low-income households and that the policy of quantitative easing may have contributed to the increase in inequality during the Great Recession in the case of the UK. Lenza and Slacalek (2018) find that quantitative easing compresses the income distribution since many households with lower incomes become employed. Samarina and Nguyen (2019) find that expansionary monetary policy in the euro area reduces income inequality, especially in the peripheral European countries. Recently, Hansen, Lin and Mano (2020) as well as both Hohberger, Priftis and Vogel (2020) and Cravino, Lan and Levchenko (2020) have found that a policy of lower interest rates leads to higher wages on the margin, and thereby disproportionately benefits the poor, who rely more on labour income, in a TANK (Two-Agents Neo-Keynesian model) model, a DSGE model, and a Neo-Keynesian model of heterogeneous agents respectively. Using a Bayesian proxy SVAR, Albert, Peñalver and Perez-Bernabeu (2020) do not find a significant effect of monetary policy on income inequality. Epstein and Montecino (2020) find that, larger firms have benefited from unconventional monetary policy.

The article that comes closest to analysing the connection between the interest rate and the rate of profit in the long run is that of Valle Baeza and Mendieta Muñoz (2012). In this paper, the authors analyse the case of the US economy, finding a very weak positive long-term correlation (0.14) between long-term interest rates (Aaa corporate bond) and profit during the period 1869–2009. Also, they find that the general rate of profit has fixed an upper limit to the real short-term and long-term Federal Funds interest rates, and that the real long-term Federal Funds interest rate has undergone movements similar to those of the general rate of profit, whereas the short-term Federal Funds interest (Federal Funds effective rate) has experienced opposite movements regarding the latter (correlation = −0.13). They also find that variations in real short-term and long-term interest rates precede variations in the general rate of profit at 5%

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This paper provides an interesting theoretical and empirical review of the literature on the topic. Some papers that try to deal with the empirical part are those by Duménil and Lévy (2001, 2004, 2007) and Shaikh (2011). However, these papers are more focused on descriptive statistics rather than econometrics techniques and are based on a Marxian theory in which the Say’s law holds. Other non-mainstream scholars who have addressed this issue include Hein and Ochsen (2000), Power, Epstein, and Abrena (2003) and Hein (2010), who have found that there is a close relationship between rentiers’ income and the real interest rate.
level of significance. The paper assumes that the Federal Funds rate can be set exogeneously by the Federal Reserve.\textsuperscript{11} However, Valle Baeza and Mendieta Muñoz do not apply any particular econometric methodology besides long-term correlations and Granger-causality tests.

When reviewing the recent literature, it can be seen that the direct impact of long-term interest rates and profit has not yet been analysed. Why has not the direct relationship between interest and profit rates been studied in depth? The most immediate answer has to do with the fact that the model mostly used today in central banks (NK-model) assumes that the rate of profit is a given mark-up determined by monopoly power rather than by monetary factors (Blanchard 2017, p. 147). For this reason, this paper will attempt to shed some light on this issue.

4. Data, Methodology and Results

4.1. Data and Methodology

As I mentioned before, Serrano criticized Pivetti arguing that the relation between money wages and prices can be governed by the rate of interest only if ‘relative prices do not change’ (Serrano 1993, p. 123). Schefold also limits the claim by arguing that the mechanism is at work only under historical conditions of slow accumulation (Nell 1992; Schefold 1985). Although these kinds of situations will never occur in actual economies, it is well known that EMU-associated countries have maintained fixed exchange rate parities since 1999.\textsuperscript{12} After the collapse of the Bretton Woods Agreement, during the ‘Great Moderation’, while the most resistant trade unions were suffering from complete disarmament, the central banks were strengthened around the dispute over income distribution. Added to this, in recent years some countries have suffered from a kind of deflation, reflecting a certain stability in relative prices. For these reasons, and because it is a closed economy with certain relative price stability, I believe that it is plausible to analyse the relation between real interest rate and profits for the Eurozone. These conditions would help me to avoid the issues raised by Serrano and Schefold.

In my view, the empirical analysis can be done even in economies with large relative price changes and growing at high rates. It can be carried out in any context in which the necessary control variables can be considered, so as to bring the empirical part as close as possible to the theory. However, the case of the European Union is a peculiar one that allows me to analyse the relationship between these variables without including an excessive number of controls.

