

Evaluating the falling rate of profit in the context of the UK economy

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ABSTRACT

In this study, by utilizing quarterly data for the UK economy over the period 1985Q1 to 2019Q4, we explore (a) the determinants of the profit rate in the context of the Marxian tradition and (b) by using a probabilistic framework of analysis, we investigate the factors associated with the occurrences of UK recessions. The evidence indicates that the wage share of income is inversely related to the profit rate whilst the capacity utilization, the capacity-to-capital ratio and the monetary expression of labour time have all a positive impact on the profit rate. Additional evidence suggests that the probability of a recession decreases with higher profitability, whilst at the same time the *wage-led* hypothesis is also supported. Finally, the impact of interest rates on the likelihood of UK's economic recessions is found to be insignificant.

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1. Introduction

The development of a range of Marxist crisis theories since the 1970s has rekindled the interest of many academics to revisit the writings of Marx so as to unravel the implied multifaceted description of capitalism. As a result, different approaches emerged that provide a variety of potential explanations for economic crises. In this domain, theoretical perspectives focusing on the impact of *class struggle on the rate of profit* (see, [Glyn and Sutcliffe, 1972](#); [Boddy and Crotty, 1975](#)), or on *the struggle over production* ([Bell, 1977](#)) gave way to theories that explained economic crisis in terms of the *law of the tendency for the rate of profit to fall (LTRPF)*, either through the direct channel – the rising organic composition of capital ([Mattick, 1969](#)), or indirectly, via the exhaustion of the reserve army of labour ([Itoh, 1988](#)).

Despite the inherent differences in their approaches these theories have one common denominator. They all seem to reject the prevailing, in the circles of Marxist economists, notion of *underconsumptionism* (see [Grossmann, 1929](#)). The fact that the *underconsumptionism* is closely bound up with Keynesian macroeconomic policies such as direct intervention at the level of distribution and exchange, whilst ignoring the social relations of capitalist production, indicated that the narrative had to be superseded by one,

wherein economic crises that arise in capitalism can be effectively explained through *general conditions of capitalist production* ([Marx, 1990](#)).¹

Within the Marxian tradition, the LTRPF is regarded as one of the key factors conditioning the performance of capitalist economies. Money is used in capitalism as a camouflage of a system that is based on exploitation. Capitalists engage in investment because at the end of the production process, they will be left with a *surplus value*, otherwise known as *profit* (i.e., the difference between wages and the actual value created during the process). The surplus value that is generated in the system gets divided between the capitalists through competition which serves as the driving force that turns capitalism into a dynamic economic system but at the same time a system permeated with uncertainty and friction.

Surviving in capitalism entails capturing and creating new markets, introducing new products onto the market, expanding operations, etc. In the short run, many adjustments will have to take place in many sectors around the economy but in the long run, as mainstream economists put it, the price mechanism will ensure that equilibrium is reached ([Kirman, 2009](#) and [Reinert, 2012](#)).

¹ [Dutt \(2011\)](#) however argues that the Marxian approach is more convoluted as aggregate demand assumes significance in the short run whilst in the long run it ceases to be a relevant determinant of long-run growth.

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During this process, competing firms invest heavily in *constant capital* i.e., new technologies or equipment. The initial competitive advantage enjoyed by the innovating capitalist will increase the share of profit over the rest of the capitalists but, with time, the new techniques will become common practice and the initial advantages will be frittered away. As more capitalists invest in *constant capital* than in *variable capital* (labour) their payments to machine-making capitalists will increase, hence leaving only one option available for them, to increase their profitability through the exploitation of the labour force.²

In simple terms, high rate of profit implies that capitalism is relatively buoyant where investment is thriving, unemployment is declining, and the living standards of workers is generally rising. Gains in productivity however, put downward pressure on prices and hence profits. The resulting low rate of profit causes prosperity to turn into stagnation and depression.

For Marx, the recurrent crises of capital devaluation are instrumental in explaining the initial loss of profits, but also the recovery of profits via accumulation that follow. It is in this sense that Marx considered the tendency of the rate of profit to fall to be a key factor in explaining crises in capitalism. Marx's approach to explaining crisis has been the subject of intense debate whilst his critics argue that such thesis is not only improbable but impossible. In the respective literature, some scholars would argue that Marx fails to effectively showcase that the tendency of the profit rate to fall without this being counter-acted by increases in the rate of surplus value (Heinrich, 2013), or, until recently, that the Okishio Theorem³ (Okishio, 1961) logically disproves the law, which makes it impossible to consistently formulate Marx's labour theory of value.

In this study we break new ground by evaluating the LTRPF in the context of the UK economy using quarterly data over the period 1985–2019. By applying an autoregressive distributed lagged (ARDL) model approach and a probabilistic framework of analysis we provide evidence on (a) the key determinants of the profit rate and (b) the impact of profitability on the probability of a recession in the UK. To the best of our knowledge, it is the first time that these aspects of the Marxian approach, in the context of the UK economy, have been empirically evaluated.

The rest of the paper is organized as follows: Section 2 touches on the theoretical perspectives and competing theories in the realm of Marxian analysis whereas Section 3 presents the methodological framework of analysis. Section 4 presents and discusses the results whilst Section 5 provides some concluding remarks.

2. Theoretical perspective

For Marx, Capitalism is centred around the value that it creates when commodities are exchanged – i.e., the value that is derived from the time that workers spend for the production of those commodities – the so-called *labour theory of value*. Marx treats commodity as a factor that plays a fundamental role in his analysis of capitalism. Despite the fact a commodity has both a use-value and an exchange-value, Marx posits that in economic systems that are based on the capitalist mode of production, commodities cease to be objects of utility or consumption; they possess only exchange-values which, in the form of goods and services, are used exclusively to generate profit.

² Seeking innovations in technologies reflects the existing rivalry between capitalists. It might be case however that some such innovations may be using techniques which are not capital intensive but equally there will be others that are more capital intensive. A successful capitalist will try to engage in investment activities that involve both sorts of innovation.

³ Intuitively, Okishio Theorem suggests that the introduction of a new technique in the production process not only does it increase the profit rate for a single capitalist, but it also adds to the collective rate of profit for all capitalists.

In so far as the exchange-value is perceived to be a social construct, Marx (1990) insists that a commodity is an unnatural element which reflects wealth of modern societies. In this sense, the accumulation of wealth is nothing more than an abstract accumulation of value. The presupposition therefore that labour can be expressed in terms of value suggests that labour has both a use-value and an exchange-value. The *hitherto* conceptualization of the nature of labour provided the basis for the Marxian theory of exploitation.

