Profit rates in developed capitalist economies: A time series investigation

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Theoretical research on the dynamics of profit rates in capitalist economies has been particularly prolific in classical and heterodox economic theory, with their focus on the inherent instability and cyclical nature of capitalism. Various other economists such as Keynes and Schumpeter have also examined the profit rates problem but in a broader context, looking at the overall ability of capitalism to sustain profit rates opportunities and to expand. Neoclassical economics was also concerned with the level of profit rates, and focused more narrowly on the health of the corporate sector, considering profit rates as fundamentals of financial markets performance.

In a related vein, empirical research attempted to establish regularities (tendencies, cycles etc.) in the profit rates' series to provide a factual basis for theories.

The recently revived interest in the subject has been due to declining growth rates in the developed economies, increased volatility and turbulence in the global economy and structural torsion. Availability of economic data on profit rates (at the national and sectoral level) has also been stimulating applied research on the topic.

This paper revisits the hypothesis of the secular decline in profit rates (the tendency of profit rates to decline in the long-run) that has been recurrent in classical economics and attempts to validate empirically whether profit rates in developed economies have declined in recent decades. *Inter alia* it addresses a number of issues that were not adequately dealt with in previous studies. First of all, the analysis of profit rates has to rely on a theoretically sound indicator; it

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has to acknowledge the differences that exist between the definition of profit rate in classical economics and contemporary definitions of profit rate that form the basis for profit rate indicators in modern national accounts. Likewise, we have to define the scope of the profit rate indicator (economy-wide rate versus rate in the manufacturing sector or in a particular industry), as well as the variables from which the profit rate indicator is derived (in particular the definition of capital stock). Second, the majority of the studies conducted so far examined profit rates in a single economy or in a small set of economies (usually as a variable in the study of a country's capital accumulation, in macroeconomic analyses or the study of a country's structural problems). This shortcoming stemmed from the lack of available economic data that could allow comparative analysis. Third, the empirical treatment of data on profit rates mostly relied on the visual inspection of profit rate series or on simple regression techniques (e.g. estimation of the linear trend) without proper consideration of the unit root properties of the series, the possibility of trend reversals and breaks in the data.

This paper attempts to address these issues by adopting a profit rate indicator based on national accounts, by comparing a larger number of economies, and by using a combination of earlier-generation and more advanced econometric techniques.

Specifically, the sample includes 21 industrialised economies in Europe, North America, East Asia and Oceania and covers a period of over 40 years, starting from the early 1960s. The use of a broader sample and of a sufficiently long series is advantageous in several respects: it allows examining secular tendencies in profit rates beyond cyclical fluctuations; it helps us trace structural and policy changes that took place over the recent decades in the developed economies; it also allows us to take into account the economies' varying "modes of capitalism", including free-market economies (USA), regulated capitalist economies (Western Europe) and corporatist economies (Japan).

The national accounts' data is sourced from an Extended Penn World Table (EPWT). Given the nature of national accounts (no differentiation between productive and unproductive activities, and the inclusion of government sector and residential capital), such a methodological choice may be problematic, as far as a possible interpretation of empirical results from a Marxist political economy perspective is concerned and when correspondence between empirical findings and Marxian theoretical concepts is postulated. Nonetheless, the use of national accounts is useful, when coherence and consistency of results is needed (and particularly salient considering that Marxian analyses of profit rates tend to use a variety of sources, including country-specific ones, to construct profit rate indicators). Likewise, the use of national accounts allows for the conceptualization of economic activity (and respectively profitability) in a broader sense, encompassing activities that would not have been included in a Marxian analysis. Indeed, the use of national accounts in the analysis of profit rates was common in other heterodox schools, such as the Kaleckian school (Lopez Martinez et al., 2013, is an example). In this respect, the present paper falls into the stream of non-Marxist analysis of profit rates that include Downe (1986), and Feldstein and Summers (1977) among others.

The eclectic econometric approach that will be used in this paper is justified by the fact that neither of the testing procedures is likely to give definitive and robust conclusions if taken singularly. While visual observation as a sole method of analysis is usually treated with a pinch of salt, we consider it nonetheless important as an exploratory technique that could precede formal analysis. Likewise, while simple linear trends potentially give spurious results, the proper estimators can increase the power of linear trend model and help yield consistent estimates. With regards to unit root tests, none of them is a perfect tool for inference and none of them is a dominant tool (Mahadeva and Robinson, 2004, p. 12; Stock, 1994). Conventionally, the earlier-generation tests (e.g. Augmented Dickey-Fuller/ADF) are followed by unit root tests that account for instabilities and breaks in the series (e.g. Zivot-Andrews, henceforth ZA, Lumsdaine-Papell, henceforth LP, and Lee-Strazicich, henceforth LS). The present paper adopts this type of sequential testing.

The principal contribution of this paper is that it shows that there is no firm evidence supporting the hypothesis of secular decline in economy-wide profit rates in *all* developed economies. Instead, a diverse pattern of movements in the profit rates has been identified, including upward or downward deterministic trends, staggered declines, random walk, or stability and reversion to the mean. Structural breaks have been preponderant and significant, largely corresponding to broader international and country-specific economic and political changes.

1. Literature review

The early consideration of profit rates dates back to A. Smith, who postulated the decrease in the level of profit as a consequence of competition, and D. Ricardo, who argued that competition would reduce the differences in profit on investments but not the general rate of profit. The latter would only fall if wages rise, for example due to diminishing returns in agriculture and a rise in food prices in an agriculture-based economy (Tsoulfidis and Paitaridis, 2012; Ricardo, 1951, p. 120; Mizuta, 2015). Later, the possibility of insufficient profit generation in capitalism was an area of concern for J. M. Keynes and J. A. Schumpeter, the former attributing it to failures in the financial sector, the latter to the possible degeneration of the entrepreneurial function in the corporate capitalist system (Argitis, 2003, p. 13; Keynes, [1936] 1991, chapter 24; Schumpeter, [1942] 1976, part II).

Profit generation problems go hand in hand with other factors that condition crises and instability in capitalist economies (Edvinsson, 2005, p. 23). Sweezy (1962) and Ramirez (2007) for instance, point to under-consumption and deficient aggregate demand as well as to disproportionality in production and the anarchic nature of capitalism as an explanation for crises, instability and stagnation. Likewise, Minsky (1986), Onaran et al. (2012) and Stockhammer (2012) see the origins of instability and crises in debt-led rather than investment-led growth in capitalism.

Overall the complex interplay between finance and financial profits, effective demand, structural torsion between branches of the economy, debt, and non-financial profits has long been a matter of investigation in heterodox economics – be it classical, Keynesian, Schumpeterian and Minskian (Argitis, 2003). One of the formulations of such interplay is found in works of Steindl (1952). Here, the macroeconomic stagnation is attributed to an increased monopolization and oligopolisation of the economy. With the growing dominance of imperfectly competitive firms, the shocks caused by declining demand or by technological advancement are absorbed through the decline in capital utilization, and in increasing profit margins and mark-ups (due to price rigidity and labour saving technical progress). When oligopolies are unwilling to invest (due to excess capacity) and competitive firms are unable to invest (due to lack of funds), the overall level of investment and aggregate demand decline. This tendency is reinforced by a constant propensity to save, which causes profit margins and net realized profit rates to decrease (Hein, 2016, pp. 15-16).

In Marxist literature, the secular decline hypothesis is explained as follows. Capitalist competition allows innovating capitalists to reap super-normal profits that subsequently dwindle when their innovations swarm through the economy. The need to maintain profits forces capitalists to introduce labour-saving technologies and to ensure a sufficient pool of reserve labour (and thereby low real wages). Combined with the ongoing capital accumulation, this creates disparity between growth in capital accumulation and growth in surplus value (the latter growing at a slower pace), and leads to a fall in the rate of profit (Marx, [1867] 1967, p. 612). Rate of profit, defined as a ratio of surplus value and capital outlay, decreases due to wage and profit factors in the numerator of the ratio, such as declining rate of exploitation, rising real wages and fall in profit share (Tutan, Campbell, 2005). It also decreases due to factors on the capital stock side in the ratio's denominator such as change in the value composition of capital and falling capital productivity (Duménil and Lévi, 2004; Mohun, 2009; Wolff, 2003).

We note that while it has been common in heterodox economics to talk about secular decline and the "law of the tendency of the rate of profit to fall", the precise form of this decline (whether it be deterministic decline, cyclical fluctuation around falling trend, or no falling trend at all) has been debatable. For instance, Marx's works suggest that this tendency is not inevitable and that various countervailing factors (and restorative crises of various sorts) may slow down, reverse, or halt the decline in the rate of profit. This would mean that resilience is in-built in capitalist economies (Marx, 1894, chapter 14). Possible countervailing factors could include stagnant real wages and availability of cheap labour-power (Zachariah, 2009), export of capital and foreign investment (Brewer, 1990), foreign trade to expand markets (Grossman, 1992, pp. 142-201), deviation of productive investment into the financial sector (Guillén, 2014, p. 458). In a related vein, as Reuten (2004, p. 170) eloquently puts it, certain economists, including Kaldor (1957, pp. 597-598, 613), did not consider the secular deterioration hypothesis plausible at all, and rather hypothesized the stationarity of profit rates (Kaldor for instance attributed constant profit rates to constant saving propensities and hence wage and profit shares, and to similar growth rates of output and capital per capita, hence constant capital-output ratio). This is one of Kaldor's well-known "balanced growth" facts.

