Factor price convergence in OECD economies: the case of three profit rates indicators

Ivan D. Trofimov[1]

Resumo

Este artigo examina a convergência da taxa de lucro (taxas de retorno do capital) nas economias da OCDE nos períodos de 1960-2016 e subperíodos relevantes. Ele também compara a convergência das taxas de lucro em economias selecionadas desenvolvidas e em desenvolvimento, usando os dados para o período 1973-2003. As taxas de economia produtiva e de manufatura em toda a economia são estimadas e três conceitos de convergência são considerados (beta, sigma e convergência estocástica). Usamos uma combinação de modelos de séries temporais transversais e univariadas e análise de distribuição de densidade. Para cada medida de taxa de lucro, uma forte evidência de convergência beta é fornecida. Em contraste, a convergência sigma é indicada apenas no caso da taxa de lucro da economia produtiva; enquanto em outros casos, a divergência sigma ou a ausência de convergência ou divergência são prováveis. A convergência estocástica está presente em um número menor de economias e está confinada à economia produtiva e manufatura. A comparação da dinâmica de convergência em economias desenvolvidas versus em desenvolvimento confirmou a convergência beta em ambos os grupos e para seu agregado, mas não estabeleceu convergência sigma, dada a significativa diversidade de economias e suas diferentes trajetórias econômicas.

Palavras-chave

Taxas de lucro, Convergência, Raiz unitária

Abstract

This paper examines profit rate (rates of return to capital) convergence in OECD economies in the periods of 1960–2016 and relevant sub-periods. It also performs comparison of profit rates convergence in selected developed and developing economies, using the data for 1973-2003 period. Economy-wide, productive economy and manufacturing rates are estimated and three convergence concepts are considered (beta, sigma, and stochastic convergence). We use a combination of cross-sectional and univariate time series models and density distribution analysis. For each profit rate measure, a strong evidence of beta convergence is provided. In contrast, sigma convergence is indicated only in the case of productive economy profit rate; while in other cases, sigma divergence or the absence of either convergence or divergence are likely. Stochastic convergence is present in a smaller number of economies and is confined to productive economy and manufacturing. The comparison of convergence dynamics in

[1] Senior Lecturer – Kolej Yayasan Saad (KYS) Business School - Lebuh Ayer Keroh 75450 Ayer Keroh, Melaka, Malaysia – E-mail: ivan.trofimov1@gmail.com – ORCID: https://orcid.org/0000-0002-5037-2764.
Recebido: 02/06/2022. Aceito: 30/05/2023.
Editor Responsável: Dante Mendes Aldrighi

developed versus developing economies confirmed beta convergence in both groups and for their aggregate, but did not establish sigma convergence, given the significant diversity of economies and their different economic trajectories.

Keywords
Profit rates, Convergence, Unit root

JEL Classification
E25, C22, O40, F15

1. Introduction

The equalisation and convergence of distributive variables (returns to production factors, factor prices, and factor shares) has been a well-researched topic in economics. Several aspects of the phenomenon have been considered in literature: convergence of profit rates at the industry level in the context of competition among producers (Vaona, 2011; Tescari & Vaona, 2014); convergence and equalisation of distributive income shares (Izyumov, Vahaly, 2014); factor price equalisation (FPE) internationally and regionally as a result of differential factor endowments (Rassekh, 1993; Burgman, Geppert, 1993; Berger, Westermann, 2001; Bernard et al, 2002); the possibility of the lack of convergence of output and factor prices across economies due to unequal exchange tendencies in the international economy (Emmanuel, 1972); the effect of commodity price on factor price convergence (O'Rourke, Williamson, 1994; convergence of economies, starting from different positions in a production function to a steady state growth path or on convergence due to technological spillovers and human capital externalities (Barro, Sala-i-Martin, 1992; Mankiw et al, 1992); among other issues.

On the other hand, the empirical analysis of profit rate convergence on international scale has been limited in the literature and this paper is intended to contribute to filling this gap. The paper presents empirical analysis of factor price convergence (FPC) in OECD economies, with a specific focus on profit rates. As part of robustness checks it also compares the profit rate convergence in selected developed and developing economies using alternative profit rate indicator. We distinguish alternative measures of profitability, in particular economy-wide rate of profit, the rate of profit in the productive economy (thereby separating capitalist and non-capitalist sectors of the economy and excluding the latter from the analysis), and the rate of profit in manufacturing. We examine three aspects of convergence: beta-convergence, sigma-convergence, and stochastic convergence. We also use two alternative sources of information to construct rates of profit indicators. We conduct a series of econometric and statistical procedures: regression with cross-sectional data, analysis of dispersion coefficient and kernel density plots, linearity, structural break and unit root tests, and time-series regressions. Regarding terminology, we focus on FPC as opposed to FPE, as Carter (2003: 85-86) notes that the latter is viewed as the outcome of the former.

The paper is organised as follows. Section 2 presents a review of theoretical and empirical works in the area. Section 3 discusses the data used in the analysis, the aspects of convergence, and econometric methods. Section 4 contains the results of empirical analysis, and Section 5 provides concluding remarks.

2. Literature review

FPE theorem views free trade as a substitute to international movement of production factors and implies that trade between economies (even in the absence of production factor movements that would likewise lead to factor returns equalisation) brings equalisation of wage and profit rates (Weeks, 1999: 3). The export of goods that embody abundant production factors and import of goods that use scarce production factors would lead to changes in demand for abundant (scarce) factors and hence to changes in the prices of the factors (abundant factors become cheaper, and scare factors become more expensive) and to equalisation of factor returns (Weeks, 1999: 3). This prediction necessarily rests on the assumptions of sufficiently similarly factor endowments to avoid complete specialisation; similar demand structures and consumer preferences; perfect competition in domestic markets, zero transportation costs or trade policy interventions; technologies of degree one homogeneity; different factor intensities of products/sectors and no factor intensity reversals (Hernan Vallejo, 2004: 3; Deardorff, 1994: 167-8).

In addition, the process may be impeded by the low scale of capital inflows, particularly from the developed to the developing economies, by the persistence of institutional differences, non-capitalist relations, and variation in production techniques that would perpetuate profit rate differentials (Glyn, 2004: 7; Weeks, 1999: 11). Greater trade openness and more intense competition in product markets may result in lower profit margins, while the relocation of capital through FDI may put downward pressure on wages and restore the profits, the net effect of these opposing forces on international profit rates' differentials being unclear (Glyn, 2004). Finally, the international movement of production factors may only partially moderate profit (and other distributive variables) differentials that originate at the enterprise level and relate to variation in production techniques, with those enterprises with more advanced techniques being able to earn superior profits (Weeks, 1981; Tsoulfidis & Tsaliki, 2005: 9).