During the capitalist production process labour creates new value which accrues to capitalists. Capitalists then pay for the generic and abstract capacity to perform labour, otherwise known as labour-power. In this context, labour-power has an exchange-value which produces not just use value but use-values for others (Marx, 1990). A new principle of social organization emerges according to which “relations of personal dependence no longer form the given social foundation” and in which “labour and its products . . . assume a fantastic form different from their reality” (Marx, 1990, p.170).

When the value of a worker's labour-power is less than the value that labour produces during production then surplus-value arises which also encompasses the working-time spent in excess of the required amount of work to sustain and reproduce one's livelihood. In this sense, surplus-value is the exclusive source of profit in capitalism.

Within the Marxian analysis the LTRPF constitutes potentially the most important law of modern political economy (Marx, 1973). The idea, however, that a falling rate of profit will cause capitalism to stall, is far from novel. As Harvey (1999, p.177) points out the prediction that capitalism would eventually reach “stationary state with a zero rate of accumulation” originated in the writings of Classical political economists such as Smith, Ricardo, Malthus, and Mill.

For the classical economists, the decline of capitalism, was attributed to factors external to capitalism (Smith, 2014) or the negative impact of population growth, via declining productivity, rising costs of food and wages, on profits (Ridacro, 2004). Marx being very critical of Ricardo's argument, in a rather sarcastic tone, stated that Ricardo “flees from economics to seek refuge in organic chemistry” (Marx, 1973, p.754). What differentiates, however, Marx's approach from the one of the classical thinkers is the fact that the falling rate of profit is perceived as an endogenous *self-destructive* proclivity of capitalism.

According to Marx, the rising organic composition of capital, *ceteris paribus*, will inevitably lead to a falling profit rate due to the new value, including the surplus value, that is created during the production process.⁴ The inherent tendency of capitalism to introduce innovative elements in the production process will cause labour to be replaced by machines which in turn will lead to a rising organic composition of capital and shrinking profitabil-

⁴ A long-standing criticism of Marx's theory of prices of production relates to the failure to transform the inputs of constant capital and variable capital from values to prices of production. The validity of this criticism depends on the method of determination of the inputs of constant capital and variable capital i.e. whether these inputs taken as given as quantities of money capital or derived from given quantities of physical capital Moseley (2000). One of the most prominent challenges to the interpretation of Marx's theory has been the so-called *new interpretation* to the transformation problem, which was first introduced independently by Foley (1982, 1986) and Dumenil (1980,1983–84), and has since been followed by Mohun (1993), Campbell (1997) amongst others. The novel element of this approach rests in the assumption that variable capital is the money-wage paid by capitalists to workers rather than derived from a given real wage. The aggregate price-value equality is also perceived to be in net terms, rather than gross terms (for more on the new interpretation to the Marxian transformation problem see Foley, 1982,1986; and Dumenil (1980,19834); Moseley (2006, 2008) whereas for a discussion on methodological issues involved in the empirical definition and the measurement of key Marxian variables see Maniatis 2005).

ity. In this context, [Eichengreen and Ritschl \(2008\)](#) and [Pessoa and Reenen, 2014](#) produced evidence that points towards a consistent rising trend in productivity that spans a period of more than six decades now, mainly, due to rising capital-to-labour ratios in Germany, US and the UK.

Despite the articulate manner by which Marx conceptualized the law of the tendency of the profit rate to fall, there has been growing speculation as to what Marx really meant by this. As [Harvey \(1999\)](#) argues, Marx foresaw several counteracting influences on the law, such as, a rising rate of exploitation; dwindling costs of constant capital; wage reduction below the value of labour-power; and an increase in the industrial reserve army. The impact of these counteracting influences on capital accumulation has served as a platform upon which different approaches have been advanced over the years.

[Howard and King \(1992\)](#), are categorical in stating that Marx, despite the counteracting influences, predicted that the rate of profit must eventually decline. The falling rate of profit is related to cyclical economic crises of intensifying severity, but the causal dimension is unspecified. In the same spirit, [Harvey \(1999\)](#) argues that Marx makes explicit statements about capitalism's inevitable collapse and therefore the empirical trend is predicted.

Conversely, [Geert \(1991\)](#) is of the view that Marx's prediction is not that the rate of profit will fall continuously, whereas [Kliman \(2007\)](#) argues that the tendential law "predicts recurrent economic crises that restore profitability- largely by means of the cheapening of the means of production- rather than a falling trend in the rate of profit" (p. 44). In particular, [Kliman \(2012\)](#) using different measures of profit, confirmed, at least in the case of the US experience, that there has been a tendency for profit to fall and that this has been the main factor responsible for economic stagnation since the 1930's. In the same spirit, [Tsoulfidis and Paitaridis \(2018\)](#), have concluded the two distinctive long-wave phases observed in the US economy are associated with the falling rate of profit and the stagnation of real net profits.

In this context, trying to envisage a discernible profit trend is not a straightforward task as economic data do not directly correspond to the fundamentals of Marx's analysis. Take for instance, the surplus-value, a key element of the formula to derive the Marxian rate of profit; apart from being distributed as profits, there are other factors that should also be considered in the distributional process i.e., rents, interest, taxes or even as compensation to *unproductive labour* (see, [Moseley, 1992](#); [Shaikh and Tonak, 1994](#); [Mohun, 2005](#)). In effect, a surplus-value that is not solely distributed as profits, implies that surplus-value can move in the opposite direction vis-à-vis profits.

On a different note, [Kliman \(2007\)](#) by invoking Alan Greenspan⁵, sustains that the fact that rising productivity can squeeze the rate of profit implies that the LTRPF can be thought of as a theory of cyclically falling prices and devaluation. By decomposing the rate of inflation into the growth rate of the monetary expression of labour time (MELT) and the growth rate of values it can be shown that both the nominal and the real rates of profit may fall ([Kliman 2007](#)). It might also be possible, however, that an accelerating MELT growth rate may dampen the effects of a growing inflation rate, hence, leaving the profit rate intact.

Undoubtedly, Marx did acknowledge that a falling profit rate might be ascribed to other factors as well, such as the rise in real wages due to class struggle (see [Glyn and Sutcliffe, 1972](#); [Boddy and Crotty, 1975](#); [Bowles et al., 1990](#); [Maniatis, 2012](#)) or realization failure (underconsumption) ([Baran and Sweezy, 1966](#); [Clarke, 1994](#)). Even though the mechanism by which a rising

labour's share of income will cause the profit rate to fall is not explicitly spelled out, the implied inverse relationship between surplus-value and variable capital is however evident ([Marx, 1973](#)).