From an empirical standpoint, studies of profit rates look at two distinct issues. First of all, equalization tendencies in the rate of profit both between (Glyn, 2007), and within economies (Kambahampati, 1995; Tescari, Vaona, 2014) and convergence to steady-state (Pyo, Nam, 1999) have been considered, either through time-series analysis or through the probabilistic analysis of the distribution, equalisation and divergence of the rates of profits (Cottrell and Cockshott, 2006; Farjoun and Machover, 1983).

Secondly, a number of studies look at trends and cycles in the rates of profit (economy-wide rates, rates for manufacturing and corporate sector), both in individual developed and developing economies. The studies include, among others, Weisskopf (1979) and Mohun (2006) for the USA; Mohun (2002) for Australia; Reati (1986) and Poletayev (1992) for Germany; Hayashi and Prescott (2002) for Japan; Román (1997) for Spain; Erixon (1987) for Sweden. Comparative studies include Daly and Broadbent (2009), Li et al. (2007), and Sylvain (2001). Results of the empirical analyses are rather conflicting: while some studies attest to the long-run fall in profit rates (Hayashi and Prescott, 2002), others provide evidence of periods when profit rates recover and rise (Mohun, 2006), stabilise (Izquierdo, 2007), or experience cycles (Basu and Manolakos, 2010). This can partly be attributed (in addition to issues of measurement and profit rate indicators) to the fact that most empirical studies with the exception of Basu and Manolakos (2010) tended to rely on the visual inspection of the data or on the use of early generation econometric methods (simple linear trends).

This paper does not engage in a theoretical debate on the causes and effects of the fall in the rate of profit. Instead, it attempts to describe profit rate patterns and dynamics statistically and econometrically. For this purpose, it looks at which of the theoretical lines in the literature looks more plausible (long-run tendency to decline versus a more diverse behaviour of profit rates) and documents which events could have contributed to the results. Specifically, we attempt to differentiate within profit rate series between the deterministic trend, the deterministic trend with breaks, the stochastic trend around a non-zero mean, pure random walk or reversion to the historical mean.

2. Methodology

This paper considers the profit rate in the whole economy, as opposed to the profit rate exclusively in the private economy, or in the manufacturing sector only, the profit rate on a non-residential capital stock, or the profit rate in productive activities as defined in Marxist political economy. Such considerations are justified as follows.

First of all, while manufacturing has conventionally been considered as the core and backbone of the national economy, profound changes have taken place in developed countries' economic structure over the last few decades (specifically the decline in manufacturing and the rise of the tertiary sector), which need to be addressed in the analysis.

Secondly, the data needs to include government sector activities in both output and capital stock. Whether profitability motives apply to or guide government activities is debatable, as is the possibility of calculating the profit rate for the government sector. However we note that there is a tight link between private and public sectors in modern economies and that the former has a supportive role in the economic reproduction process (Evans and Karras, 1994). (Aschauer, 1988, p. 11) argues, for instance, that public investment policy might alter the marginal product of private capital and therefore private investment, and might indirectly contribute to private output (for example by developing economic infrastructure), thus affecting the private profit rate (a large part of decline of US rate of return for private capital over the 1953-1985 period was attributed to the decline in public capital stock). Therefore, the idea that government investment has been crowding out private investment, or that government activities have been reducing aggregate welfare and should be considered separately with respect to the reproduction of the private economy may be unwarranted. Moreover, the government sector (state-owned enterprises) and the various economic activities performed by the government (government contracting) continue to play an important role in industrialised economies, even after the wave of privatisations that took place in the 1980-90s and the ongoing process of devolution of government functions to the private sector. Indeed, public-private "hybrid enterprises" are not uncommon (see the Tennessee Valley Authority, a public enterprise with a return on investment but no mandate to maximise it, or the French public and nationalised enterprises), and need to be accounted for (Feigenbaum, 1985, pp. 149-151; Moore, 1967, p. 107). Finally, the imposition of budget constraints in the government sector, the rise of business models for the public sector, and the growing emphasis on efficiency, value creation and, implicitly, profitability (Rao, 1989) might require the construction of public sector profitability indicators and some sort of inclusion of this sector into aggregate profitability measures.

Thirdly, with regards to the residential sector, the data considered dwellings as a part of the capital stock. An argument can be raised against this, as the residential sector represents a substantial part of the total capital stock, while generating a much smaller part of the added total value that is produced (Tutan, Campbell, 2005, p. 15). On the other hand, Edvinsson (2005) argues that the inclusion of residential capital in the total capital stock may be warranted, as "renting out residential buildings is an important source of profit in contemporary society, and the rents paid are important components of the expenses of wage workers" (p. 192).

The empirical analysis makes use of data on profit rates contained in the Extended Penn World Table version 4.0 (EPWT), constructed by Foley and Marquetti (2012). EPWT itself is largely based on the Penn World Table 7.0/PWT 7.0 (Heston et al., 2011). The critical feature of the EPWT is that it provides capital stock series for a large sample of developed economies over a 40-50 year period, making time series econometric analyses possible.

The rate of profit variable was constructed as:

$$\pi = \frac{(Y - Nw - D)}{K} \qquad (1)$$

where Y is the chain index of real GDP in 2005 purchasing power parity (PPP), K is the net fixed standardised capital stock in 2005 PPP, D is the estimated depreciation from K, w is the average real wage in 2005 PPP, and N is the number of employed workers.

Variable Y was constructed as the product of population and real GDP per capita in 2005 PPP according to the data from PWT 7.0. Variable N was obtained by dividing variable Y by the real GDP per worker according to PWT 7.0. Variable K was computed using the perpetual inventory method (PIM) from investment series based on the real investment share of GDP presented in the PWT 7.0. Variable D was calculated from capital stock values as:

$$D_t = K_{t-1} + I_t - K_t \quad (2)$$

Foley and Marquetti (2012) acknowledge shortcomings in the variables' construction in the PWT. Examples are the inclusion of common and high rates of depreciation across economies in the database (a problem that becomes inevitable when the aim is to ensure comparability of capital stock estimates); the inclusion of gross residential capital formation and change in inventories; the short reporting period for investment variables, as well as *ad hoc* assumptions about an asset's lifespan across gross capital formation categories.

Based on the EPWT, profit rate series were constructed for the following economies (and periods): Australia, Austria, Belgium, Canada, Ireland, Italy, Luxembourg, Netherlands, New Zealand, Spain, UK, the USA (1964-2008); Denmark, Finland, France, Sweden (1964-2009); Japan, Norway, Switzerland (1964-2007); Greece (1965-2008); and Portugal (1965-2009).

Several data observations are missing for the Netherlands (1965-1968) and Norway (1964-1967). Newton's interpolation polynomial was used to obtain continuous series for these economies. Germany, being the third largest developed economy, was not included in the sample: the EPWT contained real wage data only for West Germany starting from 1982, making the sample too short and not including variables pertaining to former East Germany.

As a first step, we estimated a linear trend model based on the following semi-logarithmic equation:

$$\ln \pi = \alpha + \beta t + \mu_t \quad (3)$$

where $\ln \pi$ is the natural logarithm of the profit rate series, t is the year of observation and μ_t is the random disturbance term. Coefficient β stands for trend coefficient, i.e. the average annual rate of change in the profit rate over the respective period. To correct possible autocorrelation, AR terms were included in the equation. The number of AR terms in this linear trend model (as well as the lagged difference terms in the autoregressive model below) was determined by Breusch-Godfrey's serial correlation Lagrange Multiplier (LM) test, in which the AR term is retained if the test's $p(\chi^2)$ statistics exceeded conventional significance level.

As mentioned by Nelson and Kang (1984), the OLS estimators in a simple trend model tend to be inconsistent if the variable in question is nonstationary. In this case, the estimates of the trend are biased and spurious trends are present. Additionally, the rejection of normality and the presence of heteroskedasticity are frequent problems that are encountered in the estimation of the linear trend. Notwithstanding this, if we follow Canjels and Watson (1997), the use of a linear trend model may be deemed appropriate and a correct inference may be obtained, if efficient estimators such as Prais-Winsten are used. This paper, therefore, uses a conventional linear trend model with AR terms and estimators obtained using the Prais-Winsten procedure.

In light of the spurious trend problems, two alternatives are available. A two-step approach may be adopted where series are tested for the order of integration, with series then estimated as either trend-stationary:

$$\ln \pi = \alpha + \beta t + \mu_t \tag{4}$$

or as difference-stationary models:

$$\Delta \ln = \beta + \mu_t \tag{5}$$

Alternatively, a one-step procedure may be carried out by estimating an autoregressive model of Augmented Dickey-Fuller (ADF) type that addresses the above-mentioned problems, encompasses both trend- and difference-stationarity, and does not require prior testing for the order of integration. The autoregressive model with a time trend (used in this paper) has the following form:

$$\ln \pi = \alpha + \beta t + \delta \ln \pi_{t-1} + \mu_t, \tag{6}$$

where t is time variable and μ_t is the random disturbance term. This model has been applied in a number of contexts to examine series' univariate dynamics (Athukorala, 2000; Erten, 2011, among others).