As far as empirical research on international rate convergence is concerned, the following results emerge. The rates of return to capital vary across the economies and are substantially higher in the developing economies (Harberger, 1978; Peterson, 1989; Bai et al., 2006; Bigsten, 2000; Izyumov & Alterman, 2005; Udry & Anagol, 2006), reflecting disequilibria in world capital markets, differences in relative costs of labour and capital across groups of economies, and the effects of capital transfer via development assistance. While equalisation of capital rewards is more likely than equalisation of labour rewards (due to free movement of capital internationally, and restricted movement of labour), there is no pronounced equalisation of profit rates nor a systematic pattern of increasing profit rates in capital-scarce economies and a decline in the rates in capital-abundant economies (Harberger, 1978). There was certain evidence of convergence in returns to capital across OECD and Western European economies, driven by the processes of political and economic integration (Floystad, 1973; Mokhtari and Rassekh, 1989). Convergence in output-capital ratios played role in profit rate convergence internationally (Chou et al, 2015), in turn, reflecting the accelerating dissemination of technology as part of the globalisation process. The convergence process was the fastest during the period characterised by the Keynesian model of economic governance, decelerating drastically in the aftermath period (Carter, 2003). Globalisation and international competition effects on profit rate convergence are the most vigorous in manufacturing, hence, consideration of manufacturing profit rates in this paper (Glyn, 2004). Other studies did not find the evidence of profit rate convergence (particularly at economy-wide level, as opposed to manufacturing), either in any individual group of economies or across the groups (Glyn, 1997; Izyumov, Vahaly, 2014). The hypothesis that greater competition or movement of capital on an international scale brings profit rate equalisation was likewise not supported (Glyn 1997).

Overall, as suggested by the literature review, there is only partial evidence of equalisation even in the highly integrated economies of Western Europe and the OECD. This is in line with theoretical analysis by Trefler (1993), who hypothesises empirical rejection of FPE due to diversity of production factors embodied in traded goods, as well as Kemp (2001) and Bernhofen (2009), who assume FPE towards multiple equilibria. Re-examination of the issue would be instructive, using up-to-date econometric techniques and more recent and comprehensive data.

3. Methodology

3.1. Data

This paper considers three alternative profit rate measures: profit rate for the total economy, profit rate for the productive economy (including agriculture, mining, manufacturing, utilities, construction, transport, storage and communication, wholesale and retail trade, and hotels and restaurants), and manufacturing profit rate.

Following Duménil and Lévy (2004a), the exclusion of real estate, government sector, finance and insurance, and sectors assisting social reproduction and maintenance (health, education, social, and community work) is necessary, as these sectors do not participate in the creation of capitalist profits, are driven by not-for-profit motives, and/or re-distribute capitalist profits. In addition, in the case of real estate, the residential capital stock is not considered productive.

The first of the profit measures is estimated using AMECO (the European Commission macroeconomics database) for two groups of countries: Group 1 comprising 19 OECD economies in the 1960–2016 period and Group 2 comprising 21 OECD economies in the period of 1980–2016. The profit rate measures for the productive economy and the manufacturing sector

(Groups 3 and 4) are estimated using the EUKLEMS database for 11 OECD economies in 1977-2006.

The profit rate for the total economy is estimated as net returns on the net capital stock, with the relevant adjustments for self-employment, as follows:

$$PR = \frac{(UVND - (UWCD \times (NETD / NWTD)}{(OKND \times PIGT) / 10000} \quad (1)$$

where $UVND$ is domestic income at current prices, $UWCD$ is the compensation of employees for the total economy, $NETD$ is employment in all domestic industries, $NWTD$ is the number of employees in all domestic industries, $OKND$ is the net capital stock for the total economy at 2010 prices, and $PIGT$ is the price deflator for gross fixed capital formation. This paper adopts measurement of capital stock at current (replacement), as opposed to historical cost, in line with the majority of studies in the field (Duménil, Lévy, 2011; Shaikh, 2010). The former method values the stock elements at prices at which they could be purchased in the current market; the latter carries over the capital elements at the prices at which they were originally purchased (Basu, 2013: 294). Given that old vintages of capital are less productive and less relevant for the present business decisions, the use of current cost is seen as a preferred measurement method. With net capital stock provided in AMECO database at historical 2010 cost, the PIGT price deflator for capital formation is used to reflate the capital stock to current replacement costs.

The productive economy and manufacturing profit rates are estimated using capital input data (November 2009 release) as net returns on the net capital stock, as per the following formula:

$$PR = \frac{((COMP / DEFL) - DEPR)}{(K_{real} - DEPR)} \times 100 \quad (2)$$

where K_{real} is real fixed capital stock at 1995 prices, $DEPR$ is consumption of fixed capital at 1995 prices, $COMP$ is capital compensation at current prices, and $DEFL$ is gross fixed capital formation price index with the base in 1995.

Sigma and beta convergence analyses are performed on profit rates, as defined in Equations (1) and (2). For stochastic convergence analysis, the relative profit rate, a measure of profit rates' differential, is estimated as the ratio of individual economy profit rate and the weighted average profit rate. The weights are estimated based on consistent real GDP and real sectoral output data from the Maddison Project Database 2018 (for the weighted average profit rate in the total economy), and the UN National Accounts database, "GDP and its Breakdown at Constant 2010 Prices in US Dollars" (for the productive economy and manufacturing rates).

3.2. Types of convergence

The paper examines three types of convergence – beta convergence, sigma convergence, and stochastic convergence – accentuating the different aspects of the convergence process.

Beta convergence (convergence in levels) examines whether profit rates in a cross-section of economies move over time to some unique level common to all the economies in question. The unconditional beta convergence analysis is performed by running regression with cross-sectional data as follows:

$$\frac{PR_{i,T} - PR_{i,0}}{T} = \alpha + \beta PR_{i,0} + \gamma D_i + \varepsilon_i \tag{3}$$

where $PR_{i,0}$ is the profit rate in economy i in the initial period (for different groups of countries, the initial period is 1960, 1980, or 1977), and the left-hand side term is the annual rate of change in profit rate between initial period 0 and final period T (1960–2016, 1980–2016, or 1977-2006). The regression is augmented by dummy variables D_i (introduced to account for outlier data in individual economies) and is re-estimated to account for cyclicality (recessions in 1980–1982 and 2009 that affected the majority of OECD economies). The beta convergence is indicated when the gap between the profit rates is eliminated (reduced) as a result of economies with initially higher rates experiencing the most rapid declines (hence, the negative sign of the beta coefficient $\beta < 0$).

Sigma convergence (convergence in variance) concerns the cross-sectional dispersion of profit rates (specifically, increase versus stability or decrease in dispersion). Sigma-convergence analysis is conducted using raw profit rate and weighted average profit rate data.

First, the dispersion coefficient is estimated as follows:

$$\sigma_t = \frac{1}{n}\left(\sum_{i=1}^{n}\left(\frac{PR_i^t - \overline{PR^t}}{\overline{PR^t}}\right)^2\right)^{1/2} \tag{4}$$

$$\text{with} \quad \overline{PR^t} = \frac{1}{n}\sum_{i=1}^{n} PR_i^i \tag{5}$$

where $\overline{PR^t}$ is the average profit rate. The movements in the dispersion coefficients are analysed using sequential methodology applied in the case of stochastic convergence analysis (see below), which includes a range of univariate tests. The reduction of the value of the coefficient indicates sigma convergence.