Kalecki, who regarded his work as an extension of the basic two-sector Marxian model ([Toporowski, 1999](#)), perceived *class conflict* to be different from the Marxian view due to the fundamentally distinctive conditions arising under monopoly capital and those under competition ([Kalecki, 1943a](#)). In so far as firms have pricing power, he argues that an increase in the money wages due to the power of labour does not pose a significant economic threat to capital even if the economy is at full employment. [Kalecki \(1943b\)](#) observed that the "rise in wage rates resulting from the stronger bargaining power of the workers is less likely to reduce profits than to increase prices and thus affects adversely only the rentier interests. But 'discipline in the factories' and 'political stability' are more appreciated by the business leaders than are profits. Their class instinct tells them that lasting full employment is unsound from their point of view" (p. 325). It was in this context that Kalecki introduced the concept of the *political business cycle*, whereby the capitalist state would alternate between expansionary and contractionary policies to generate *controlled under-employment*.

Kalecki's exploration of the business cycle theory started and ended with the Marxian investment functions where the rate of profit, being the main determinant of investment, tends to fall as capital accumulation progresses ([Toporowski, 1999](#)). Unlike Marx for whom profits at any given level of production, are determined by the ratio of surplus value to wages, for [Kalecki \(1954\)](#) profits depend on the actual net flow of funds which, through the price mechanism, are distributed amongst capitalist firms.

The rise of imperfectly competitive firms suggests that advanced capitalist economies, unlike earlier stages of capitalist development, have entered a new stage of capital accumulation where the existing capital stock is sufficient to provide jobs for the entire labour force. As a result, economic growth and employment are determined by different factors such as the unused capacity due to lack of effective demand ([Kalecki 1943a](#)). So, for both Keynes and Kalecki the main problem with advanced capitalist economies is the underutilisation of capital which can be remedied by stimulating effective demand through increasing government expenditure. A fundamental difference however between the Kaleckian and Keynesian theoretical approaches lies in their views on stabilizing capitalism ([Toporowski, 1999](#)). Whilst for Keynes, fiscal and interest rate policy are effective in stabilizing investment at a level near full employment (see, [Keynes, 1936](#); [Sawyer, 1985](#)), Kalecki was more sceptical about the effectiveness of fiscal and monetary means in maintaining a stable volume of private investment ([Kalecki, 1945](#)).⁶

For Marx, insufficient demand could only come from consumption due to the dynamics under the competitive phase of capitalism.⁷ As Marx famously stated: "Accumulate, accumulate! that is Moses and the prophets" ([Marx, 1887](#), Chapter 24).

⁶ Kalecki implied that the problem with investment is that it adds capacity which in turn creates additional competition for the demand. "Investment considered as expenditure is the source of prosperity, and every increase of it improves business and stimulates a further rise in investment. But at the same time every investment is an addition to capital equipment, and right from birth it competes with the older generation of this equipment. The tragedy of investment is that it causes crisis because it is useful. Doubtless many people will consider this theory paradoxical. But it is not the theory, which is paradoxical, but its subject the capitalist economy." ([Kalecki, 1939](#), p. 149)

⁷ Broadly speaking, growth models in the classical-Marxian tradition are influenced mainly by the growth of aggregate supply rather than by the changing conditions on the demand-side, for instance, through the impact of animal spirits on investment expenditure, and hence on the long-run growth rate of the economy ([Dutt, 2011](#)).

⁵ "Indeed, the increased availability of labor-displacing equipment and software, at declining prices and improving delivery times, is arguably at the root of the loss of business pricing power in recent years" ([Kliman, 2007](#): p.127)

According to Crotty, (1993) Marx's theory of competition develops a simple conditional investment theory⁸ in Volume I whilst in Volumes II and III, by introducing the concept of realization crises, a theoretical context of the financial markets and a dialectical dimension to the character of competition, Marx lays the ground for an independent behavioural investment equation.

The development of capitalism meant that consumption is a relatively stable component of demand whilst investment became the key variable that, for both Kalecki and Keynes, provides sustenance to effective demand (Kalecki, 1968). Despite however, the fact that Kalecki subscribed to the Keynesian conceptual framework of the role of investment in determining the flow of saving (or profits), "he was rather critical of the MEC analysis" (Alexiou, 2010, p.428).

Furthermore, Sweezy, (1970) contrary to the belief that Marx dismissed underconsumption as a potential cause of crises, maintains that "there could be nothing more absurd . . . [than to claim that] Marx regarded the magnitude of consumption as of no consequence in the causation of crises" (1970: 151). The fact that Marx (1973) argues that "The last cause of all real crises always remains the poverty and restricted consumption of the masses as compared to the tendency of capitalist production to develop the productive forces in such a way that only the absolute power of consumption of the entire society would be their limit" (p. 568) implies simply that Marx failed to provide a fully developed coherent theoretical perspective. Sweezy (1970) suggests that a potential decline in the ratio of the rate of growth of consumption to the rate of growth of the means of production might indeed signal realization failure but it might be that the production of consumer goods lags behind the production of the means of production that is responsible for such a failure.

The inherent ambiguity regarding the causal dimension in realization failure theories has caused a lot of criticism to emerge. For instance, Dunayevskaya (1989), maintains that dwindling sales is a consequence rather than a cause of falling profitability whereas Kliman (2003) in the same spirit argues that human consumption does not constrain the growth of output that is productively invested. Furthermore Dutt (2011) argues that recently developed models fail to produce robust evidence on the long-run independence of growth from aggregate demand.

According to Lebowitz (2003) *Capital* contains elements of abstract laws and logic and expresses in an abstract manner the end of capitalism without making any empirical predictions in relation to the LTRPF. The fact that society is not overwhelmed by this logic, implies that the predicted self-destruction of capitalism will not materialize (Albritton 1999).

2.1. Competing theoretical arguments

In the realm of the LTRPF a number of contemporary perspectives have emerged to provide insightful analysis that relate dwindling profitability to violent swings in economic activity. One such potential explanation is the one advanced by Brenner (2006) and concerns the observed decline, since the 1960s, in the growth rate of both GDP and profit rate - mainly in the manufacturing sector - in all advanced capitalist economies.