Equation (6) may be re-parametrized in a different form that reads:

$$\Delta(\ln \pi) = \alpha + \beta t + \gamma \ln \pi_{t-1} + \mu_t \ , \qquad (7)$$

where $\gamma = \delta - 1$.

To correct the possible presence of autocorrelation, an additional lag of the dependent variable (in first difference) is added, as $\Delta(\ln \pi_{t-1})$ conventionally irrespective of its significance. If autocorrelation is not eliminated with one lag, additional lags $\Delta(\ln \pi_{t-m})$ are introduced until the problem is solved (Said, Dickey, 1984). The testing equation is therefore:

$$\Delta(\ln \pi) = \alpha + \beta t + \gamma \ln \pi_{t-1} + \psi \Delta(\ln \pi_{t-1}) + \theta \Delta(\ln \pi_{t-m}) + \mu_t \qquad (8)$$

The estimation results of this autoregressive equation can be interpreted in the following ways:

If $\beta \neq 0, \gamma < 0$, there is a non-zero deterministic trend and series revert to this trend after short-run disturbances.

If $\beta = 0, \gamma < 0$, there is no deterministic trend, but series revert to the historical mean.

If $\beta = 0, \gamma = 0$, the series exhibit random walk with a mean of zero (meaning that the past behaviour of profit rate series gives no indication of future dynamics, and that profit rates may be higher, smaller or equal to the current value in the future).

If $\beta \neq 0, \gamma = 0$, the series present a random walk with drift (i.e. a stochastic trend). In this case, if $\beta > 0$, it is likely that the future level of profit rate will be higher than the current one, while if $\beta < 0$, it is likely that profit rates will decline in the future.

In the first two cases an ideal error-correction model with a statistically significant and negative γ coefficient, belonging to $-1 < \gamma < 0$, can be obtained (Engle and Granger, 1987).

In this regard, only the first two cases can be considered as reliable guides for profit rates' future dynamics. Also, the hypothesis of a secular decline in profit rates will be supported when $\beta < 0, \gamma = 0$ and $\beta < 0, \gamma < 0$. The possibility of a secular increase is also acknowledged (in this case $\beta > 0$).

The long run trend rate from the above autoregressive estimation is defined as:

$$b = -\beta\gamma^{-1} = -\frac{\beta}{\gamma} \quad (9)$$

If $\gamma = -1$, then equation (3) defined above is obtained.

Regarding the interpretation of the regression results, we ensured that coefficient γ on a lagged dependent variable is statistically significant and that $-1 < \gamma < 0$ holds (because of the specification of hypotheses in the ADF model, with $\gamma = 0$ being a unit root null and $\gamma < 0$ being a stationarity alternative, as a higher negative γ indicates a stronger rejection of the null). Of course, the case of $\gamma > 0$ is not considered (and not tested in ADF) as it is highly unlikely, and would imply persistent and increasingly large shocks to the series, also known as an explosive process. Following Pesaran et al. (2001), the t-statistics of the coefficient was compared to the usual t-value of critical bounds, as well as to Dickey and Fuller (1979) unit root t-statistics (in cases when dependent variable is not stationary in levels and the distribution of t-statistics is non-standard). We also ensured that coefficients on the respective dummy variables were significant too. We then performed post-estimations of the model, usual diagnostic tests for autocorrelation, normality, heteroskedasticity, and the ARCH effect.

The autoregressive ADF-type model was first estimated without dummy variables, provided that all the diagnostic tests had been passed. If non-normality of residuals, autocorrelation or heteroskedasticity were present, the dummy variables were introduced and the model was re-estimated. The procedure to determine relevant dummy variables included the identification of all the possible dummies that corresponded to impulse shifts, breaks in intercept or trends in the series of a particular year. The identification procedure involved running ADF regressions without dummies, followed by the inspection of residuals, recursive residuals or N-step forecast graphs for outliers (Brown et al., 1975). In addition to this intuitive method, a formal Quandt-Andrews test (Andrews, 1993) was performed. Re-estimation was carried out with different combinations of dummies until the best fit was achieved and diagnostic tests delivered the best statistics. As a robustness check, the identified breaks and instabilities were compared to breaks identified by the Bai-Perron (2003) procedure. Regarding the type of chosen dummy variable (impulse or shift), the above information about the dummy variables was compared to the series' graphical data. In the absence of *ex ante* knowledge about the type of dummy, visual observation provided some guidance; the regressions were respectively run with either impulse or shift dummies (in the former case, the dummy is set to 0 or 1 *in* a particular year; in the latter case, to 0 or 1 *after* a particular year). Alternatively, in the case of regressions using breaks from Zivot-Andrews, Lumsdaine-Papell and Lee-Strazicich tests, two equations were estimated for each economy, one with an impulse and one with a shift dummy.

In case of inconsistency of results between the linear trend model and the ADF model (with or without a dummy), or between the results of these models and the graphical data, additional and more powerful unit root tests were performed to differentiate between trend stationarity with breaks and unit root behaviour, as well as between trend stationarity with breaks and unit root with breaks behaviour. To identify the former type we used the Zivot-Andrews (1992) test and the Lumsdaine-Papell (1997) test; for the latter type we used the Lee-Strazicich (2003; 2004) one. ZA and LP tests (with one and two breaks respectively) were performed in three variants: allowing for a shift in the level of series, in the series' growth rate, or both. LS tests (with one or two breaks) were performed based on a more general "break" model, allowing for structural breaks in both the intercept and the slope under the alternative hypotheses.

The linear trend model was then re-estimated, including the dummy variables corresponding to the breaks identified by the ZA, LP and LS tests. It was acknowledged that these tests are not tests for break timing *per se*, that dummy variables were thereby likely to be insignificant and that normality and heteroskedasticity problems were likely to re-appear.

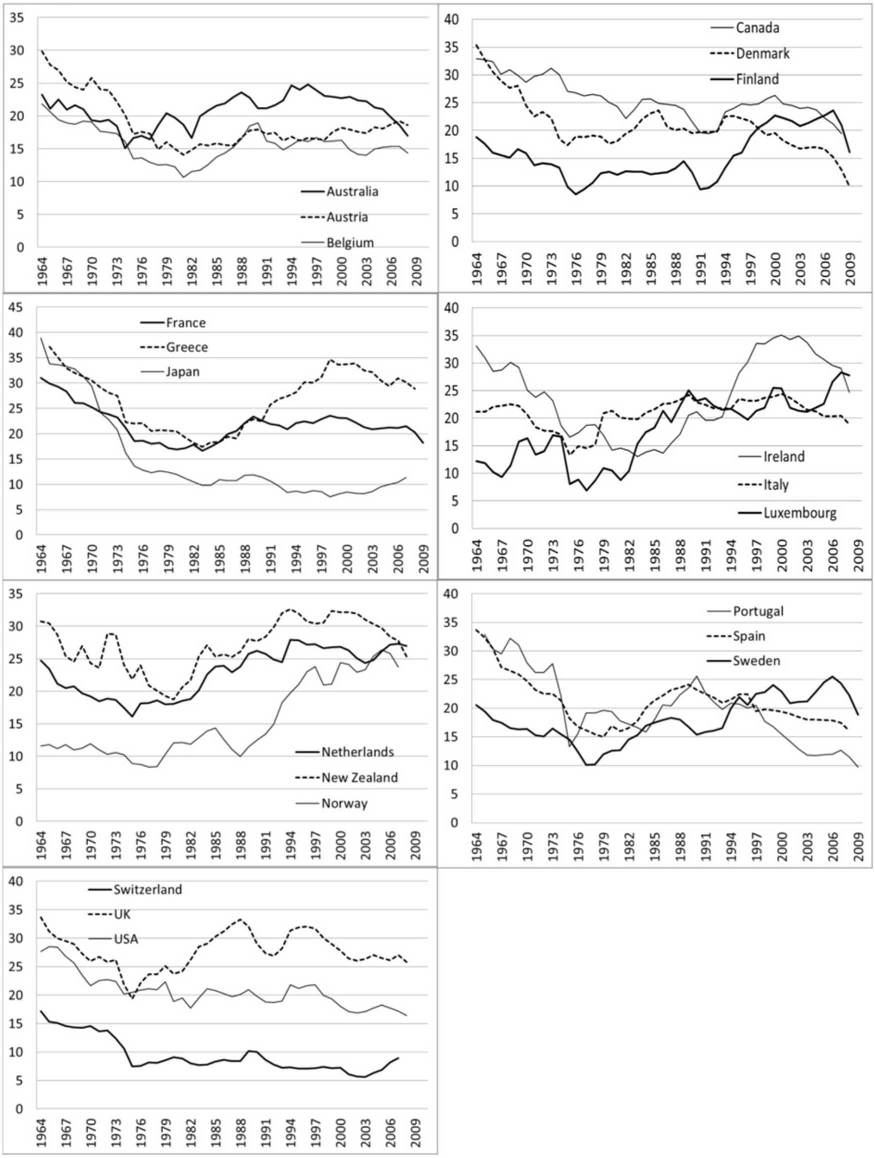
The overall conclusion was drawn when concordance between the results of the three types of models (the linear trend with dummies based on residuals, the autoregressive model with and without dummies, and the linear trend with dummies from ZA, LP and LS tests) was ensured.