Secondly, cross-sectional kernel densities of the profit rates are presented for selected years to examine changes in distribution of profit rates over time (the first and the last year of the respective series, as well as the years when the relative profit rate was the highest/ lowest). Following Aldy (2007: 357), the densities are estimated using the Epanechnikov kernel and Silverman's (1986) bandwidth choice rule.

Stochastic convergence analysis (Bernard & Durlauf, 1995) focuses on the dynamics of the convergence process and considers the persistence (or absence) of profit rate differentials. Unit roots in the differentials indicate that shocks affect differentials on a permanent basis, hence they stochastically diverge. In contrast, reversion to the mean (mean stationarity) or to deterministic trend after the shock indicates stochastic convergence. In the latter case, the following condition is satisfied:

$$\lim_{k\to\infty} E(e_{i,t+k} - e_{j,t+k} \,||\, I_t) = 0, \forall t\,, \tag{6}$$

where I_t is the information set at time t for countries i and j that contains current and past series $e_{i,t}$ and $e_{j,t}$.

To conduct stochastic convergence analysis, the sequential procedure is used. Firstly, to determine whether series embed nonlinearity characteristics, the Brock-Dechert-Scheinkman test (BDS) is performed (Brock et al., 1987) on the first differences of the series.

Secondly, if non-linearity was suggested by the BDS test, the Kapetanios-Shin-Snell/KSS (2003) non-linear unit root test was considered. All series are likely to have contained positive constants and possibly trends (based on visual observation), hence the KSS test was performed on de-meaned series or de-trended and de-meaned series. The functional forms of KSS test are as follows:

$$\Delta\sigma = \sum_{k=1}^{p} \rho_k \Delta\sigma_{i,j,t-k} + \delta\sigma_{i,j,t-1}^{3} + \varepsilon_{i,j,t} \text{ and} \tag{7}$$

$$\Delta RPR = \sum_{k=1}^{p} \rho_k \Delta RPR_{i,j,t-k} + \delta RPR_{i,j,t-1}^{3} + \varepsilon_{i,j,t} \tag{8}$$

where σ is the dispersion coefficient and RPR is the relative profit rate. The null hypothesis of unit root ($\delta = 0$) is tested against the alternative of non-linear stationarity ($\delta < 0$), the latter hypothesis implying non-linear convergence.

Thirdly, for those series found by the BDS test to be linear or those that contain unit roots according to KSS test, the conventional unit root tests are considered (Augmented Dickey Fuller test (ADF), Kwiatkowski-Phillips-Schmidt-Shin (KPSS), and DF-GLS) (Dickey, Fuller, 1981; Kwiatkowski et al, 1992; Elliott et al, 1996). The most general specification of the ADF test was considered (constant plus trend) to identify four alternative outcomes: random walk, random walk with drift, mean reversion, and deterministic trend.

$$\Delta\sigma_t = \alpha + \beta t + \gamma\sigma_{t-1} + \sum_{i=1}^{n} \varphi\Delta\sigma_{t-n} + \varepsilon_t \text{ and} \tag{9}$$

$$\Delta RPR_t = \alpha + \beta t + \gamma RPR_{t-1} + \sum_{i=1}^{n} \varphi\Delta RPR_{t-n} + \varepsilon_t \tag{10}$$

If $\beta \neq 0$ and $\gamma < 0$, the series were deemed to follow a deterministic trend. In the case of $\beta = 0$, the ADF test with constant was conducted and if $\gamma < 0$ (based on ADF critical values), the series reverted to the historical mean (i.e., stationary), while if $\gamma = 0$, the series followed random walk. In the case of $\beta \neq 0$ but $\gamma = 0$, the series were following random walk with drift. The KPSS and DF-GLS tests were conducted using the same type of specification (constant or constant plus trend) as the ADF test. In the case of contradiction between the results, other specification were also tried. With the exception of the case where all three tests pointed to (trend) stationarity, the testing procedure was carried further and results from Phillips-Perron and Ng-Perron tests were obtained (Phillips & Perron, 1988; Ng & Perron, 2001). The presence of at least one unit root across the tests likely pointed to the presence of discontinuities due to structural breaks, and thus the Bai-Perron procedure was conducted to determine the presence and number of breaks (Bai & Perron, 1998, 2003). The number of unknown breaks was identified using the global maximisation method ('global L breaks versus none'), specifically the unweighted max-F test, with the maximum number of breaks set to 2.

In the event that the Bai-Perron procedure did not identify a break, it was determined that series are non-stationary without breaks. Where at least one break was identified by the procedure, the Lee-Strazicich (LS) Lagrange Multiplier unit root tests with up to 2 breaks were conducted (Lee & Strazicich, 2003, 2004). The 'crash' and 'break' specifications were tried (Models A and C, in line with Lee-Strazicich definitions): the former for the series that likely contained constants, as suggested by the ADF test, the latter for the series with constant and trend. The maximum number of lags was set to 8, and the breaks at a particular date were identified using the general-to-specific procedure. The test was initially performed with two structural breaks, and if one trend dummy were insignificant, the test with a single break was performed (hence, models AA and CC for the test with two breaks, and models A and C for the tests with a single break). Where none of the breaks are significant, the Schmidt-Phillips Lagrange Multiplier unit root test without breaks (Schmidt, Phillips, 1992) determines whether series follow random walk (under the null hypothesis) are stationary. The LS test statistic is obtained from the following:

$$\Delta LS_t = d' \Delta Z_t + \phi \tilde{S}_{t-1} + \sum \delta_i \Delta \tilde{S}_{t-i} + \varepsilon_t \quad (11)$$

where $\tilde{S}_t$ is a de-trended series, Z_t is a vector of exogenous variables $[1, t, D_{1t}, D_{2t}, DT_{1t}, DT_{2t}]$, with D_{jt} denoting an intercept shift in the deterministic trend, and DT_{jt} denoting a change in slope of deterministic trend. Both D_{jt} and DT_{jt} are equal to 1, when $t \geq T_{Bj} + 1, j = 1,2$, and they are otherwise zero (T_{Bj} being the timing of the break). The null hypothesis of unit root with break(s) is contrasted with the alternative hypothesis of trend stationarity with break(s).

In the final step, for those series deemed stationary around a linear trend, the linear trend models were estimated using ARMA maximum likelihood, generalised, or conditional least squares. For those cases where breaks were present, the trend model included break(s) identified by the Bai-Perron procedure (given that LS tests are the tests of unit roots with breaks, rather than tests of the presence/number of breaks). If the trend model with break(s) had insignificant trend coefficient, it was re-estimated solely with breaks and no trend.

Overall, evidence of σ convergence is present when dispersion coefficient declines along a deterministic trend (with or without breaks) or shifts downward as a result of break (in line with previous studies that necessarily associate sigma convergence with reduction in dispersion; e.g., Young et al., 2008). In contrast, stochastic convergence is present when series are 1) stationary (linear or non-linear) around the constant and reverting to historic mean, or 2) trend stationary (with or without breaks) and the sign of the trend is negative. The possibility of incomplete convergence or movement of series across the level that corresponds to convergence (the former case being convergence to the level that is below or above the weighted average rate, the latter being the movement of the relative profit rate from the level above the weighted average rate to the level below).