This decline has been ascribed to the ascendancy of neoliberalism as a dominant economic dogma as well as the inability

of labour to act in a unified manner to protect its own economic interests (Rosenfeld, 2006; Brenner, 2006; Dumenil and Levy 2004). In this context, Alexiou and Trachanas (2020) argue that "the changing landscape of capitalism has been widely attributed to the rise of neoliberalism, globalization, and financialization" (p.211)

A potential factor for long downturns is the so-called *contradictions of Keynesianism* thesis (Brenner, 2006). The premise of this thesis lies in the management of the macroeconomy through demand-side policies which were proved to be rather self-defeating, undermining both profitability and economic growth. According to Brenner (2006) the re-industrialization that took place in many advanced economies after World War II intensified international competition which inevitably affected profitability adversely.

Theoretically speaking, perfectly competitive markets drive inefficient firms out of the market; in reality however, such a proposition might not be the case, as inefficient firms remain in business in so far as average profit margins are maintained. The fact however that they will have to reduce prices to remain competitive squeezes their overall profitability in the market vis-à-vis the profit rate that prevailed before the efficient competitors penetrated the market. It is in this sense that Brenner (2006) argues that the production process is highly erratic, unplanned and lacking self-adjusting and transitional mechanisms.

In contrast to the above arguments, Dumenil and Levy (2002) posit that (a) increased competition does not necessarily lead to dwindling profitability and (b) declining profitability did not occur only in the manufacturing sector as initially claimed but was rather observed across different sectors. Moreover, they also established that the fall in both the output-capital ratio and the profit share, precipitated by a decline in real productivity, and a relative increase in the prices of fixed capital to output, caused profitability to follow suit.

In a similar vein, Freeman (2009) by using a rather simplistic and empirically dubious econometric specification model argues that only a very low percent of the variation of the profit rate is explained by the profit share. Thereby, the magnitude of the existing antiquated capital stock has resulted in a falling output-capital ratio which in turn caused profitability to fall.

In a much earlier study conducted on the non-financial corporate business sector for the United States over the period 1949 to 1979, Weisskopf (1979) suggests that the decline in profitability arises "almost entirely from a rise in the true share of wages, which indicates a rise in the strength of labour" (p.370). Furthermore, Raffalovich et al. (1992) by focusing predominantly on labour's share of income rather than the rate of profit find that unemployment is inversely related to the wage share, but they find no significant relationship between unemployment and compensation. In rationalizing these results, it was suggested that the envisaged negative relationship between unemployment and the wage share is the outcome of increasing employment that absorbs more of the national income rather than workers getting paid more.

In a different spirit, the proponents of the Post Keynesian tradition by dismissing Marx's theory of value, focus on distributional aspects that relate to either wages or profits which they consider to be instrumental in triggering economic crises (see, Minsky, 1986; Onaran and Galanis, 2012; Stockhammer, 2011). In their analysis the level of debt assumes a prominent role, as it is thought to act as a compensating mechanism that provides liquidity to low-paid workers whilst they argue that crises in the neoliberal era are mainly *wage-led*.

For Marx however, it is the collapse in profitability and profits in the productive sectors that are the necessary basis for a slump

⁸ In a competitive environment investment is constrained only by access to finance. On the assumption that there are no financial markets, "investment will equal profit (which equals saving) and the net rate of growth of the capital stock equals the rate of profit. There is no independent investment decision for the firm to make" (Crotty, 1993, p.3).

in the 'real' economy.⁹ When profitability in the productive sectors of the economy dwindles, capital shifts from low profitability in the productive sectors to high profitability in the financial (i.e., unproductive) sectors. But profits in these sectors are fictitious; they exist only on the accounting books. They become real profits only when cashed in. When this happens, the profits available to the productive sectors shrink. The more capitalists try to realize higher profit rates by moving to the unproductive sectors, the greater become the difficulties in the productive sectors. This countertendency – capital movement to the financial and speculative sectors and thus higher rates of profit in those sectors – cannot hold back the tendency, that is, the fall in the rate of profit in the productive sectors.

3. Empirical investigation

In assessing the impact of the various theoretical propositions encountered in the LTRPF literature we utilize a data set for the UK economy that spans the period 1985Q1 to 2019Q4. It should be stressed that due to data availability we resorted to a relatively shorter time span.

The baseline model is a variant of the one developed by Weisskopf (1979) and its general form is expressed in the following terms:

$$rop_t = \beta_0 + \beta_1 X_t + \varepsilon_t \quad (1)$$

where rop_t is the profit rate and X_t is a vector of factors that have been used interchangeably in the respective heterodox literature and thought to affect the profit rate. As such, the profit rate (rop) is calculated as income minus compensation, divided by total fixed assets; X consists of the following explanatory variables: the wage share of income (ws) which is used as a proxy capturing many aspects of the distributional spectrum; capacity utilization (cu) which acts as a proxy for the productivity of capital in price terms; the capacity to capital ratio (c/k) intended to approximate the inverse of the organic composition of capital; the consumer price index (cpi) as a proxy for inflation; and the monetary expression of labour time ($melt$) used as a proxy for exploitation¹⁰; ε_t is the error term satisfying the usual assumptions, and the subscript t stands for time (Table A1 in the Appendix presents the sources and definitions of variables whilst Table A2 reports the cross correlations of the explanatory variables).

3.1. Cointegration methodology

For the empirical investigation we employ cointegration techniques and error correction modelling (ECM). We firstly determine the order of integration using an ADF test with breaks. Once we have established the order of integration, we then proceed to testing the cointegration of the series adopting the bounds-testing approach in the context of the ARDL framework.

Given the various methodologies developed over the last years to investigate long-run equilibria (see, Engle and Granger, 1987; Phillips and Hansen, 1990; Johansen and Juselius, 1990) in

⁹ Up until the early 1980s, credit was used mostly to finance production of goods and services. Growth in credit from 1945 to 1980 was closely linked with growth in incomes. The incomes that were generated were then used to amortize and eventually extinguish the debt. This represented a healthy use of debt; it increased incomes and introduced negligible financial fragility. But from the 1980s, credit creation shifted toward asset-based transactions (e.g., real estate, equities, bonds, etc.). This transition was also fuelled by the record-high (double-digit) interest rates in the early 1980s and the relatively low risk adjusted returns on productive capital.

¹⁰ According to Mohun (2004) the value of money m (measured in hours per unit of money) is expressed as $m = \lambda y / py$. The inverse of the value of money is the 'monetary equivalent of value' or the 'monetary equivalent of labour time' or $melt$.

this empirical effort we have opted for the Autoregressive Distributed Lag (ARDL) approach, introduced originally by Pesaran and Shin (1999) and further extended by Pesaran et al. (2001) and Narayan (2005). This method is supposed to be superior to other single cointegration procedures as endogeneity problems and the inability to test hypotheses on the estimated coefficients in the long-run are avoided whilst all variables are assumed to be endogenous and the long and short-run parameters of the model are estimated simultaneously.