3. Empirical results

Before formally testing the secular decline hypothesis, it is useful to observe the profit rate patterns (figure 1). The visual observation suggests that over the study period (1964 to late 2000s) profit rates were likely to exhibit downward trends in Austria, Canada, Japan, Portugal, Spain, Switzerland and USA. Upward trends were likely in Luxembourg and Norway. In other economies either there was no distinct trend, or trend reversals and random walk behaviour were likely.

Visual inspection of this figure also suggests two distinct patterns for profit rates in most economies – decline until the mid or late 1970s, followed by partial or complete reversal. Early decline was probably present in all economies, except Luxembourg and perhaps Norway. Complete recovery was witnessed in Australia, Greece, Italy, Ireland, New Zealand, Netherlands, Sweden and the UK, while partial recovery or stabilisation seemed likely in Austria, Belgium, France and Spain. Countries such as Luxembourg and Norway witnessed not only complete recovery but also a reversal of the trend.

Figure 1 – *Profit rates in OECD economies*



These visual observations, however, should be interpreted with caution, as spurious regressions and particularly spurious trends and cyclicality are possible (Granger and Newbold, 1974; Nelson, Kang, 1981).

As to the explanation of the phenomenon, Kliman (2012) argues that an initial downward trend was inevitable, due to the initially very high profit rates in the early post-WWII period: this was a result of a previous decline in the value of physical capital and financial assets during the turbulent 1930-40s. Hence, the decline in the 1960-70s was predetermined, and the low profit rates in the 1970s were not seen as unprecedented, but more as historically normal. Explaining the recovery that has taken place since the 1980s, authors such as Duménil and Lévi (2004) and Glyn (2006) point to the profound pro-business political and economic restructuring that has been occurring, as well as to the rise of a rentier class and of "unproductive" sectors such as finance and the military-industrial complex.

Table 1 presents the results of a linear trend model estimated with the logarithm of the profit rates' series. The model uses the ARMA conditional least squares (CLS) method based on the Gauss-Newton/Marquardt algorithm, and includes up to three AR terms included to correct the serial correlation. In the case of Austria and Japan, the CLS method delivered results that seemed to contradict the data (specifically, CLS resulted in the positive sign of the trend) and hence ARMA generalized least squares (GLS) was additionally performed. To ensure the normality of the data, shift or impulse dummy variables were incorporated into the trend regression. The choice of dummies was dictated by the presence of large positive/negative residuals in the trend regression with no dummies, as well as by visual observation of the series. In the case of Denmark, several specifications of the trend regression with or without dummies resulted in a heteroskedasticity problem; to address it, the sample was curtailed to 1964-2007. Likewise, heteroskedasticity (at a 5% significance level) was present in the case of Italy and the UK even after the inclusion of dummy variables; the problem was addressed by obtaining Huber-White heteroskedasticity-robust standard errors.

Table 1 – *Linear trend regressions with AR terms*

	Trend	Model	Adj. R^2	Normality	Serial correlation	Heterosk.	ARCH	Dummy variable	Dummy variable	Dummy variable date
Australia	-0.0001 (0.986)	AR(1)	0.81	0.837 (0.658)	0.231	0.137	0.356	-0.15 (0.000)	-0.149 (0.000)	D(1974=1, 1982=1)
Austria	-0.0071 (0.299)	AR(1)	0.92	1.951 (0.377)	0.433	0.198	0.234	0.144 (0.013)		D(1 before 1978)
Belgium	0.0002 (0.969)	AR(2)	0.86	3.832 (0.147)	0.946	0.603	0.874	-0.106 (0.004)		D(1981=1)
Canada	**-0.0079** (0.003)	AR(2)	0.87	0.168 (0.919)	0.781	0.291	0.843			
Denmark	-0.0034 (0.419)	AR(1)	0.9	0.485 (0.785)	0.199	0.87	0.776	0.157 (0.012)		D(1 before 1974)
Finland	0.0094 (0.197)	AR(2)	0.91	1.033 (0.597)	0.123	0.628	0.867	-0.114 (0.017)	-0.156 (0.009)	D(1975-76=1, 1991=1)
France	-0.0001 (0.988)	AR(2)	0.9	2.423 (0.298)	0.409	0.247	0.367			
Greece	**0.0225** (0.071)	AR(1)	0.94	2.714 (0.257)	0.323	0.188	0.604	-0.099 (0.013)		D(1974=1)
Ireland	0.0142 (0.31)	AR(2)	0.94	0.729 (0.694)	0.217	0.077	0.319			
Italy	0.0028 (0.619)	AR(2)	0.9	0.269 (0.874)	0.216	0.0304	0.58	-0.179 (0.000)	-0.176 (0.012)	D(1975=1, 1979-80=0)
Japan	-0.0262 (0.127)	AR(2)	0.98	0.27 (0.873)	0.466	0.471	0.94	0.142 (0.026)		D(1 before 1971)
Luxembourg	0.0267 (0.223)	AR(3)	0.9	0.091 (0.956)	0.424	0.05	0.636	-0.824 (0.000)		D(1 after 1975)
Netherlands	**0.0139** (0.000)	AR(1)	0.93	3.946 (0.139)	0.184	0.549	0.471			

(*continues*)

(*continued*)

	Trend	Model	R^2 adj	Normality	Serial correlation	Heteroskeda sticity	ARCH	Dummy variable	Dummy variable	Dummy variable date
New Zealand	0.0077	AR(1)	0.8	0.515	0.359	0.11	0.034	-0.106		D(1972=0)
	(0.130)			(0.773)				(0.052)		
Norway	**0.0278**	AR(2)	0.95	1.188	0.104	0.791	0.265			
	(0.000)			(0.552)						
Portugal	**-0.0221**	AR(2)	0.91	0.056	0.551	0.07	0.207	-0.277		D(1975=1)
	(0.007)			(0.972)				(0.000)		
Spain	-0.0028	AR(2)	0.9	3.299	0.453	0.151	0.289			
	(0.654)			(0.192)						
Sweden	0.009	AR(2)	0.91	0.011	0.91	0.536	0.741	0.123		D(1 after 1978)
	(0.133)			(0.994)				(0.089)		
Switzerland	**-0.0142**	AR(2)	0.92	0.625	0.678	0.779	0.386	-0.137		D(1975=1)
	(0.036)			(0.732)				(0.004)		
UK	0.0012	AR(2)	0.86	2.372	0.952	0.003	0.674	-0.149		D(1974-75=1)
	(0.707)			(0.305)				(0.000)		
USA	**-0.0074**	AR(1)	0.83	2.323	0.689	0.717	0.614			
	(0.003)			(0.313)						

Notes: statistically significant trend coefficients are highlighted in bold; the values in parentheses are *p*-values. For normality tests, the Jarque-Bera values and respective *p*-values (in parentheses) are presented. The reported autocorrelation and heteroskedasticity tests are respectively the Breusch-Godfrey Serial Correlation LM test, and the White test. For Denmark, the estimates are performed on a curtailed sample (1964-2007) using the Prais-Winsten procedure. For Austria and Japan, the ARMA generalised least squares method is used, instead of conditional least squares. For Italy and the UK, Huber-White heteroskedasticity-consistent standard errors were obtained for the correct interpretation of coefficients in the presence of heteroskedasticity.

A positive trend was observed in 11 cases (Belgium, Finland, Greece, Ireland, Italy, Luxembourg, the Netherlands, New Zealand, Norway, Sweden and the UK). Statistically significant positive trend coefficients were, however, only present for Greece (at 10% significance level), the Netherlands and Norway (at a 5% level). A negative trend was observed in 10 cases (Australia, Austria, Canada, Denmark, France, Japan, Portugal, Spain, Switzerland, and the USA). A statistically significant negative trend coefficient was present for Canada, Portugal, Switzerland and the USA (at a 5% significance level). With regards to Austria and Japan, trend coefficients were insignificant irrespective of the estimation method. The estimates suggest that profit rates rose by 2.3%, 1.4% and 2.8% per annum over the study period in Greece, the Netherlands and Norway respectively. Profit rates declined by 0.8%, 2.2%, 1.4% and 0.7% per annum in Canada, Portugal, Switzerland and the USA over the studied period.

Table 2 contains the suggested dates of the structural breaks in the series obtained from the four alternative tests. The negative or positive sign in parentheses represented a fall (or rise) in the series. We note that the fact that the Bai-Perron procedure is more systematic and robust than the four other tests confirms the timing of the breaks and instabilities in the series. The Bai-Perron method of sequential testing of I+1 versus I breaks points to the same breaks as the Quandt-Andrews test, and suggests an additional break in 1990 in the Netherlands, in 1999 in Austria and in 1974 in Portugal. Compared to residuals, recursive residuals and N-step forecasts, the Bai-Perron procedure indicates at least one similar break in all economies, except Austria, Canada, Denmark, France, Norway and Portugal. In these latter economies, however, the location of the break was quite close to the actual one.