4. Empirical results

This section presents the empirical results. The sub-sections that follow examine consecutively the beta-, sigma- and stochastic convergence.

4.1. Beta convergence

There was a solid evidence of beta convergence in all four groups, though in most cases correction for outliers and cyclical variation was needed. In a basic specification (unconditional form of convergence with no dummy variables), the convergence coefficient was positive and insignificant, and the regression residuals were not normally distributed (given that the average annual rate of change in profit rates in Portugal was substantially lower, and in Australia, Ireland, and Luxembourg somewhat higher than in the rest of the group). A significant and negative coefficient was obtained when the dummy variable was set for the four economies. Excluding Portugal and setting dummy variables for the recession years of 1980–82 and 2009, or restricting the sample to 1982–2016, gave a negative (albeit insignificant) convergence coefficient. In Group 2 (including 21 economies over the period of 1980–2016), similar evidence of beta convergence arose (with dummy variables for Ireland and Luxembourg). Regarding Groups 3 and 4 (productive economy and manufacturing profit rates in 1977-2006, based on KLEMS data), all specifications indicated beta convergence. (Due to the presence of heteroscedasticity, the use of Huber-White standard errors was required in two estimations.)

The beta convergence regression results are presented in Table 1, and the scatterplots of the change in profit rates against their initial levels are shown in Figure 1 (given the similarity of the results and to conserve the space, only two specifications are presented). The conclusion is that profit rates for the total economy, manufacturing, and productive economy converged to a steady-state over the respective periods; but in certain instances, the sample had to be restricted or additional dummy variables were needed (i.e., conditional beta-convergence was present).

Table 1 - Unconditional beta convergence in profit rates

Models	Constant	Beta	R^2_{adj}	JB	Het.
Group 1					
Specification 1	-0.489	0.119	0.021	96.475	0.231
	(-0.309)	(0.606)		(0.000)	
Specification 2	3.097	-0.156	0.964	1.378	0.503
	(7.379)	(-3.917)		(0.502)	
Specification 3	2.196	-0.121	0.125	1.377	HW
	(2.965)	(-1.238)		(0.502)	
Specification 4	4.421	-0.153	0.487	0.749	HW
	(5.457)	(-1.501)		(0.688)	
Group 2					
Specification 5	5.932	-0.337	0.686	0.996	0.761
	(8.926)	(-4.234)		(0.608)	
Group 3					
Specification 6	8.663	-0.699	0.441	0.014	HW
	(3.399)	(-2.745)		(0.993)	
Group 4					
Specification 7	9.908	-0.514	0.292	0.187	0.172
	(3.539)	(-2.262)		(0.911)	

Note. Specification 1 (19 economies, economy-wide profit rate, AMECO data, 1960–2016 period); Specification 2 (dummy variables for Portugal, Australia, Ireland and Luxembourg); Specification 3 (dummy variables for 1980–82 and 2009, exclusion of Portugal); Specification 4 (all economies, 1982-2016 period); Specification 5 (21 economies, economy-wide profit rate, AMECO data, 1980–2016 period); Specification 6 (11 economies, productive economy profit rate, KLEMS data, 1977-2006 period); Specification 7 (11 economies, manufacturing profit rate, KLEMS data, 1977-2006 period). HW is Huber-White robust standard errors. JB is Jarque-Bera test for normality; Het. is White test of heteroscedasticity. T-statistics and Jarque-Bera probabilities are indicated in parentheses.

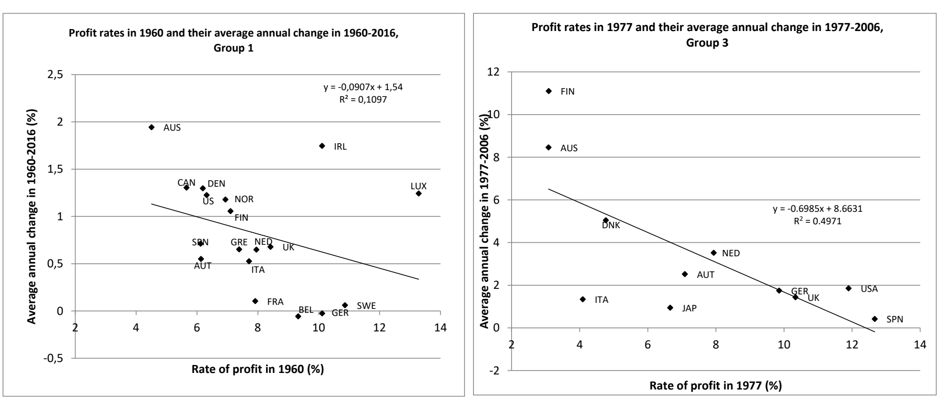

Figure 1 - Scatter plots of profit rates in 1960 and 1977 against their annual change over 1960–2016 and 1977-2006

4.2. Sigma convergence

Figure 2 demonstrates that the dynamics of the dispersion differed across the groups and over time.

The dispersion of economy-wide profit rates, while fluctuating within the 0.2-0.4 band during the period of 1960–2016, trended downwards in the 1960s, increased in the early-1970s, fell in the second half of the 1970s, exhibited stability in 1980–1998, and then substantially increased in the late 1990s and into the post-GFC period. This regularity confirms the observation made by Carter (2003: 55), who attributed declining dispersion in the 1960s to the commonalities in distributive regimes (Keynesian economic governance regime) in Western economies and declining dispersion in the distributive variables in the second half of the 1970s to the common response to the problems caused by the 1973–1975 recession (manifested in rising wage share across the majority of developed economies). The entrenchment of neoliberal economic policies and modes of regulation were associated with stable dispersion coefficient through the 1980s and 1990s. Given that such entrenchment was not uniform across the economies and occurred at different times and paces, some minor increase in dispersion is observed in the late 1980s (Carter, 2003: 56-57). The dissimilarities in profit rates experienced in the late 1990s and 2000s and particularly in the post-GFC period can be attributed to the differential change in unit labour costs and real wages across the economies (Berger, Wolff, 2017); differential effects of trade liberalisation (in particular, following the WTO Uruguay Round); the expansion of foreign investment; a general increase in openness (Glyn, 2004: 3-6); as well as the effects of product price equalisation (Slaughter, 1997: 195), immigration and labour movement (Taylor, Williamson, 1994), and change/convergence in countries' employment mix (Dollar & Wolff, 1988). We note that the clear increase in dispersion during the period contrasts with the observations made by Izyumov and Vahaly (2014: 703) and Chou et al. (2015: 1162) regarding the stability of the dispersion in the developed economies in 1997-2014 and 1995-2007.

Group 2 additionally included Japan. This did not alter the *dynamics* of the dispersion coefficient, but only its level (compared to Group 1 economies). However, as noted by Glyn (2004: 12), the precipitous and sizeable decline in Japan's profit share and rate during the 1970s (from the high levels experienced during the heyday of the 'Economic Miracle') could have contributed to the aforementioned reduction in dispersion coefficient in the second half of the 1970s.