Additionally, the ARDL methodology can be implemented regardless of whether the underlying variables are $I(0)$, $I(1)$ or fractionally integrated (Pesaran et al., 2001). On the downside, however, is the inability of the ARDL to provide robust results when variables are integrated of the second order i.e. $I(2)$.

The ARDL specification based on Eq. (1) is then transformed to a conditional error correction version of the profit rate and its determinants:

$$\Delta rop_t = \beta_0 + \sum_{i=1}^p \beta_{1i} \Delta rop_{t-i} + \sum_{i=1}^p \beta_{2i} \Delta X_{t-i} + \beta_3 rop_{t-1} + \beta_4 X_{t-1} + \varepsilon_t \quad (2)$$

In Eq. (2), β_1 and β_2 represents the short-run dynamics of the model, β_3 and β_4 represents the long-run relationship; Δ is the first difference operator, and p is the optimal lag length. The joint hypothesis that the long-run multipliers of the lagged level variables will be tested by means of a bounds testing procedure developed by Pesaran et al. (2001) whilst the order of lags in the ARDL specification will be determined by the Akaike (AIC) selection criterion i.e., the lag length that minimizes the AIC, before the selected model is estimated by ordinary least squares.

The final step would be to determine the speed of adjustment (λ) to long-run equilibrium after a shock which is captured by the error correction representation and expressed as follows:

$$\Delta rop_t = \beta_0 + \sum_{i=1}^p \beta_{1i} \Delta rop_{t-i} + \sum_{i=1}^p \beta_{2i} \Delta X_{t-i} + \lambda EC_{t-1} \quad (3)$$

The error correction component (EC) is represented by:

$$EC = rop_t - \beta_0 - \sum_{i=1}^p \beta_{1i} \Delta rop_{t-i} - \sum_{i=1}^p \beta_{2i} \Delta X_{t-i} \quad (4)$$

3.2. Further empirical probing: determinants of the probability of UK's recessions

Next step in our empirical investigation would be to explore the determinants of the probability of UK recessions over the same period (1985Q1–2019Q4) by means of a multivariate probit model. The general form of our model which is along the lines developed by Alexiou and Trachanas (2020) is expressed as follows:

$$R_t = \alpha + \beta \Xi + \gamma^X + \varepsilon_t \quad (5)$$

The dependant variable R is a binary recession indicator series that is defined as:

$$R_t = \begin{cases} 1, & \text{if the economy is in a recession at time } t \\ 0, & \text{if the economy is in an expansion at time } t \end{cases} \quad (6)$$

The binary dependant variable is constructed in accordance with OECD based Recession Indicators Sourced from the Federal Reserve Bank of St Louis business cycle reference dates. Fig. 1 depicts graphically the binary dependant variable (i.e., recession periods) along with UK's real GDP growth for our sample period.

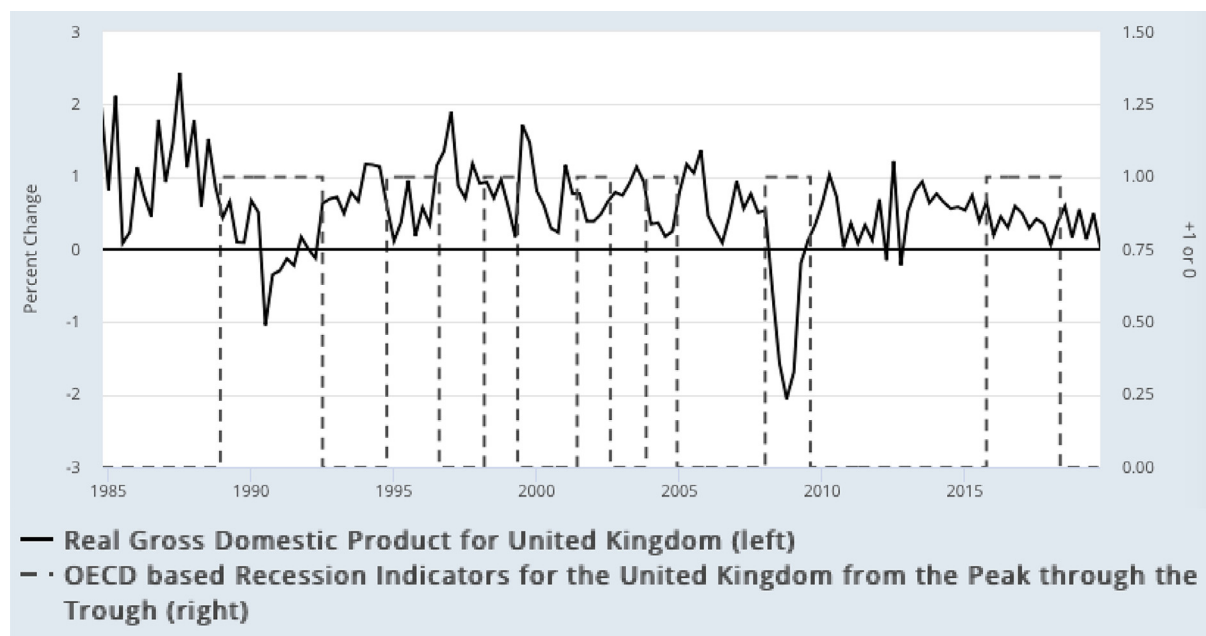


Fig. 1. UK's real GDP growth rate – Source: ONS; Recession indicators for the UK – Source: OECD.

Vector Ξ in Eq. (5) consists of two measures of profitability, i.e., the rate of profit (*rop*) and the incremental rate of profit (*iror*)¹¹, respectively; the wage share of income (*ws*) which attempts to capture the bargaining power of workers in setting higher wages; the nominal interest rate (*ir*) that purports to capture the financial conditions that are bound to affect cyclical fluctuations of economic activity both in the upturn and downturn; vector χ consists of additional explanatory variables accounting for plausible determinants of a recession, such as: the credit-to-GDP ratio (*cred*) attempting to capture the increasing role of the financial sector in the economy; the consumer price index rate (*cpi*) as a proxy for inflation and macroeconomic stability; gross fixed capital formation growth rate (*gfcf*) as a measure of investment activity; and the residential property prices index (*hp*). Table A1 in the Appendix provides a detailed description of all variables and sources whilst Table A2 in the Appendix presents the contemporaneous correlations of the explanatory variables.

We estimate four probit models using the aforementioned variables in the $\mathbf{X}$ vector as common independent variables in all models; we then add in each model an alternative key independent variable found in the Ξ vector in order to gauge the efficacy of the theoretical arguments that these variables are linked to.