The four tests combined indicate up to three possible instabilities for most of the economies. These instabilities are clustered in three periods – the mid-1970s, early 1980s and late 2000s, with most of the residuals in these periods being negative. The negative residuals from the mid-1970s can be attributed to the first oil shock, the collapse of the Bretton-Woods system, stagflation and the worldwide recession. Negative residuals in 2009-2010 reflect the Global Financial Crisis,

Table 2 – *Tests of breaks and instabilities in profit rate series*

	Recursive residuals	N-step forecasts	Residuals	Quandt-Andrews
Australia	1974(-), 1978-9(+)	1974(-)	1974(-), 1982(-), 1983(+)	1984
Austria			1971(+), 1975(-), 1978(-)	1974
Belgium	1975(-), 1991(-)	1975(-)	1975(-), 1981(-), 1991(-)	1974
Canada	1982(-), 1994(+)		1982(-), 1983(+), 1994(+)	1976
Denmark	1977-8(+)	1977-8(+)	1974(-), 1977-8(+), 1994(+)	1971
Finland	1974-5(-), 1997(+)	1975(-), 1997(+)	1975(-), 1990-1(-)	1997
France	1975(-), 1982(+)	2009(-)	1974-5(-), 1983(-)	1973
Greece	1974(-), 1988(+)	1974(-)	1974(-), 1988(+), 1991(+)	1993
Ireland	1974(-), 1987(+)	1974(-), 1987(+)	1974(-), 1980(-), 1994(+)	1995
Italy	1975(-), 1979(+)	1975(-)	1975(-), 1979(+)	1979
Japan	1972(+), 1985(+)		1971(-), 1974(-), 1985(+)	1974
Luxembourg	1975(-), 1977(-)	1975(-)	1969(+), 1975(-), 1977(-)	1984
Netherlands	1976(+), 1994(+)		1974-5(-), 1976(+), 1994(+)	1984
New Zealand	1972(+), 1983(+)	1972(+), 1983(+)	1969(+), 1972(+), 1974(-)	1989
Norway	1975(-), 1979(+)		1975(-), 1979(+), 1986(-)	1993
Portugal	1974-5(-)		1974-5(-)	2000
Spain	1980(+), 1997(-)	1980(+)	1980(+), 1981(-), 1997(-)	1971
Sweden	1973(+), 1976-7(-), 1982(+)		1973(+), 1976-7(-), 1982(+)	1994
Switzerland	1976(+), 1989(+)	1975(-1)	1975(-), 1989(+), 2001(-)	1975
UK	1974(-), 1978-9(+)		1972-5(-), 1976(+)	1983
USA	1971(+), 1980(-), 1994(+)		1980(-), 1982(-), 1994(+)	1970

Notes: for Denmark, the estimates are performed on a curtailed sample (1964-2007).

while instabilities in the early 1980s reflect the recession of the early 1980s, the rejection of Keynesian economic policies, and certain financial crises (Latin American debt crisis, and the savings and loans crisis in the USA). The number of breaks associated with the Great Recession of the late 2000s was much smaller. Importantly, the breaks occurring in the 1970s were in most cases due to the fall in the profit rates; in general, adverse economic events and developments resulted in negative residuals and fall in series.

In addition, country-specific factors were prominent. In Australia, the 1982-1983 dummy variable corresponds to the beginning of economic deregulation, trade liberalisation and the movement towards a flexible exchange rate system undertaken by the Fraser and Hawke governments.

In Belgium, the 1991 dummy variable corresponds to the economic recession of the early 1990s (the worst since the end of WWII), as well as to the negative institutional characteristics not conducive to economic growth, epitomised as Eurosclerosis - over-regulation, rigid wages, excessive unemployment protection compensation (Giersch, 1985; Kuhn, 2002, p. 471).

In Finland, the 1990 dummy reflects the breakup of COMECON and the Soviet Union, and the demise of Finland’s foreign trade with its Eastern European partners. The dummy variables for the USA (1980, 1982 and 1983-1984) relate to the beginning of the Reagan presidency and the onset of a set economic policies known as Reaganomics, as well as to the deep recession of the early 1980s. In Norway, the 2000 dummy variable reflects the period of low oil prices that affected the Norwegian petroleum sector. The impulse dummies in Greece (1974, 1988, 1991), Spain (1975, 1984) and Portugal (1975) can be attributed to the political transition to democracy that took place in the mid-1970s (demise of regimes of Franco, Salazar and the “regime of the colonels”), as well as accession to the European Community (the case of Spain in mid-1980s) and its broad implications. In Italy, the 1979 dummy reflects the deep political crisis during the 1979 general elections.

The dummy variables to be used in the autoregressive ADF model are presented in table 3; dummy variables are respectively set at 1 or 0 to correct structural changes. We note that if the structural shifts were modelled, the dummy variables were set greater or smaller than one after the specific date of the shift.

Table 3 – *Dummy variables in autoregressive ADF model*

	Dummy variables		Dummy variables
Australia	1974=1, 1983=0	**Luxembourg**	1975=1, 1977=1, 1981=1
Austria	1975=1, 1978=1	**Netherlands**	1975=1, 1994=0
Belgium	1975=1, 1991=1	**New Zealand**	1972=0, 1983=0
Canada	1982=1	**Norway**	1975=1
Denmark	1974=1	**Portugal**	1975=1
Finland	1975=1, 1990-1991=1	**Spain**	1997=1
France	1975=1	**Sweden**	1976-1977=1
Greece	1974=1, 1988=0, 1991=0	**Switzerland**	1975=1
Ireland	1974=1	**UK**	1972-1975=1
Italy	1975=1, 1979=0	**USA**	1980=1
Japan	No dummies		

Notes: for Denmark, the estimates are performed on a curtailed sample (1964-2007).

Tables 4 and 5 present the estimates from the autoregressive ADF model, the first table with no structural breaks, and the second with breaks (in the form of impulse or structural shifts). In all cases, we ensured that the coefficient of the lagged variable $\ln\pi_{t-1}$ has a negative sign. To address possible serial correlation, additional lag terms of $\Delta\ln\pi_{t-1}$ were included (irrespective of its significance). We also ensured that included dummy variables are statistically significant.

In the autoregressive ADF model without dummy variables (table 4), the trend was statistically significant in the case of Canada, Norway and the USA, with profit rate series falling by 0.79% and 0.67% per annum respectively in Canada and the USA during the 1964-2008 period. In Norway, profit rates rose by 2.78% per annum over the 1964-2007 period. For the other countries in question, the trend rate was not estimated due to the insignificance of the trend coefficient. Likewise, using Dickey-Fuller critical values, the coefficient of $\ln\pi_{t-1}$ term was significant only for the USA, while using conventional *t*-statistics critical values it was also significant for Canada and Norway..

Table 4 – *Results of autoregressive ADF estimation with no dummy variables*

	Constant	t	$ln\pi_{t-1}$	$\Delta ln\pi_{t-1}$	$\Delta ln\pi_{t-2}$	Adj. R^2	Serial Corr.	Heterosk.	ARCH	Normality	Trend (%)
Canada	0.767	-0.0018	-0.227	0.417		0.18	0.781	0.291	0.843	0.168	-0.79
	(0.011)	(0.042)	(-2.718)	(0.008)						(0.919)	
France	0.278	0.0000	-0.093	0.355		0.15	0.409	0.247	0.367	2.423	X
	(0.065)	(0.988)	(-1.998)	(0.026)						(0.298)	
Ireland	0.183	0.0013	-0.07	0.518	-0.207	0.2	0.343	0.241	0.268	0.299	X
	(0.163)	(0.271)	(-1.607)	(0.003)	(0.217)					(0.861)	
Norway	0.37	0.0049	-0.178	0.41		0.21	0.104	0.791	0.265	1.189	2.78
	(0.012)	(0.014)	(-2.692)	(0.008)						(0.552)	
Spain	0.326	-0.0003	-0.109	0.364		0.18	0.453	0.151	0.289	3.299	X
	(0.045)	(0.675)	(-2.203)	(0.017)						(0.192)	
USA	1.39	-0.003	-0.441	0.123	0.234	0.21	0.95	0.934	0.496	4.000	-0.67
	(0.001)	(0.013)	(-3.742)	(0.415)	(0.123)					(0.136)	

Notes: values in parentheses include p-values, and for the $\ln\pi_{t-1}$ term they include t-ratios. For the normality test, Jarque-Bera values and the respective p-values (in parentheses) are reported. The autocorrelation and heteroskedasticity tests reported are respectively the Breusch-Godfrey Serial Correlation LM Test, and the White test. For Denmark, the estimates are performed on a curtailed sample (1964-2007).