The dispersion in manufacturing profit rates tended to co-move with the productive economy rate dispersion until the early 1990s, with divergence between the coefficients then becoming more pronounced. Figures in the Appendix confirm this regularity: starting from the early 2000s, a group of economies with substantially higher and growing profit rates than the rest of the sample (Australia, Austria, Finland, the Netherlands, and the US), as well as Italy as a clear outlier (with low and declining rates), can be identified. In the OECD context, the diverging manufacturing performance (albeit not precisely in terms of profitability) has been documented by both micro-level (Andrews et al., 2015) and macro-level (Lucchese et al., 2016; Romano, 2016; Sabatino, 2016) studies. The former type analysed manufacturing divergence in terms of productivity differences (and specifically productivity divergence between firms at the technological frontier and the laggard firms) and linked firms' performance (including profitability) to this factor. In contrast, the macro-level studies examined manufacturing divergence as a divergence between manufacturing systems (e.g., the study by Romano that pointed to a 'multi-speed manufacturing landscape' in Europe, where Italy, the UK, and to a lesser extent France and Spain, are characterised by sluggish manufacturing performance) or as a result of country- or region-specific factors (e.g., industrial or structural policy failures).

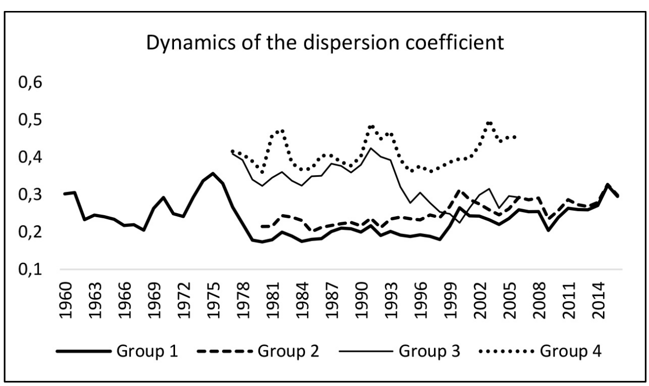

Figure 2 - Trends in the dispersion of the profit rates

We further apply density distribution analysis to examine the dynamics of dispersion (Figure 3). In all groups, the mass of distribution tended to shift to the right over time, confirming a general increase in profit rates during the respective periods. For Group 1, the heights of the peaks remained the same in 1960 and 2016, while the peak increased dramatically in 1980 (confirming the reduction of the dispersion). In addition, an increase in the right tail of the distribution is indicated in 2016, pointing to the emergence of another group of economies with substantially higher profit rates. Group 2 witnessed an increase in dispersion (suggesting sigma divergence in profit rates) and an elongation of the right tail of distribution. The density of productive economy rates in Group 3 was generally stable (1977, 1991, and 2006), while more compact distribution was evident in the early 2000s. In Group 4 (manufacturing rates), the distribution was bi-modal in 1977 and unimodal in 1992, 2001, and 2006. While distribution was compact for the most of the period, its widening in the early 2000s was likely due to growing sigma divergence of profit rates.

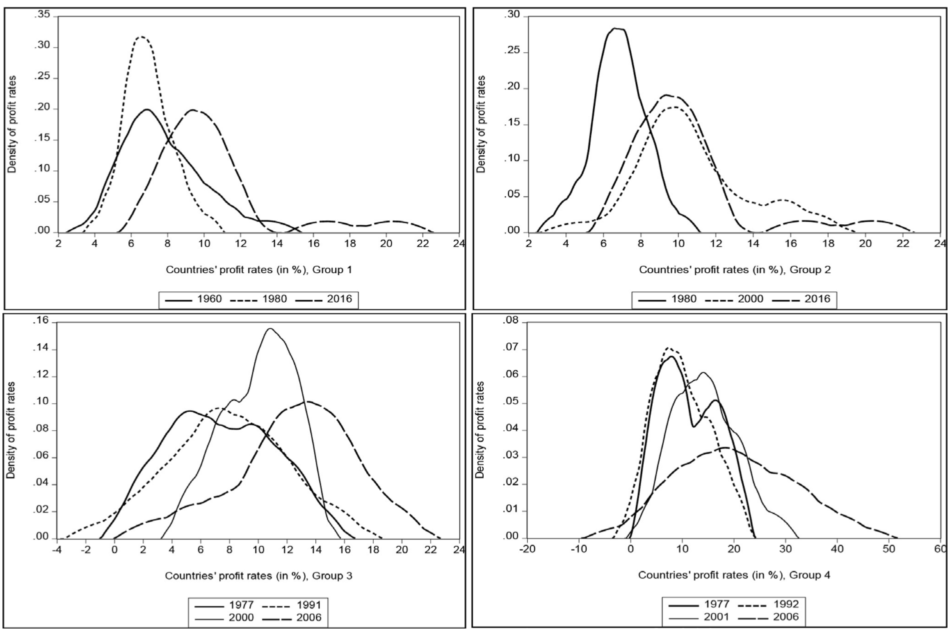

Figure 3 - Kernel densities for the countries' profit rates

Note. Estimates are based on Epanechnikov kernel function and Silverman bandwidth choice rule.

The results of the formal econometric tests of the dispersion coefficients are in line with the distribution analysis (Table 2). In all groups, the dispersion coefficients were linear and hence subject to linear unit root tests. The coefficients were stationary around the mean in Groups 1 and 4 (the absence of sigma convergence or divergence, notwithstanding certain increase in dispersion across manufacturing rates). Dispersion was stationary with a break in Group 3 (productive economy profit rates); but given the negative sign of the dummy and the 24.1% fall in dispersion after 1994, sigma convergence was present. In Group 2, the dispersion coefficient was trend stationary with a positive trend coefficient, indicating sigma divergence.

Table 2 - Univariate tests of the dispersion coefficients

Test		Group 1 Total economy	Group 2 Total economy	Group 3 Productive economy	Group 4 Manufacturing
BDS	d=2	0.743	0.546	0.726	0.759
	d=3	0.506	0.149	0.706	0.795
	d=4	0.158	0.835	0.824	0.616
	d=5	0.082	0.810	0.557	0.451
	d=6	0.069	0.657	0.978	0.716
ADF	Stat.	-3.119	-3.868	-1.890	-2.933
	Model	Constant [1]	Constant+trend [0]	Constant [0]	Constant [0]
KPSS	Stat.	0.177	0.067	0.431	0.159
	Model	Constant [5]	Constant+trend [2]	Constant [4]	Constant [1]
DF-GLS	Stat.	-1.841	-3.979	-1.483	-2.981
	Model	Constant [0]	Constant+trend [0]	Constant [0]	Constant [0]
Bai-Perron	Stat.*			45.563 [2]	
	Stat.**			54.145 [2]	
	Break			1990, 1994	
LS	Stat.			-5.457 [6]	
	Model			A	
	Break			2003	
Trend/break	Coefficient		0.009	-0.241	
	t-stat		(4.919)	(-4.505)	
	Model		ARMA-CLS	ARMA-CLS	
Summary		Stationarity Stability	Trend stationarity Divergence	Stationarity with break Convergence	Stationarity Stability