Prior to the estimation, appropriate unit roots testing has taken place to ensure that the binary choice probabilities are stationary (Regenwetter and Davis-Stober, 2018) hence, the first difference transformation operator (Δ) that denotes stationary processes when needed.

We start off by assessing the four specifications by means of a Wald test - testing whether all predictors' regression coefficients are simultaneously zero - and also by employing the Hosmer-Lemeshow goodness-of-fit test (Lemeshow and Hosmer, 1982)

¹¹ Using the *iror* obviates the need to deal with theoretical and empirical issues arising from the measurement of capital stock (Alexiou et al., 2016); *iror* is given as the ratio of change in real gross profits over the real gross investment of the last period; *iror* is also thought to be closely bound up with the short-run Keynesian index of profitability, i.e. the marginal efficiency of capital (MEC). The preponderance of heterodox studies tends to use replacement cost valuation of the capital stock (see Moseley, 1992; Kotz, 2009; Shaikh, 2010; Dumenil and Levy, 2011), whilst there are others who use the historical cost valuation (see Kliman, 2011).

where we compare the observed and estimated frequencies “in groups of observations defined by the estimated probability of the reference outcome” (Alexiou and Trachanas 2020, p.213.). Finally, by using the standard positive outcome threshold of 0.5 (50%), we also consider the fraction of observations that are actual positives (i.e., recessions) and are correctly identified, the fraction of observations that are actual negatives (i.e., non-recessions) and are correctly identified, and the overall rate of correct classification.

4. Results

4.1. ARDL specification

The initial step is to test our series for unit roots by applying a unit root with a break test (see Table A3 in the Appendix). The results suggest that we can proceed with the ARDL methodology, i.e., there is evidence of a mixture of $I(0)$ and $I(1)$ variables and a clear rejection of the hypothesis that the data are $I(2)$, which is important for the legitimate application of the bounds test.

We then proceed to the estimation of an ARDL model which will be used to apply the bounds test. The F-statistics for all the bounds tests clearly exceed the 1% critical value (see Table A4 in the Appendix) and accordingly, we strongly reject the null hypothesis of *no long-run relationship*. The selection of the ARDL specifications in all three models were based on the SIC. The maximum lag length was set to 4.

The short-run specification of the estimated model observed in Table 1 - Panel A, provides insightful dynamic information on the underlying relationships of the profit rate and the rest of the explanatory variables. The respective diagnostic and statistical tests indicate that our estimated coefficients are robust and free from any problems associated with the error term.

More specifically, the wage share, which purports to capture the distributional struggle between capital and labour, is found to be negatively related to the profit rate hence, implying that as the share of total national income that is distributed to labour increases it causes the profit rate to fall. The fact that capacity utilization is positively related to the profit rate suggests that when factories or equipment are more efficiently utilized during economic booms, then profitability increases. Furthermore, the over-

Table 1
ARDL (4, 4, 0, 4, 1, 2) estimation results: dependant variable is *rop*.

PANEL A Short-run dynamics and error correction			PANEL B Long-run estimates		
Variable	Coefficient	Std. Error	Variable	Coefficient	Std. Error
<i>constant</i>	0.277***	(0.096)	<i>constant</i>	4.379***	(0.961)
<i>rop_{t-1}</i>	−0.063***	(0.015)	<i>ls</i>	−0.119***	(0.026)
<i>c/k_{t-1}</i>	0.601***	(0.106)	<i>c/k</i>	1.801***	(0.174)
<i>cu</i>	0.531***	(0.057)	<i>cu</i>	0.004***	(0.001)
<i>cpi_{t-1}</i>	−0.0006	(0.001)	<i>cpi</i>	−0.009	(0.020)
<i>ws_{t-1}</i>	−0.007***	(0.002)	<i>melt</i>	0.003***	(0.001)
<i>melt_{t-1}</i>	0.002***	(0.0001)			
<i>D (rop_{t-1})</i>	0.007	(0.049)			
<i>D(rop_{t-2})</i>	−0.045	(0.049)			
<i>D(rop_{t-3})</i>	0.079**	(0.035)			
<i>D(c/k)</i>	10.191***	(0.224)			
<i>D(c/k_{t-1})</i>	−0.382	(0.502)			
<i>D(c/k_{t-2})</i>	0.554	(0.507)			
<i>D(c/k_{t-3})</i>	−1.504***	(0.371)			
<i>D(cpi)</i>	0.006**	(0.003)			
<i>D(cpi_{t-1})</i>	−0.0003	(0.003)			
<i>D(cpi_{t-2})</i>	−0.0001	(0.003)			
<i>D(cpi_{t-3})</i>	0.005*	(0.003)			
<i>D(ws)</i>	−0.068***	(0.003)			
<i>D(melt)</i>	0.001***	(0.0002)			
<i>D(melt_{t-1})</i>	−4.3497	(2.683)			
<i>EC_{t-1}</i>	−0.104***	(0.009)			
<i>R² - adj.</i>		0.99	<i>Serial Correlation</i>		0.362
<i>F-statistic</i>		83.67	<i>Normality</i>		0.102
<i>DW-statistic</i>		2.37	<i>Heteroscedasticity</i>		0.281

Note: (***), (**), (*) denote significance at 1%, 5% and 10% levels respectively.

all positive effect of capacity to capital ratio, which is the inverse of Marx's organic composition of capital, indicates that profit rises with more productive capital. The inflation rate and the monetary expression of labour time (*melt*) are both found to be positively correlated with the profit rate as suggested by Kliman (2011) hence indicating that a rising rate of inflation and a rising rate of *melt* should be correlated with a rising rate of profit. In passing it should be stressed that the above argument qualifies on the assumption that prices rise continuously which makes outputs more expensive than inputs. Finally, the positive effect of the dynamic term of the profit rate suggests that lagged profit rate positively affects current profit rate.

The coefficient of the error correction term (*EC_{t-1}*) confirms the existence of a long-run relationship.¹² The negative and highly significant error correction component suggests that there is a relatively speedy adjustment from disequilibria of the previous years' shock, back to the long-run equilibrium in the current year.

As far as the long run estimates are concerned (see Table 1 - Panel B), these are in line with what has already been established in the short run with the only difference the result pertaining to inflation hence suggesting that in the long run inflation does not play a significant role in determining profitability.

4.2. Probit specification

Table 2 (Panel A) presents the results of the probit regressions for the four estimated models. For interpretation purposes we should stress that a positive/negative coefficient indicates that an increase in the predictor variable leads to an increase/ decrease in the predicted probability.