In order to find some answers to the questions developed in the previous sections, a panel database for some European countries is built. The data are retrieved from AMECO (see Appendix A for details on the database) and cover the period from 1999 to 2019 for 11 countries (220 observations). The selected countries for the sample are

\textsuperscript{11}See Deleidi and Levrero (2021) who show that monetary policy is able to permanently affect long-term interest rates and that the central bank has a certain degree of freedom in setting the levels of the short-term policy rate.

\textsuperscript{12}The fact that some European countries decided to peg their currency and be part of a monetary union frees us from the problem of working with economies as if they were open economies and dealing with the nominal exchange rates that might also affect distribution (see Álvarez 2021; Dvoskin, Feldman and Ianni 2020; Gahn and Machado 2019; Ianni 2016). The case of sterling and the possible impacts on monetary policy during the 1970s is also discussed by Kaldor (1980, p. 317).
the founders of the Eurozone: Austria (1), Belgium (2), Finland (3), France (4), Germany (5), Ireland (6), Italy (7), Luxembourg (8), the Netherlands (9), Portugal (10) and Spain (11). Variables are the long-term real interest rate, net returns on net capital stock (as a proxy of the effective rate of profits) and the rate of growth of GNI.\textsuperscript{13}

Before moving forward, one thing must be clarified. As Hein (2015) states, managers’ compensation is included in the compensation of workers in national accounts. As in this case, following the AMECO database, it is impossible to detect how much of the workers’ compensation goes to managers. For Panico and Pinto (2018), managers’ compensation should be part of the rate of return on capital. This, therefore, is one of the weaknesses of this work and a possible subject of future analysis with a more specific dataset.

With this caveat in mind, Figure 1 shows the performance of the real interest rate and the rate of profit.

Although at first glance there appears to be an inverse relationship, this relationship could be disrupted by changes in the level of output or other variables. As the normal rate of profit is hardly observable in the aggregate\textsuperscript{14} and a potential proxy is represented by the effective rate of profit, it is important to try to disable the possible effects of a change in output on the effective rate of profit. When the economy grows, in the short run, entrepreneurs use the same amount of capital more intensively – they increase capacity utilization – which may increase the effective rate of profit temporarily (Hahnel and Sherman 1982). This effect can be captured by the growth rate if it is included as a control variable.\textsuperscript{15} Indeed, when looking at the empirical relationship between the effective rate of profit and the growth rate of the economy, at first glance, a close relationship can be observed (see Figure 2).

On the other hand, the normal profit of enterprise ($\text{np}_{et}$) is an unobservable variable but given its apparent stability, it can be proxied by a constant. Before presenting the econometric model, I test the stationarity of our time-series using different tests (Levin, Lin, and Chu 2002; Im, Pesaran and Shin 2003; ADF and PP; see Table 4 in Appendix B). In some cases, the null hypothesis is not rejected for real interest rate and profit rate; indeed, taking into account also $\Delta GNI$, the variables are of different order of integration. Autoregressive Distributed Lag (ARDL) models are the de facto standard of estimation when the orders of integration of the underlying variables are unclear. Therefore, the following econometric equation that will be tested in order to investigate the (non) existence of a long-term relationship between the rate of profit and the real rate of interest:\textsuperscript{16}

\[ \Delta r_{i,t} = \beta_1 i_{i,t} + \alpha + \beta_2 \Delta GNI_{i,t} + \beta_3 \Delta i_{i,t-n} + \beta_4 \Delta r_{i,t-n} + \mu \]

\textsuperscript{13}I have chosen the GNI instead of the GDP to include also the foreign income of residents.

\textsuperscript{14}The normal rate of profit is the expected rate of profit on newly installed equipment.

\textsuperscript{15}This is one of the key points in economic theory. The level of activity can affect the effective rate of profit (Garegnani 1992). A passage in Kaldor (1980) is useful to clarify this, as he considers that an increase in interest rates could have an effect on activity levels and thus bankrupt firms:

And where circumstances are such that the rise in interest charges cannot be passed on they eat into profits; with continually rising rates, this is bound to lead to a situation where firms become insolvent for lack of cash to pay interest on their loans, or where they have to borrow in order to pay interest on previous borrowing, a process that is sure to lead to bankruptcy. (Kaldor 1980, p. 315)

Hence, activity levels (and capacity utilization) must be taken into account when analysing the effective rate of profit.