Note. Augmentation lags are shown in square brackets. * and ** represent UDMax and WDMax statistics (that indicate the number of selected breaks); the breaks are based on the UDMax statistic. The critical values for UDMax and WDMax are 8.88 and 9.91 respectively. The critical values for ADF test are -4.13, -3.49, -3.17 at 1%, 5% and 10% level for the model with constant and trend, and -3.55, -2.91 and -2.59 at 1%, 5% and 10% level for the model with constant. The KPSS test critical values are 0.22, 0.15 and 0.12 at 1%, 5% and 10% level for the model with constant and trend and 0.74, 0.46 and 0.35 at 1%, 5% and 10% level for the model with constant. The DF-GLS test critical values are -3.77, -3.19 and -2.89 at 1%, 5% and 10% level for the model with constant and trend and -2.63, -1.95 and -1.61 at 1%, 5% and 10% level for the model with constant. AA indicates 'crash' specification for the Lee-Strazicich test. The critical values for the Lee-Strazicich AA model are -4.54, -3.84 and -3.50 at 1%, 5% and 10% level of significance; for model A are -4.24, -3.57 and -3.21 at 1%, 5% and 10% level of significance.

4.3. Stochastic convergence

Stochastic convergence analysis was performed for the relative profit rates in the respective economies in the four groups. The results of the tests are shown in Tables 3–6.

In Group 1 (economy-wide profit rates, 1960–2016, 19 economies), according to the BDS test, the relative profit rates in Austria, Germany, Greece, Portugal, and Spain exhibited non-linearity characteristics (Table 3). The KSS test, however, confirmed the presence of non-linear stationarity in only Austria and Germany. The remaining relative rates were examined using linear unit root tests. According to ADF, KPSS, DF-GLS, Ng-Perron, and Phillips-Perron tests, the relative rates were stationary in Australia, Denmark, and Finland, while in other economies the random walk (with or without drift) was indicated. In most of the series that followed random walk, the Bai-Perron procedure identified two structural breaks, except in Ireland (single break). We therefore performed LS tests with two breaks in all cases except Ireland. Based on the LS test, trend stationarity with two breaks was detected in France, Portugal, Spain, and the UK, and trend stationarity with a single break in Luxembourg and Sweden. No significant breaks were found in relative profits in Canada, Ireland, or Italy; thus it was concluded that the series contain unit roots without breaks. The remaining series contained unit root with break(s).

In Group 2 (economy-wide profit rates, 1980–2016, 21 economies), according to the BDS test, the relative profit rate in Greece was likely to have been non-linear (Table 4). The KSS tests further confirmed non-linear stationarity in this case. Other tests demonstrated stationarity of the relative rates in Denmark and trend-stationarity in the UK. The relative rates in other economies likely contained stochastic trends. The Bai-Perron procedure identified two breaks in all economies except the Netherlands, for which the LS test with a single break was conducted. According to the LS test, trend stationarity with two breaks was present in Australia, Canada, Finland, Germany, Luxembourg, the Netherlands, Norway, Spain, Sweden, and the USA, while trend stationarity with a single break was identified in Japan. The remaining series followed unit root with break(s).

In Group 3 (productive economy profit rates, 1977-2006, 11 economies), non-linearity in the relative rates was detected in Austria, while non-linear stationarity was likely to have been present in only the de-trended data (Table 5). All series were thus subject to linear unit root tests and unit roots were detected in all cases. Based on the Bai-Perron test, two structural breaks were present in all cases. According to the LS test, in all cases except Finland and Japan (unit roots with and without breaks, respectively) trend stationarity with break(s) was present.

In Group 4 (manufacturing profit rates, 1977–2006, 11 economies), relative rates were non-linear in Japan, but according to KSS test, linear non-stationarity was detected for both demeaned series and de-trended and demeaned series (Table 6). Based on other tests, some form of random walk behaviour was present in all cases. The Bai-Perron test identified two structural breaks in all cases. The LS test indicated trend stationarity with break(s) in all cases except Japan and Spain, where unit root with a single break was identified.

In summary, in Group 1, relative profit rates exhibited deterministic behaviour (linear or non-linear stationarity with or without trends and breaks) in 11 of 19 cases. However, stochastic convergence to the weighted average rate level was experienced in 31.6% of cases (five of 19). In Austria, Finland, and Germany, the relative rate was stationary at a level other than 1. In France, Luxembourg, and Spain, the relative profit rate trended towards a level other than 1. In Group 2, the stationarity of various forms was observed in 11 cases out of 21. Stochastic convergence to the weighted average rate level was detected in Greece and the UK (nonlinear stationarity and trend stationarity without breaks, respectively), thus in 9.5% of cases. In other economies, relative rates trended away from 1 (Australia, Luxembourg, the Netherlands, and Spain) or fluctuated around a non-unitary mean (Denmark, Norway, Portugal, Sweden, and the US). In Group 3, deterministic patterns were identified in eight cases of 11. Stochastic convergence to the unitary level was observed in 36.4% of cases (Australia, Denmark, Finland, and the Netherlands). Among Group 4 economies as well, the deterministic behaviour was evident in eight cases, and stochastic convergence to the weighted average rate level in Australia, Austria, Finland, and the Netherlands (36.4% of cases). These findings are largely in line with sigma convergence analysis results, as most instances of convergence were observed in the productive economy and manufacturing, and for total economy, during 1960–2016, rather than 1980–2016.

Table 3 - Univariate tests of the relative profit rates (Group 1, 1960–2016)