As it can be observed the common explanatory variables in all four models are found to be statistically significant. More specifically, the credit-to-GDP ratio ($\Delta cred$) is statistically significant, suggesting that an increase in the credit-to-GDP ratio increases the

probability of a recession. This finding provides sustenance to the view by Bernanke (2018) that the severity of the Great Recession was to a great extent due to *financial panics*. It should be noted however that in a similar study conducted for the US recessions by Alexiou and Trachanas (2020), credit was found to be insignificant hence their interpretation that financialization might be a symptom rather than a key factor responsible for explaining potential downswings in the business cycle as implied by the Marxian tradition.

Inflation (*cpi*) is also found to be statistically significant and positive indicating that a sustained increase in inflation increases the probability of recession. Such a finding is in line with the view that higher prices lead to reduced demand for products thereby stifling economic activity. Additionally, the growth rate of investment ($\Delta g/cf$) is statistically significant and negative suggesting that increasing investment expenditure will be expected to reduce the probability of a recession. Furthermore, the house prices index (*hp*) suggests that there is an increased probability of a recession when property values increase. This finding is in line with Greenspan, (2005), Rajan, (2005), and Shiller, (2007) who argue that low risk premiums, are bound to misalign incentives for risk-taking and it is therefore plausible that high house prices precede a recession; this finding is however diametrically opposite to what Alexiou and Trachanas (2020) established in their study for the US economy.

Turning now our attention to the key explanatory variables of the estimated equations we observe that the probability of a UK recession declines significantly when the wage share of labour (*ws*) increases (Model 1) hence suggesting that as worker's income increase the probability of a recession significantly declines. In all likelihood, this finding is in line with the *wage-led* growth hypothesis proposed by the Post Keynesian tradition. More specifically, Stockhammer, (2011) argues that wage growth has a positive impact on demand and productivity growth whilst insufficient wage growth may contribute to economic crisis. This result, however, stands in stark contrast to the Marxian class struggle theory according to which falling profitability due to growth in labour wage share will potentially trigger a recession.

The two proxies for profitability, (*ROP* and *IROP*) in Models 2 and 3, appear to be yielding the same negative and significant results which are in line with the theoretical expectations surrounding the LTRPF. It should be stressed however, that the *IROR* which is also a proxy for the short-run Keynesian index of profitability, i.e., the marginal efficiency of capital (MEC), is found to be weakly significant – i.e., at the 10% level. In Model 4, the change in the interest rate (Δir), which in this context purports to capture the level of risk in the UK economy, is found to be insignificant. This finding might be reflecting the ineffectiveness of monetary policy in a zero-low-bound (ZLB) interest rate environment experienced by the UK economy (Kiley and Roberts, 2017).

Panel B in Table 2 reports the conditional marginal effects which are akin to the ones provided in Panel A. It should be noted however, that the estimated coefficients in this case, should be interpreted as the effects of a unit change in the mean value of the independent variables on the probability of a recession.

Finally, Table 2 also provides several statistics that purport to evaluate the predictive power of our models. For instance, both the Wald statistics and the Hosmer-Lemeshow goodness tests, indicate that the models perform significantly better than a model with no predictors and that the models' fit is rather good. When considering a 0.5 positive outcome threshold, the percentage of recessions that are correctly identified range from 46.67% to 53.33% while the overall rate of correct classification ranges from 67.65% to 73.53%. In view of the above, the models' predictive performance appears to be rather satisfactory.

¹² This finding might be at odds with the non-long run equilibrium inspired by Kliman (2007).

Table 2
Estimation results.

Panel A: Probit models				
	Model 1	Model 2	Model 3	Model 4
$\Delta cred$	0.164*** (0.061)	0.122** (0.061)	0.146** (0.059)	0.135** (0.054)
cpi	0.145*** (0.062)	0.185*** (0.060)	0.181*** (0.060)	0.187*** (0.050)
$\Delta gfcf$	−0.617** (0.291)	−0.495* (0.278)	−0.981** (0.385)	−0.280* (0.143)
hp	0.0001** (0.00003)	0.0005** (0.0002)	0.0004** (0.0002)	0.0001*** (0.00002)
ws	−0.217** (0.094)			
rop		−1.045** (0.005)		
$iror$			−0.360* (0.198)	
Δir				0.186 (0.190)
$constant$	8.821** (4.437)	1.312*** (0.358)	−1.331*** (0.355)	−2.217*** (0.580)
Panel B: Conditional marginal effects				
	Model 1	Model 2	Model 3	Model 4
$\Delta cred$	0.060** (0.022)	0.121** (0.093)	0.041** (0.015)	0.128** (0.060)
cpi	0.053** (0.0227)	0.015*** (0.103)	0.067*** (0.022)	0.183*** (0.060)
$\Delta gfcf$	−0.173* (0.102)	−0.173* (0.100)	−0.152* (0.091)	−0.958* (0.498)
hp	0.0022** (0.00013)	0.002** (0.00009)	0.00003** (0.00001)	0.00008** (0.00003)
ws	−0.795** (0.034)			
rop		−0.457*** (0.174)		
$iror$			−0.172* (0.101)	
Δir				0.036 (0.075)
McFadden's pseudo- R^2	0.133	0.264	0.114	0.124
Log-likelihood	−78.21	−17.17	−16.03	−79.90
Wald stat.	32.65*** [0.000]	35.89*** [0.000]	38.32*** [0.000]	31.46*** [0.000]
Hosmer-Lemeshow stat.	11.144 [0.193]	8.056 [0.428]	11.970 [0.152]	5.160 [0.740]
Correct recession (50%)	46.67%	53.33%	60.00%	40.00%
Correct non-recession (50%)	84.21%	89.47%	78.95%	60.85%
Correct overall (50%)	67.65%	73.53%	70.59%	56.27%

Notes: Robust standard errors are given in parentheses. p -values are given in square brackets. ***, ** and * denote statistical significance at the 1, 5 and 10% level, respectively.

5. Concluding remarks

Political economists have been trying for many decades to provide a well-define theoretical perspective that explains adequately periodic economic crises in capitalist economic systems. In this direction, despite the many different types of theories that have been developed, a central theme that appears to be shared by most of these theories is that the rate of profit is a critical determinant of macroeconomic activity. In this context, the Marxian theory of capitalist economic crisis that regards the falling rate of profit as the fundamental source of economic crisis, has been at the forefront of the academic debate for some time now.