\textsuperscript{16}This equation can be derived from the theoretical ARDL model developed in Greene (2000, p. 605).
where $\Delta r_{i,t}$ is the profit rate dynamic of country $i$ in year $t$, $\beta_s$ are coefficients, $i_{l,t}$ is the long-term real rate of interest,\footnote{The choice of the real interest rate follows a fairly simple logic. The system expressed in nominal terms says very little about relative earnings in inflationary contexts. In these contexts, it cannot be known the true distributional adjustment cannot be known if real variables are not analysed. This is why I decided to do it with the variables in real terms. However, one referee drew my attention to the fact that the objectives of monetary policy may be other than a} $\alpha$ is a constant, $\Delta GNI_{i,t}$ is the change in GNI, $\Delta i_{l,t}$ is

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1}
\caption{Real interest rate and net profit index. Source: own elaboration based on the data provided. Real interest rate (solid line-left axis). Net Profit Index (dashed line-right axis). See Appendix A for details.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2}
\caption{Net profit index and growth rate. Source: own elaboration based on data provided. Net Profit (solid line – left axis). D(GNI) (dashed line – right axis). See Appendix A for details.}
\end{figure}
the real interest rate dynamic in $t - n$, $\Delta r_{t-n}$ is the rate of profit dynamic in $t - n$ and $\mu$ is an error term. The first term of the RHS ($b_i t$) corresponds to the long-term while the others to the short-term effects of the ARDL equation. The lag selection criteria indicate that the best model is an ARDL (1,2) under the AIC criteria (see Appendix C). Once the correct methodology and lag-criteria were defined, I performed the tests for the ARDL (1,2) model with variables in levels. Given this ARDL model is (1,2), $\Delta r_{t-n}$ does not appear in the short-term equation.

4.2. Results

4.2.1. Cointegration and Pooled Mean Group/ARDL

Although the long-term relationship will be tested on the basis of panel ARDL models, I also present the results of the cointegration tests for two variables (profit and interest) to clear up any doubts in this respect. These results are presented in Table 2.

Under the Fisher methodology it appears that the existence of at least one cointegration relationship between interest and profit cannot be rejected for the following countries: Austria, Belgium, France, Germany and Luxembourg. However, as I said before and since I cannot clearly identify the order of integration of the variables, I rely on an ARDL model. Results are presented in Table 3. The dependent variable is $\Delta r$ and the independent ones are $i$, $\Delta GNI$, a constant $(\alpha)$, $\Delta i_{t-n}$ and the cointegration equation. All the variables are significant and with the expected sign in the long-term equation.

These results would indicate that a one-unit increase in the interest rate level increases the rate of change of the profit rate by 2.70 units on average and *caeteris paribus*. Part of the positive changes in the short-term real profit is explained by a constant term $(\alpha)$ that could embody the idea of *risk and trouble* or other unobservable variables. In the short-term equation, the correlation with the real interest rate ($\Delta i$ and $\Delta i_{t-1}$) is negative. One possible explanation is that since the rate of profits in the current study is the *effective* or actual one, this inverse relation may be occurring through the negative impact of increases in real short-term interest rates on some components of aggregate demand (i.e., consumption or residential investment), which reduces the actual capacity utilization and hence the effective rate of profit; however, this effect should be captured by the growth rate of the economy ($\Delta GNI$). There may also be changes in the composition of output which affect the level of profit rate, resulting from the change in the real interest rate not detected with this simple model. $\Delta GNI$, which is included as a control variable, also affects the effective rate of profit positively in the short run. Furthermore, the magnitude of the cointegration equation coefficient implies that nearly 20% of any disequilibrium between real interest rate and profits is corrected within one period (i.e., one year).

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18 Given that the long-term real interest rate reaches negative values in some years, it is not possible to transform it into logarithms.

19 For Pedroni and Kao, I have chosen the existence of an individual intercept. For Fisher I have chosen lag intervals (1 1) and intercept (no trend) in CE – no intercept in VAR.