Country	BDS		KSS (1)		KSS (2)		ADF			KPSS		DF-GLS		Bai-Perron		LS				Trend	Summary
	p-value	d	t-stat		t-stat		t-stat			LM-stat		t-stat		UDMax	Breaks	LM-stat		Model	Breaks		
Australia	0.870	5					***-3.300***	0	CT	***0.082***	4	***-3.191***	0							0.012	TS
Austria	***0.059***	2	***-3.224***	0	***-3.465***	0															NLS
Belgium	0.639	5					-2.326	0	CT	***0.096***	5	-2.371	0	49.627	1975, 1995	-4.385	6	C	1973		URB
Canada	0.924	2					-2.068	0	C	0.447	5	-0.989	0	128.734	1973, 2009	-2.540	4	SP			UR
Denmark	0.945	3					***-3.280***	0	CT	***0.178***	5	***-3.342***	0							0.005	TS
Finland	*0.168*	2	-2.059	0	-2.871	1	***-3.514***	1	C	***0.118***	5	***-2.062***	0								ST
France	0.254	5					-2.042	1	CT	***0.100***	5	-2.170	1	59.809	1975, 2009	***-7.543***	8	CC	1978, 2000	-0.005	TSB
Germany	***0.003***	5	***-4.153***	0	***-3.553***	0															NLS
Greece	***0.003***	4					-2.987	0	CT	***0.121***	5	-2.167	0	101.556	1969, 1978	-5.181	7	CC	1976, 1991		URB
Ireland	0.957	6					-2.192	0	CT	***0.129***	5	-1.983	0	41.789	1974, 1995	-2.688	4	SP			UR
Italy	0.133	4					-1.934	0	C	***0.126***	5	***-1.873***	0	48.152	1987, 2009	-2.063	0	A	1985		URB
Luxembourg	0.569	4					***-4.475***	0	CT	***0.185***	4	***-2.983***	0	39.371	1975, 2008	***-5.778***	0	C	1976	0.006	TSB
Netherlands	0.753	3					-3.131	0	CT	0.235	5	-1.715	0	34.245	1971, 1997	-4.635	2	CC	1974, 1996		URB
Norway	1.000	6					-1.906	0	CT	0.517	5	-1.873	0	52.302	2000, 2009	-4.912	1	CC	1985, 2006		URB
Portugal	***0.000***	2	***-3.247***	0	-3.034	0	-1.662	2	C	***0.484***	5	***-1.687***	2	38.043	1972, 1980	***-4.218***	8	AA	1976, 1983		SB
Spain	***0.007***	5	-1.010	0	***-3.530***	0	***-3.209***	0	CT	0.139	5	-1.931	0	56.856	1993, 2005	***-5.665***	5	CC	1979, 1986	-0.005	TSB
Sweden	0.321	3					-2.982	0	CT	***0.086***	4	-2.839	0	107.902	1977, 1990	***-5.385***	1	C	1989	-0.005	TSB
UK	0.425	2					***-3.187***	1	C	***0.241***	5	***-3.007***	1	17.339	1979, 1999	***-4.668***	6	AA	1976, 1986		SB
USA	0.642	2					-2.962	0	CT	***0.094***	4	-2.401	0	70.767	1975, 2009	-3.973	3	C	1985		URB

Country	Ng-Perron				Phillips-Perron	
	MZa	MZt	MSB	MPT	Adj t-stat	
Australia	***-14.825***	***-2.694***	***0.182***	***6.318***	***-3.300***	0
Denmark	***-15.839***	***-2.795***	***0.176***	***5.867***	***-3.205***	4
Finland	***-7.335***	***-1.903***	***0.259***	***3.385***	***-2.646***	2
UK	***-18.830***	***-3.026***	***0.161***	***1.453***	-2.545	3

Note. As per Table 2. For the BDS test, the highest p-values are reported at the relevant dimension (*d*). ADF, DF-GLS and LS tests include augmentation lags; KPSS includes relevant estimation bandwidth. The critical values for the KSS unit root test are: for the de-meaned series, -3.48, -2.93 and -2.66; for the de-meaned and de-trended series, -3.93, -3.40 and -3.13 at 1%, 5% and 10% levels of significance respectively. The range of critical values for the Lee-Strazicich unit root tests (break model) is -5.59 to -5.73 at 5% level of significance (model with 2 breaks, CC), and -4.45 to -4.51 at 5% level of significance (model with 1 break, C). The 5% asymptotic critical values for the Ng-Perron test are -8.1, -1.98, 0.23 and 3.17 for MZa, MZt, MSB and MPT (model with constant); and -17.3, -2.91, 0.17 and 5.48 (model with constant and trend). The PP test critical values are -4.23, -3.54 and -3.20 at 1%, 5% and 10% levels (model with constant and trend); and -3.63, -2.95 and -2.61 at 1%, 5% and 10% levels (model with constant). Highlighted values indicate nonlinearity (in BDS test), nonlinear stationarity (in KSS test), (trend-)stationarity (in ADF, KPSS, DF-GLS tests), (trend-)stationarity with break(s) in LS test. C and CT indicate constant and constant plus trend respectively. SP is Schmidt-Phillips LM test. Trend stationarity is TS, nonlinear stationarity is NLS, UR is unit root, URB is unit root with break, ST is stationarity, SB is stationarity with break. Trend coefficient is estimated in the log-linear model.

Table 4 - Univariate tests of the relative profit rates (Group 2, 1980–2016)

Country	BDS		KSS (1)		KSS (2)		ADF			KPSS		DF-GLS		Bai-Perron		LS				Trend	Summary
	p-value	d	t-stat		t-stat		t-stat			LM-stat		t-stat		UDMax	Breaks	LM-stat		Model	Breaks		
Australia	0.836	2					-2.391	2	CT	***0.084***	3	-2.457	1	39.433	1995, 2006	***-7.851***	5	CC	1992, 2006	0.010	TSB
Austria	***0.075***	2	-2.469	0	-2.347	0	-2.603	1	CT	***0.101***	4	-2.766	1	28.494	1992, 2012	-3.594	4	C	2004		URB
Belgium	0.833	5					-2.331	0	CT	***0.083***	4	-2.244	0	49.461	1995, 2009	-3.785	7	C	2000		URB
Canada	0.994	2					-0.802	0	C	***0.234***	4	-0.580	0	104.535	2000, 2009	-2.381	8	A	2009		URB
Denmark	0.870	5					***-3.131***	0	C	***0.109***	3	***-2.782***	0								ST
Finland	*0.341*	2	-1.541	0	-1.568	0	-1.830	1	C	***0.201***	4	***-1.853***	1	49.017	1997, 2009	-2.310	6	AA	1994, 2014		URB
France	0.870	2					-1.981	5	CT	0.184	5	-0.856	0	44.960	1987, 2009	-4.224	3	C	2000		URB
Germany	*0.563*	2	***-2.970***	0	-2.985	0	-2.419	0	C	***0.229***	4	***-1.705***	0	27.439	1993, 2006	-2.474	1	A	2009		URB
Greece	***0.074***	2	***-3.658***	0	***-4.283***	0															NLS
Iceland	0.983	2					-2.696	2	CT	***0.114***	0	-2.581	2	44.121	1987, 2002	-3.790	7	C	2003		URB
Ireland	0.611	3					-1.355	0	C	0.501	4	-0.636	0	40.537	1996, 2004	-3.209	8	A	2015		URB
Italy	0.221	4					-0.769	0	C	***0.245***	5	-0.779	0	51.391	1987, 2009	-2.466	8	A	1999		URB
Japan	0.904	2					-1.472	0	C	***0.100***	4	-1.489	0	53.955	1985, 1992	-2.327	3	SP			UR
Luxembourg	0.879	3					***-3.349***	0	CT	***0.079***	2	***-3.441***	0	75.025	1988, 2006	***-5.922***	1	CC	1990, 2005	0.008	TSB
Netherlands	0.704	2					-2.740	1	CT	***0.103***	4	-2.826	1	81.717	1997, 2009	***-5.653***	7	CC	1990, 2007	0.013	TSB
Norway	0.763	2					-1.445	0	C	***0.318***	4	-1.462	0	21.056	1986, 2000	***-3.578***	8	A	1997		SB
Portugal	0.969	3					-1.574	0	C	***0.150***	4	-1.266	0	37.136	1986, 1996	***-4.311***	8	AA	1998, 2004		SB
Spain	***0.004***	2	-0.802	0	-1.332	0	-2.053	0	CT	***0.142***	4	-1.906	0	38.676	1993, 2005	***-7.364***	7	CC	1995, 2008	-0.012	TSB
Sweden	0.912	4					-1.717	0	C	0.601	5	-0.964	0	84.497	1989, 2000	***-3.970***	5	A	2005		SB
UK	0.768	2					***-4.788***	1	CT	***0.058***	1	***-3.979***	1							-0.008	TS
USA	0.273	6					-2.806	1	CT	***0.079***	4	-2.776	1	56.170	1992, 2009	***-8.281***	6	CC	1995, 2007	0.003	TSB

Country	Ng-Perron				Phillips-Perron	
	MZa	MZt	MSB	MPT	Adj. t-stat	
Denmark	***-10.340***	***-2.266***	***0.219***	***2.400***	***-3.109***	5
Luxembourg	-13.728	-2.565	0.187	6.947	***-3.272***	3
UK	***-26.551***	***-3.642***	***0.137***	***3.443***	***-3.523***	3

Note as per Table 3.