The contribution of this study is twofold, in that it (a) sheds light on the key determinants of the profit rate as implied by the Marxian tradition and (b) by using a probabilistic framework of analysis, it provides novel evidence on the impact of profitability on the probability of UK recessions. Overall, the evidence generated bolsters up the theoretical arguments put forward in support of the LTRPF.

The first part of the analysis, where the determinants of the profit rate are explored, confirms the inherent relationships of the key explanatory variables linked to the Marxian analysis. In particular, the negative relationship between the wage share – reflecting the strength of labour vis-à-vis capital – is in line with the theoretical postulates in the area. Profitability is also found to be affected positively by the increasing capacity utilization whilst the capacity-to-capital ratio suggests that profit tends to rise with more productive capital. The inflation rate is found to have no significant impact on the profit rate in the long run, whereas the monetary expression of labour time appears to be positively associated with the profit rate.

The effect of technological change is an inherent element of Marx's theory of the falling rate of profit as well as a present feature of capitalist economies. The introduction of new technology tends to replace workers with machines and hence reduce the amount of labour employed vis-à-vis the total capital invested. In other words, whenever the rate at which total capital invested (or the ratio of constant capital to variable capital) is greater than the

rate at which workers are employed, then the rate of profit tends to fall.

In the second part of the empirical investigation the evidence suggests that there is a significantly decreased probability of an occurrence of UK recession when the profit rate increases. The impact of the wage share on the probability of a recession is negative whilst no impact was established when the interest rate was considered. Furthermore, the negative impact of both the wage share of labour and investment expenditure on the probability of a UK recession lend support to the Post Keynesian tradition. In this context, consumption propensities are assumed to be different across income level or income classes while investment propensities are predominantly affected by the size and strength of a firm. As such, investment expenditure is a key determinant of demand, output and employment whilst shifts in the distribution of income and wealth has a profound impact on aggregate demand and through this on economic activity. In addition, the notion that the burgeoning growth of private credit might be a factor responsible for triggering recessions, is also supported by the evidence. In other words, credit patterns appear to be of a paramount importance in explaining recent economic episodes, such as the 2007/8 financial crisis, which tend to lead to severe and prolonged economic downturns.

On the whole, this study has exposed the profit-led character of capitalist economies, as suggested by the Marxian theory, whilst at the same time, it has also revealed interesting aspects of the Post Keynesian analysis that mainly relate to the impact of the distribution of income on economic activity.

Author statement

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Declarations of Competing Interest

none

Appendix

Tables A1–A4

Table A1
Description of variables.

Variable	Description	Source
<i>R</i>	Binary recession indicator series	OECD based Recession Indicators.
<i>Cred</i>	Credit-to GDP ratio (total credit to private non-financial sector;% GDP)	Bank for International Settlements.
<i>Cpi</i>	Consumer price index ratio	Organization for Economic Co-operation and Development.
<i>c/k</i>	Capacity to capital ratio	Author's calculations using data for potential output and fixed capital from Organization for Economic Co-operation and Development.
<i>Cu</i>	Capacity utilization	Organization for Economic Co-operation and Development.
<i>Gfcf</i>	Gross fixed capital formation growth rate (nonfinancial corporate business; gross fixed capital formation with equity REIT residential structures)	Organization for Economic Co-operation and Development.
<i>Hp</i>	Residential house prices index	Nationwide Building Society (UK) https://www.nationwide.co.uk/about/house-price-index/download-data#xtab:uk-series
<i>Ir</i>	Interest rate (nominal)	International Monetary Fund.
<i>Rop</i>	The profit rate is calculated as income minus compensation, divided total fixed assets – (nonfinancial corporations' sector)	Authors calculation using Net Domestic Product, Compensation of employees and total fixed assets (includes private and government assets, residential and non-residential) from the Office for National Statistics (UK).
<i>Iror</i>	Incremental rate of profit per unit of investment	Author's calculations: $iror = \frac{\text{the ratio of change in real gross profits}}{\text{the real gross investment of the last period}}$.
<i>Ws</i>	Wage share of income	Author's calculations using data for wages and income from the Office for National Statistics (UK).
<i>Melt</i>	Ratio of the total money price of output to the total labour-time value of the output	Author's calculations using data from the Office for National Statistics (UK).
<i>RGDP</i>	Real gross domestic product (growth)	Office for National Statistics (UK).

Table A2
Correlation matrix.

	Cpi	gfcf	rop	hp	ir	iror	cu	c/k	ws	cred
cpi	1									
gfcf	0.26	1								
rop	−0.02	−0.18	1							
hp	−0.17	−0.03	0.01	1						
ir	0.17	0.28	−0.02	−0.22	1					
iror	−0.04	0.24	−0.41	−0.07	0.05	1				
cu	−0.21	−0.12	0.15	0.13	−0.19	−0.29	1			
c/k	0.05	0.075	−0.03	−0.14	0.09	0.33	−0.10	1		
ws	−0.05	−0.05	0.17	0.23	−0.05	−0.17	0.23	−0.20	1	
cred	0.05	0.16	−0.19	−0.52	0.14	0.21	−0.09	0.05	−0.07	1

Table A3
Unit Root Test with Breakpoint.

Variables	ADF	First Difference t-stat (p-values)	T_B	Order of integration
	Levels t-stat (p-values)			
<i>cpi</i>	−7.06 (0.00)***	–	1995Q2	I(0)
<i>gfcf</i>	−1.96 (0.913)	−13.60 (0.00)***	2009Q2	I(1)
<i>hp</i>	−6.07(0.00)***	–	2006Q3	I(0)
<i>cre</i>	−4.43(0.620)	−11.45 (0.00)***	2008Q4	I(1)
<i>ws</i>	−7.89 (0.00)***	–	1998Q4	I(0)
<i>iror</i>	−15.40 (0.00)***	–	1997Q3	I(0)
<i>rop</i>	−15.55 (0.00)***	–	1997Q3	I(0)
<i>cu</i>	−2.63 (0.534)	−6.73 (0.00)***	2016Q2	I(1)
<i>ir</i>	−3.09 (0.348)	−9.22 (0.00)***	1988Q3	I(1)
<i>c/k</i>	−5.13(0.01)***	–	2017Q2	I(0)
<i>melt</i>	−14.73 (0.00)***	–	2009Q1	I(0)

Notes: Vogelsang (1993) asymptotic one-sided p-values are given in parenthesis; T_B denotes the break date; (***), (**) denote significance at 1%, and 5% levels respectively; lag length was determined by the SIC; respective dummies have been used accordingly to capture the breaks suggested by the test.

Table A4
Bounds test for cointegration .

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	12.18	10%	2.208	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

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