Table 5 – *Results of autoregressive ADF estimation with dummy variables*

	Constant	*t*	$ln\pi_{t-1}$	$\Delta ln\pi_{t-1}$	Dummy1	Dummy2	Dummy timing	Adj. R^2	Serial corr	Heterosk.	ARCH	Normality	Trend (%)
Australia	0.319	-0.0005	-0.103	0.079	-0.213	0.17	D (1974=1)	0.36	0.357	0.188	0.857	0.127	X
	(0.225)	(0.552)	(-1.177)	(0.557)	(0.001)	(0.006)	D (1983=1)					(0.938)	
Austria	0.267	0.0005	-0.098	-0.153	-0.149	-0.149	D (1975=1)	0.41	0.342	0.837	0.696	0.651	X
	(0.059)	(0.450)	(-2.219)	(0.246)	(0.002)	(0.002)	D (1978=1)					(0.722)	
Belgium	0.253	6.1E-05	-0.093	0.22	-0.16	-0.144	D (1975=1)	0.32	0.908	0.693	0.445	4.007	X
	(0.11)	(0.931)	(-1.696)	(0.106)	(0.006)	(0.013)	D (1991=1)					(0.135)	
Denmark	0.295	-0.0019	-0.083	0.191	-0.065		D (0 from 1975)	0.17	0.102	0.422	0.232	1.521	-2.33
	(0.273)	(0.069)	(-0.959)	(0.222)	(0.101)							(0.467)	
Finland	0.466	0.0018	-0.184	0.465	-0.285	-0.239	D(1975=1)	0.61	0.955	0.027	0.298	2.52	X
	(0.000)	(0.132)	(-4.739)	(0.001)	(0.000)	(0.000)	D(1990-1=1)					(0.284)	
Greece	0.502	0.004	-0.188	0.077	0.096		D (0 from 1974)	0.15	0.157	0.108	0.617	0.469	2.13
	(0.011)	(0.011)	(-2.837)	(0.622)	(0.051)							(0.791)	
Italy	0.578	0.0001	-0.097	0.032	-0.261	-0.29	D (1975=1)	0.66	0.116	0.176	0.869	0.531	X
	(0.001)	(0.824)	(-1.65)	(0.744)	(0.000)	(0.000)	D (1979=0)					(0.767)	
Japan	0.403	-0.0004	-0.171	0.408	0.129		D (0 from 1974)	0.35	0.743	0.733	0.465	1.169	X
	(0.114)	(0.849)	(-2.03)	(0.013)	(0.056)							(0.557)	
Luxembourg	0.616	0.0029	-0.222	0.192	-0.697	-0.675	D (1975=1)	0.67	0.588	0.022	0.821	0.099	X
	(0.003)	(0.195)	(-2.71)	(0.031)	(0.000)	(0.000)	D (1977=1)					(0.951)	
Netherlands	0.215	-0.0002	-0.084	0.105	0.071		D (1 from 1976)	0.24	0.826	0.772	0.675	1.985	X
	(0.334)	(0.881)	(-1.106)	(0.473)	(0.010)							(0.371)	

(*continues*)

(*continued*)

	Constant	t	lnπt-1	Δlnπt-1	Dummy1	Dummy2	Dummy timing	Adj. R2	Serial corr	Heterosk.	ARCH	Normality	Trend (%)
New Zealand	0.849	0.0019	-0.166	0.163	-0.226	-0.132	D (1972=0)	0.33	0.883	0.1	0.395	0.746	1.12
	(0.001)	(0.046)	(-2.165)	(0.229)	(0.001)	(0.046)	D (1983=0)					(0.689)	
Portugal	0.637	-0.0052	-0.177	0.195	-0.371		D (1974-5=1)	0.53	0.774	0.13	0.132	2.228	-2.92
	(0.008)	(0.002)	(-2.645)	(0.094)	(0.000)							(0.329)	
Sweden	0.172	-0.0016	-0.072	0.345	0.097		D (1 from 1978)	0.3	0.816	0.264	0.512	0.948	X
	(0.445)	(0.487)	(-0.856)	(0.029)	(0.069)							(0.622)	
Switzerland	1.053	-0.0039	-0.462	0.545	0.176		D (0 from 1975)	0.32	0.481	0.575	0.704	4.697	-0.83
	(0.001)	(0.067)	(-3.607)	(0.001)	(0.010)							(0.095)	
UK	0.386	-0.0018	-0.125	0.175	0.088		D (1 from 1976)	0.3	0.102	0.178	0.628	5.195	-1.46
	(0.106)	(0.069)	(-1.779)	(0.235)	(0.005)							(0.074)	

Notes: values in parentheses include p-values and t-ratios (indicated in bold for $\ln\pi_{t-1}$ term). For normality test, Jarque-Bera values and respective p-values (in parentheses) are presented. Autocorrelation and heteroskedasticity tests are Breusch-Godfrey Serial Correlation LM Test, and White test respectively. For Denmark, the estimates are performed on a curtailed sample (1964-2007). For Finland and Luxembourg, Huber-White heteroskedasticity-consistent standard errors were obtained for the correct interpretation of coefficients in the presence of heteroskedasticity.

We therefore concluded that in these economies, profit rates followed non-zero deterministic trend models with series reverting to the trend after short disturbances ($\beta \neq 0$, $\gamma < 0$). With regards to other economies, the coefficient of $\ln\pi_{t-1}$ was significant at 5% t-statistics critical value in France and Spain, suggesting that series in these economies reverted to a historical mean ($\beta = 0$, $\gamma < 0$). In Ireland, series followed a random walk with zero mean ($\beta = 0$, $\gamma = 0$).

The ADF model's results fall in line with estimates of the linear trend in Table 1, both in terms of significance and the sign of the trend. Both models suggest that profit rates deteriorated following a negative deterministic trend in Canada and the USA and following a positive deterministic trend in Norway. In the case of France, Ireland and Spain, the ADF model confirmed that the results of the linear trend model pointed to the absence of a deterministic trend and suggested either mean reversion or random walk as alternatives

The ADF model with dummy variables (table 5) showed statistically significant trends in Denmark, Greece, Portugal, Switzerland and the UK, with profit rates deteriorating by 2.33%, 2.92%, 0.83% and 1.46% per annum in Denmark, Portugal, Switzerland and the UK over the examined periods. In Greece, profit rates increased by 2.13% per annum over the 1965-2008 period. The coefficient of the $\ln\pi_{t-1}$ term was significant in Finland, New Zealand and Switzerland (using Dickey-Fuller critical values), and in Austria, Belgium, Greece, Japan, Luxembourg and Portugal (using t-statistics with a 5% critical value). We thus conclude that profit rates in Greece, Portugal and Switzerland have been following a non-zero deterministic trend with likely reversion to trend after disturbance ($\beta \neq 0$, $\gamma < 0$). The deterministic trend was positive in Greece and negative in the other two economies. Series in Austria, Belgium, Finland, Japan, Luxembourg and New Zealand were likely to revert to a historical mean ($\beta = 0$, $\gamma < 0$). Profit rates in Australia, Italy, the Netherlands and Sweden have been following a random walk with a zero mean ($\beta = 0$, $\gamma = 0$), while series in Denmark and the UK were likely to follow the stochastic trend (random walk with drift), as $\beta \neq 0$ but $\gamma = 0$. In both

Denmark and the UK $\beta < 0$; this suggests that profit rates were likely to decline in the future relative to the current level.

The comparison between the autoregressive ADF model and the linear trend model (table 1) demonstrates similarity in results for most of the economies: Australia and Sweden (with a negative but insignificant trend with series exhibiting random walk); Austria and Japan (with a negative but insignificant trend with series reverting to historical mean); Belgium, Finland, Italy, Luxembourg and New Zealand (with a positive but insignificant trend with series reverting to a historical mean or, in the case of Italy, following random walk with a zero mean); Denmark and the UK (with a positive or negative insignificant trend with series following stochastic trends); Greece (with a positive and significant trend in both models); and Portugal and Switzerland (with a negative and significant trend in both models). For the Netherlands, results are contradictory. While the linear trend model suggests a statistically significant positive deterministic trend, the autoregressive ADF model indicates random walk behaviour with a zero mean.

The presence of inconsistencies in certain results as well as the low power of the ADF test necessitated the use of unit root tests with structural breaks. Results are presented in tables 6 and 7.

The tests were run on the log of profit rate series, allowing for a maximum of 8 lag terms. According to the ZA test (models with trend, intercept, and more general models with both trend and intercept), the trend stationarity hypothesis is accepted only for Canada (a model with intercept), whereas in all other cases series were likely to contain unit roots. According to the LP test (using the same types of models as in the ZA test), trend stationarity is accepted for Italy and Portugal (a trend with intercept), Spain (a trend with intercept as well as trend models), and the USA (a model with intercept).

Based on LS tests (1 or 2 breaks in the series), trend stationarity with break was expected for a larger number of series, excluding those of France, Italy, Luxembourg, the Netherlands, New Zealand, Sweden, Switzerland and the UK.

Table 6 – *Results of Zivot-Andrews and Lumsdaine-Papell unit root tests with structural breaks*

	Zivot-Andrews test						Lumsdaine-Papell test					
	Trend + Intercept		**Trend**		**Intercept**		**Trend + Intercept**		**Trend**		**Intercept**	
Australia	-2.874	0	-2.921	0	-3.428	0	-4.596	0	-4.504	0	-4.056	0
Austria	-4.746	0	-4.427	0	-4.418	0	-5.498	0	-5.704	0	-4.7	0
Belgium	-3.59	1	-2.737	1	-3.193	1	-5.41	1	-5.909	1	-4.893	1
Canada	-3.684	1	-2.984	1	**-4.855**	1	-5.729	5	-5.113	5	-4.957	5
Denmark	-2.892	1	-2.731	1	-3.417	1	-5.5	3	-4.885	3	-4.176	3
Finland	-3.796	1	-3.599	1	-4.1	1	-5.499	1	-4.112	1	-5.58	1
France	-2.34	1	-2.28	1	-3.364	1	-4.202	1	-4.107	1	-4.363	1
Greece	-2.497	3	-3.236	3	-3.607	3	-5.034	3	-5.661	3	-3.518	3
Ireland	-2.513	5	-2.489	5	-4.075	5	-4.893	5	-4.52	5	-5.332	5
Italy	-4.711	0	-2.187	0	-3.097	0	**-6.805**	0	-4.47	0	-4.974	0
Japan	-2.918	1	-2.914	1	-2.169	1	-5.267	1	-4.881	1	-3.5	1
Luxembourg	-4.077	0	-2.676	0	-3.804	0	-5.61	6	-5.696	6	-3.734	6
Netherlands	-3.807	8	-3.602	8	-4.407	8	-5.614	8	-4.883	8	-5.508	8
New Zealand	-2.821	1	-2.765	1	-3.233	1	-6.128	1	-4.67	1	-4.374	1
Norway	-2.398	7	-2.781	7	-2.984	7	-3.626	7	-3.306	7	-4.006	7
Portugal	-3.02	2	-2.281	2	-3.357	2	**-6.758**	1	-5.534	1	-4.657	1
Spain	-3.048	4	-3.051	4	-3.861	4	**-9.203**	4	**-6.432**	4	-4.963	4
Sweden	-3.945	1	-3.56	1	-3.946	1	-5.443	1	-4.379	1	-4.637	1
Switzerland	-4.107	1	-3.901	1	-4.114	1	-5.395	1	-4.198	1	-4.33	1
UK	-3.804	1	-2.943	1	-4.05	1	-4.435	5	-4.858	5	-3.998	5
USA	-4.672	2	-3.864	2	-4.385	2	-5.953	2	-5.481	2	**-6.036**	2