20 This effect is also recognized by Valle Baeza and Mendieta Muñoz (2012).

21 Normality in residuals is analysed in Appendix D. Coefficients corresponding to the short-term effects by country of the ARDL model are also available upon request.
In relation to the temporal causality, J. C. W. Granger (1969) suggests a notion of causality based on the asymmetry of correlation schemes. The essence of this definition is that a variable $x$ causes another variable $y$ if knowledge of past values of $x$ allows for a better forecast of $y$ than the one obtained with a particular set of information (including past values of $y$). An important feature of this definition is that it is susceptible to empirical test. Given a pair of random variables $x$, $y$ it is always possible to evaluate which one precedes the other from the observation of correlations matrixes. It is important to emphasize that this is a statistical notion of causality — temporal precedence — and, therefore, it is not a substitute for the idea of causality prevailing in the economic analysis. The procedure that will be used was proposed by T. J. Sargent (1976) and derived directly from the definition of Granger causality. Similar to Granger’s method (1969), a linear prediction function is used. Hereinafter, $x$ and $y$ are two stationary variables. To test the simple causality from $x$ to $y$, my function examines if lagged values of $x$ in the regression of $y$ and vice versa reduces the error variance. Changing $x$ and $y$, a simple causal relationship between $y$ and $x$ can be tested. There will be a feedback relationship if the null hypothesis is rejected in both directions. However, in this case both variables are not stationary and this is an issue. One of the procedures that can be performed in this case is the Toda and Yamamoto approach to Granger non causality test (Toda and Yamamoto 1995) (Table 4).

From the results observed in Table 3 it can be inferred that there is a high level of significance by which the null hypothesis — that the real interest rate does not cause the profit rate in a Granger sense — can be rejected but not vice versa — that the profit rate does not cause the real interest rate in a Granger sense. Consequently, at least in a

<table>
<thead>
<tr>
<th>Table 2. Cointegration relation.</th>
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<tr>
<td>Methodology</td>
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<tr>
<td>Pedroni (Engle-Granger)</td>
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<tr>
<td>Kao (Engle-Granger)</td>
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<tr>
<td>Fisher (Johansen)</td>
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<th>Table 3. Pooled mean group/ARDL regression.</th>
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<tbody>
<tr>
<td>DV: $\Delta x_{it}$</td>
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<tr>
<td>Long-term equation</td>
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<td></td>
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<tr>
<td>Short-term equation</td>
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<td></td>
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<tr>
<td>Cointegration equation</td>
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Note: DV = dependent variable; IV = independent variable.

<table>
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<th>Table 4. Granger causality test — stacked test.</th>
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<tr>
<td>Null hypothesis:</td>
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<tr>
<td>Interest does not cause profit</td>
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<tr>
<td>Profit does not cause interest</td>
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</tbody>
</table>
temporal sense and in the aggregate, results support the idea that the interest rate determines the profit rate.\textsuperscript{22}

5. Conclusion

Throughout this work I have tried to find out whether the Monetary Theory of Distribution, by which the money interest rate is one of the determinants of the rate of profit, has an empirical correspondence. The empirical evidence presented here indicates that the Monetary Theory of Distribution may have some empirical correspondence: a rise in the real (and nominal) interest rate given by central banks impacts positively on the rate of profit. Working on a database representing the 11 founding countries of the Eurozone, I have found a long-term econometric relationship between the real interest rate and the rate of profit using an ARDL methodology. In addition, causality tests would seem to indicate that the hypothesis that the rate of interest does not determine the rate of profit can be rejected.

The recommendations that could be derived from these results are of utmost importance for public and monetary policy decisions. If the Central Bank can choose the level of real wages through its monetary policy, bringing real interest rates down would guarantee, in closed economies, that workers may improve their living conditions.

Finally, the results of this paper, like those of any empirical work employing theoretical (normal) variables, should be treated with some caution. However, I believe that these results can be the starting point for further empirical research on the impact of the interest rate on the rate of profit in different countries. Of course, more analysis is needed for the case of the US economy. Also, in order to better understand what the real determinants of income distribution in modern economies are, the inclusion of the nominal exchange rate in small open economies may be a possible extension of this work. It would also be useful to analyse the Monetary Theory of Distribution taking into account different monetary policies and macro-prudential financial regulation schemes under different historical-institutional contexts.

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Disclosure Statement

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\textsuperscript{22}This test was performed with different lags (2, 3 and 4) for robustness check. The results are available upon request. With two lags there is no causality, the $p$-values are greater than 0.1. Following the Toda and Yamamoto procedure I performed this test also with 3 and 4 lags. Here I show the result with 3 lags. With 4 lags the results hold. The problem when using many lags is that the test loses power (Enders 2004).
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