Notes: for Denmark, the estimates are performed on a curtailed sample (1964-2007). The identified break dates are: 1994 for Canada; 1978 and 2001 for Italy; 1973 and 1993 for Portugal; 1980, 1989 and 1990 for Spain; and 1983 and 1993 for the USA. Values in bold indicate trend stationarity with break(s).

Table 7 – *Results of Lee-Strazicich unit root tests with structural breaks*

	Lee-Strazicich (2004)		Lee-Strazicich (2003)	
Australia	-2.679	8	**-5.641**	8
Austria	**-5.762**	7	**-6.322**	7
Belgium	-3.729	6	**-6.565**	5
Canada	-4.104	5	**-5.772**	5
Denmark	-2.986	6	**-6.149**	8
Finland	**-4.641**	1	-5.306	1
France	-3.389	6	-4.31	1
Greece	-3.504	8	**-7.163**	5
Ireland	-3.76	5	**-6.303**	1
Italy	-3.96	3	-5.304	7
Japan	-3.357	3	**-6.117**	5
Luxembourg	-4.116	6	-5.524	1
Netherlands	-4.017	8	-4.871	6
New Zealand	-3.641	4	-5.323	1
Norway	-4.296	6	**-6.009**	6
Portugal	**-4.683**	1	**-7.395**	6
Spain	-2.835	4	**-5.775**	1
Sweden	-4.072	3	-4.969	1
Switzerland	-3.554	1	-5.305	4
UK	-2.965	5	-5.133	6
USA	-3.653	2	**-7.277**	6

Notes: For Denmark, the estimates are performed on a curtailed sample (1964-2007). Values in bold indicate trend stationarity with break(s).

In cases in which trend stationarity was expected, the linear trend model was re-estimated with breaks suggested by ZA, LP and LS tests (in either impulse or shift form). We must bear in mind that these tests are not tests for the presence of a structural break, that the inclusion of these break dates does not necessarily allow for normality (or absence of heteroskedasticity), and that break dates may not correspond to actual economic events or developments. The results of the modified linear trend model are presented in tables 8 and 9.

Table 8 – *Linear trend regressions with Zivot-Andrews and Lumsdaine-Papell dummy variables*

	Constant	Trend	Dummy variable	Dummy 1	Dummy 2	Model	Adj. R^2	Normality	Serial Corr.	Heterosk.	ARCH
Canada	3.397	-0.0081	D (1994=1)	0.065		AR(2), ZA	0.89	0.461	0.998	0.56	0.244
	0.000	0.003		0.016				0.794			
Canada	3.385	-0.0071	D (1 from 1994)	-0.027		AR(2), ZA	0.87	0.247	0.851	0.615	0.944
	0.000	0.029		0.605				0.884			
Italy	2.796	-0.0029	D (1 from 1978)	0.324	0.047	AR(1), LP	0.85	138.184	0.566	0.821	0.671
	0.000	0.618	D (0 from 2002)	0.000	0.44			0.000			
Italy	2.909	-0.0046	D (1 from 1978)	0.291	-0.179	AR(2), LP	0.93	0.666	0.711	0.639	0.266
	0.000	0.298	D (1975=1)	0.000	0.000			0.717			
Portugal	3.413	-0.0221	D (1975=1)	-0.277		AR(2), LP	0.91	0.056	0.551	0.07	0.207
	0.000	0.007		0.000				0.972			
Portugal	3.532	-0.0256	D (1975=1)	-0.335	-0.082	AR(1), LP	0.91	0.016	0.171	0.099	0.003
	0.000	0.029	D (0 after 1993)	0.000	0.408			0.992			
Spain	3.003	0.0002	D (1 from 1980)	-0.116	0.03	AR(2), LP	0.91	4.685	0.157	0.083	0.615
	0.000	0.975	D (0 after 1989)	0.023	0.53			0.096			
Spain	3.052	-0.001	D (1 from 1980)	-0.115	-0.003	AR(2), LP	0.91	4.054	0.165	0.056	0.641
	0.000	0.889	D (0 from 1990)	0.026	0.943			0.132			
USA	3.278	-0.0178	D (1 after 1983)	0.142	0.168	AR(1), LP	0.87	0.732	0.336	0.081	0.226
	0.000	0.000	D (1 after 1993)	0.003	0.000			0.693			

Table 9 – *Linear trend regressions with Lee-Strazicich dummy variables*

	Constant	Trend	Dummy variables	Dummy 1	Dummy 2	Model	Adj. R^2	Normality	Serial Corr.	Heterosk.
Australia	2.934	0.002	D (1 in 1981)	0.028	-0.029	AR(1), LS 2003	0.67	4.446	0.714	0.474
	0.000	0.711	D (1 in 1993)	0.597	0.581			0.108		
Austria	2.459	0.0099	D (1 in 1986)	-0.006	0.042	AR(1), LS 2003	0.91	3.071	0.901	0.156
	0.000	0.457	D (1 in 1992)	0.866	0.279			0.215		
Austria	2.481	0.0094	D (1 after 1986)	-0.007		AR(1), LS 2004	0.91	2.962	0.843	0.083
	0.000	0.461		0.866				0.227		
Belgium	2.541	0.0039	D (1 in 1979)	0.018	-0.011	AR(1), LS 2003	0.84	5.064	0.193	0.728
	0.000	0.61	D (1 in 1987)	0.707	0.814			0.079		
Canada	3.397	-0.008	D (1 in 1986)	-0.015	0.036	AR(2), LS 2003	0.87	0.198	0.752	0.481
	0.000	0.003	D (1 in 2000)	0.611	0.219			0.906		
Denmark*	3.075	-0.0055	D (1 in 1982)	0.014	0.025	AR(1), LS 2003	0.88	3.286	0.104	0.896
	0.000	0.269	D (1 in 1997)	0.764	0.589			0.193		
Finland	2.329	0.0106	D (0 in 1996)	0.076		AR(2), LS 2004	0.89	13.488	0.172	0.688
	0.000	0.139		0.156				0.001		
Greece	2.389	0.0247	D (1 after 1982)	-0.041	0.046	AR(1), LS 2003	0.93	10.692	0.671	0.162
	0.000	0.063	D (0 after 1998)	0.504	0.458			0.005		
Ireland	2.684	0.0113	D (1 after 1983)	0.078	-0.029	AR(2), LS 2003	0.94	0.561	0.247	0.098
	0.000	0.439	D (1 in 1998)	0.32	0.537			0.755		
Japan	3.472	-0.029	D (1 in 1983)	-0.011	0.017	AR(2), LS 2003	0.98	0.645	0.787	0.181
	0.000	0.153	D (1 in 1996)	0.785	0.662			0.725		

(*continues*)

(*continued*)

	Constant	Trend	Dummy variables	Dummy 1	Dummy 2	Model	Adj. R2	Normality	Serial Corr.	Heterosk.
Norway	2.015	0.0279	D (1 in 1982)	-0.042	-0.049	AR(2), LS 2003	0.95	0.581	0.166	0.302
	0.000	0.000	D (1 in 1998)	0.384	0.318			0.748		
Portugal	3.552	-0.027	D (1 after 1983)	0.075	-0.15	AR(1), LS 2003	0.86	150.679	0.106	0.975
	0.000	0.002	D (0 after 1989)	0.537	0.268			0.000		
Portugal	3.433	-0.0202	D (0 in 1986)	-0.07		AR(2), LS 2004	0.86	76.358	0.137	0.238
	0.000	0.005		0.352				0.000		
Spain	3.035	-0.0083	D (1 in 1986)	0.168	-0.01	AR(2), LS 2003	0.93	7.683	0.691	0.191
	0.000	0.163	D (1 after 1979)	0.000	0.698			0.021		
USA	3.154	-0.0075	D (1 in 1978)	-0.037	0.019	AR(1), LS 2003	0.82	3.096	0.568	0.947
	0.000	0.005	D (0 in 1995)	0.401	0.677			0.212		

The trend model with breaks from ZA and LP tests (table 8) demonstrates that the coefficient of the trend was not significant in the case of Italy and Spain, thereby confirming the earlier result of the absence of a deterministic trend in these countries' profit rates. In contrast, trend coefficient was significant for Canada, Portugal and the USA.

With regards to trend models with breaks from LS tests (table 9), trend coefficients were significant for Canada, Portugal and the USA (negative trend), as well as for Greece and Norway (positive trend). This again is in concordance with the results of the ADF and linear trend models.

4. Conclusions

This paper attempted to contribute to the empirical debate on the direction of economy-wide profit rates in developed economies. It employed comparable data from national accounts spanning a period of 5 decades. It employed a battery of econometric tests and techniques: the linear trend model with autoregressive terms and dummy variables; tests for the presence of structural breaks; the augmented Dickey-Fuller (ADF) model of a general form with and without dummy variables; the Zivot-Andrews (ZA), Lumsdaine-Papell (LP) and Lee-Strazicich (LS) unit root tests with structural breaks; the linear trend model with dummy variables based on breaks from these tests.

The results demonstrated substantial consistency across the tests that have been conducted, as well as consistency between these tests and the visual observation of the data. Specifically, the conventional linear trend model suggested a negative deterministic trend for Canada, Portugal, Switzerland and the USA, and a positive deterministic trend for Greece, Netherlands and Norway. Two versions of autoregressive ADF models also demonstrated deterministic trends for these economies with the exception of the Netherlands. Linear trend models based on ZA, LP and LS fully confirmed the autoregressive ADF model's results (with Switzerland being the exception). Other economies had non-deterministic changes in their rates of profit.

Overall, the secular decline in profit rates took place in Canada, the USA and Portugal, arguably supporting Marx's hypothesis of the tendency of the profit rate to fall along a deterministic trend. For the US it confirms earlier results by Basu and Manolakos (2010). Some support for the hypothesis could be provided by the profit rates in Netherlands, but only if the linear trend model is considered in isolation from other tests. Likewise, the case of Switzerland supports the secular decline hypothesis, but only if the results of the ZA, LP and LS tests are disregarded. Greece and Norway display a secular rise in profit rates, and this result is in sharp contrast with the classical hypothesis. In the first case this could be attributed to the rapid transformation of the economy in the 1960-1980s from a relatively low level; in the second case, the increase in economy-wide profit could have been boosted by the growth of the oil sector. In Portugal, profit rates seemed to follow a specific pattern of secular decline interrupted by crises, with rates emerging lower after every crisis (a phenomenon known as stepwise decline).

Considering Denmark and the UK, profit rates in these economies appear to have experienced a random walk with drift, indicating stochastic trends and long waves and thereby giving some support to the hypothesis of cyclical movements in profit rates. This has to be confirmed formally by isolating a cyclical component in the series. As for Denmark, the stochastic trend result was obtained with series that were trimmed due to heteroskedasticity; the result contradicts visual inspection of the data, as well as the LS test. The autoregressive model also indicates a significant and negative trend coefficient. If full series were considered, it could arguably display a negative deterministic trend, thus confirming the secular decline hypothesis.

For the group of economies where profit rates followed a random walk with zero mean (Australia, Ireland, Italy and Sweden), the hypothesis of Kaldor-like stability/stationarity has not been tested (this could have been achieved by carrying out an ADF test with no trend). It is, however, possible to estimate the innovation variance of the random walk component (Cochrane, 1988, p. 895) and thereby select the series with the smallest random walk component. Overall, based on the performed tests, we argue that profit rates in these economies give no support to either the secular decline or the decline with cyclical component hypotheses.

Those economies that experienced reversion of profit rates to historical means (Austria, Belgium, Finland, France, Japan, Luxembourg, New Zealand and Spain) are likely to demonstrate cases of restorative crises, in which previous declines in profit rates are reversed, partially or substantially. This case neither supports nor contradicts the secular decline hypothesis; more definitive conclusions would require longer series to investigate on. A similar observation may be made regarding countervailing factors that are presumed to operate in the medium and long run (Shaikh, 1992).

Overall, the behavior of profit rates has proven to be rather diverse, therefore it is unlikely that "universal profit rates' laws" hold, or that only one hypothesis is correct.

The future research of profit rate dynamics may be pursued in the following directions. First of all, future analysis will have to address the wide diversity of profit rate patterns across economies (including the economies that are supposed to demonstrate similar profit rate dynamics) as well as similarities in profit rates' patterns between economies with different political economic and social settings. This paper has brought attention to some of the facts that require explanation – similar profit rate dynamics in closely integrated economies such as Canada's and the USA's, but rather different dynamics in closely related economies in Europe (such as Belgium's and Luxembourg's); different directions for profit rates in the formerly developing economies of Portugal and Greece; similarities in profit rate patterns in Greece and Norway. The type of analysis that would be needed requires looking at national forms of capitalism and unique constellations of factors in every economy in question. Alternatively, the analysis of a single factor (economic integration, or one of the countervailing factors, such as financialization, trade liberalization) in the rates of profit in a group of economies may be undertaken. These types of investigation would, allow the unpacking of the operation of countervailing tendencies and would explain how restorative crises work through the economic system.

Secondly, while the focus of this paper has been on developed economies, an alternative research avenue could be the study of profit rates in transition and developing economies (or the few remaining centrally planned economies), with a different set of factors likely to be salient and in those contexts, and could allow the discovery different patterns. Moreover, the dynamics of profit rates would clearly be diverse if sectoral or industrial profit rates were considered. With this in mind, it would be instructive to examine profit rates in the context of structural change or sectoral re-allocation of capital. Finally, future research may be carried in a "microeconomic" fashion, in line with the above-mentioned works by Farjoun and Machover (1983), i.e. by examining profit rates across firms, narrow industries, and by considering distributions of profit rates.

The findings presented in this paper were based on the national accounts. From a Marxist political economic perspective, this may constitute a limitation as far as the interpretation of the results and the mapping of theoretical frameworks are concerned. To change this to be more in line with a Marxist perspective might require methodological changes.

There is no perfect correspondence between national accounts' and Marxian variables (e.g. constant and variable capital, and surplus value). National accounts do not distinguish between productive and unproductive economic activities, something that is conventionally done in the Marxist political economy. The former corresponds to production and creation of new value, while the latter relates to re-circulation and use of already produced value (Maniatis, 1996, p. 38). Likewise no distinction is made between productive and unproductive labour (Baran and Sweezy, 1966, p. 141; Gough, 1972; Sweezy, 1962, p. 282; Tarbuck, 1983), the former defined specifically as labour that produces surplus value, thereby excluding from productive labour distribution and social maintenance labour (Basu, 2015, pp. 3-4;

Maniatis, 1996, p. 39). Additionally, a high level of aggregation of capital stock data in many instances may preclude distinction between the capital employed in various activities and the branches of production. These issues call for the need to construct "Marxian national accounts" prior to the analysis of profit rates in the Marxian formulation. A template for such an undertaking and a systematic review of related issues was presented by Shaikh and Tonak (1996): the data for "Marxian national accounts" would come from input-output tables (with detailed information on inputs, the value added, and the uses of output), national income and product accounts (information on persons engaged in production), as well as labour statistics (to separate productive and unproductive labour, and supervisory and production workers).

The above limitation has the following implications for analysis of profit rates. First of all, given that a large part of economic activity in developed economies is unproductive according to the Marxist formulation, the overall level of profit rate is likely to be overestimated. Secondly, unproductive activities, typically embodied in the services, tended to rise over the past decades, meaning that estimated falls in profit rates might become more drastic, and certain estimated increases might become less substantial. This is in line with Moseley's (1983) argument that the negative effects of the growing capital per worker on the profit rate can only be offset by increasing profits per worker: the latter would be tenuous since profits are generated by productive labour, while unproductive labour contributes to growing costs and does not generate any profits. A similar argument is put forward when it comes to the negative effects of a changing composition of capital stock (growing unproductive capital at the expense of productive capital) on the profit rate (Moseley, 1988, p. 302). Indeed, if adjustments for unproductive activities are made, a large part of the decline in profit can be explained: some support for this hypothesis, for instance, was found in the analysis of the US profit rate over the 1948-1989 period using "Marxian national accounts" data (Basu, 2015, p. 7; Shaikh, Tonak, 1994).

Also, the estimates in this paper were performed based on the assumption that all the available capital in the given economy (including older vintages) matters for determining the profit rate. Such postulates may prove erroneous if in a real economy the competition and investment processes are driven by profit rates on new capital only, a more realistic case. In this regard, an alternative measure of the profit rate would be advantageous, such as the incremental profit rate (defined as a change in gross profit divided by the lagged gross investment). Such a measure would also be invariant to the determination of fixed capital consumption, the estimation of the useful lifespans of capital, and the distinction between economic and book depreciation (Shaikh, 2016: pp. 67-68).

Finally, in contrast with the Marxist analysis that isolates productive economic activities (labour and capital) an opposite reformulation may be proposed, in line with a more encompassing view of value and production that is typical of organizational science, by looking at resource-based theories of production and the Austrian school of economics (Lockett and Thompson, 2001;Penrose, 1959). Given that in modern economies and particularly in service sectors the value added is determined by a large extent by human capital and intangible assets (McCloskey, 2014, pp. 88-89), future research could attempt to estimate the profitability of total capital, both tangible and intangible. This would, of course, constitute a grand theoretical and methodological project on its own.

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