Table 5 - Univariate tests of the relative profit rates (Group 3, 1977-2006)

Country	BDS		KSS (1)		KSS (2)		ADF			KPSS		DF-GLS		Bai-Perron		LS				Trend	Summary
	p-value	*d*	t-stat		t-stat		t-stat			LM-stat		t-stat		UDMax	Breaks	LM-stat		Model	Breaks		
Australia	0.917	5					-3.216	2	CT	***0.146***	2	-2.832	1	67.067	1993, 2001	***-7.920***	2	CC	1995, 2001	0.041	TSB
Austria	***0.025***	2	-1.070	0	-2.269	0	-1.489	1	C	***0.360***	4	-1.608	1	82.850	1984, 2000	***-4.432***	8	AA	1989, 1995		SB
Denmark	0.794	6					-3.051	0	CT	***0.149***	0	***-3.005***	0	29.930	1994, 2000	***-5.920***	8	CC	1991, 2001	0.028	TSB
Finland	0.917	5					-1.428	1	C	***0.396***	4	-1.252	1	79.263	1995, 1999	***-4.142***	8	AA	1990, 1998		SB
Germany	0.790	4					-1.767	0	C	***0.506***	4	-1.414	0	41.136	1981, 1992	-3.385	4	SP			UR
Italy	0.353	2					-1.988	0	C	***0.075***	2	***-1.935***	0	11.726	1995, 2003	-3.449	4	SP			UR
Japan	0.320	2					-2.826	1	CT	***0.175***	4	-1.572	1	27.562	1981, 1994	-2.518	4	SP			UR
Netherlands	0.986	6					-1.764	1	C	***0.368***	4	***-1.706***	1	87.303	1987, 2000	***-3.487***	8	AA	1999		SB
Spain	0.895	5					-1.745	1	CT	***0.149***	3	-1.944	1	106.061	1986, 1992	***-18.442***	7	CC	1995, 1999	-0.016	TSB
UK	0.765	5					***-3.639***	5	C	***0.210***	4	***-3.874***	5	59.886	1982, 1986	***-8.579***	5	AA	1991, 2001		SB
USA	0.776	6					-2.746	0	CT	***0.114***	3	-2.194	0	42.333	1981, 1993	***-7.272***	6	CC	1989, 1991	0.011	TSB

Country	Ng-Perron				Phillips-Perron	
	MZa	MZt	MSB	MPT	Adj. t-stat	
UK	***-7.085***	***-1.860***	***0.263***	***3.536***	-1.800	1

Note as per Table 3.

Table 6 - Univariate tests of the relative profit rates (Group 4, 1977-2006)

Country	BDS		KSS (1)		KSS (2)		ADF			KPSS		DF-GLS		Bai-Perron		LS				Trend	Summary
	p-value	*d*	t-stat		t-stat		t-stat			LM-stat		t-stat		UDMax	Breaks	LM-stat		Model	Breaks		
Australia	0.920	3					***-4.960***	1	CT	0.462	23	***-4.854***	1	40.290	1987, 1993	***-7.823***	5	CC	1993, 2001	0.026	TSB
Austria	0.984	3					-2.192	1	CT	***0.135***	4	-2.138	1	84.729	1995, 2000	***-5.583***	7	C	1989	0.026	TSB
Denmark	0.936	6					-2.406	0	C	***0.170***	3	***-2.356***	0	10.194	1987, 1994	***-4.147***	2	A	1993		SB
Finland	0.769	2					-1.403	0	C	***0.444***	4	-1.069	0	47.310	1994, 1998	***-3.803***	8	AA	1988, 1994		SB
Germany	0.840	2					-1.634	0	C	***0.503***	4	-1.222	0	63.295	1992, 2001	***-4.114***	8	AA	1993, 1998		SB
Italy	0.703	3					-3.082	1	CT	***0.083***	1	***-3.176***	1	43.717	1990, 2003	***-8.755***	6	CC	1988, 1998	-0.039	TSB
Japan	***0.046***	2	-1.369	1	-1.128	1	***-3.404***	1	CT	***0.166***	3	-1.705	2	70.470	1981, 1994	-4.702	4	CC	1987, 1998		URB
Nether-lands	0.878	5					-2.838	0	CT	***0.154***	3	-2.454	0	111.384	1994, 2000	***-7.694***	6	CC	1992, 2004	0.037	TSB
Spain	0.872	5					-3.018	1	CT	***0.101***	3	-2.540	1	91.666	1992, 2003	-3.673	6	C	1990		URB
UK	0.841	6					-1.768	0	C	***0.138***	4	***-1.821***	0	30.754	1993, 1999	-2.687	3	AA	1992, 2000		URB
USA	0.996	2					***-4.172***	6	CT	***0.103***	4	-1.670	3	86.187	1989, 1993	***-7.571***	7	CC	1989, 2000	0.030	TSB

Note as per Table 3.

4.4. Comparative analysis and robustness checks

It may be argued that factor price convergence is phenomenon that is not limited to developed countries alone, but that concerns nations with different levels of economic development. We note that other sources of data are available for the construction of profit rate indicators. Comparison of profit rate levels and dynamics may also be instructive.

To address these issues, we make use of "Extended Penn World Tables: Economic Growth Data assembled from the Penn World Tables and other sources" database constructed A. Marquetti and estimate economy-wide profit rate for a total of 39 developed and developing economies over the 1973-2003 period. The economies included in the sample are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the UK and the US in the developed economies group, and Bolivia, Chile, Colombia, Costa Rica, Hong Kong, Israel, Jordan, Kenya, South Korea, Mauritius, Mexico, Panama, Peru, South Africa, Sri Lanka, Thailand, Trinidad and Tobago and Venezuela in the developing economies group. The database has a number of gaps in the series and shorter time series for a number of economies, hence the selection of the countries was dictated by data availability.

The profit rate is calculated conventionally as ratio of net operating surplus to capital stock as:

$$PR = \frac{\left(GDP - Nw - D\right)}{K}, \quad (12)$$

where GDP is real gross domestic product in 2005 purchasing power parity, K is net fixed standardised capital stock in 2005 purchasing power parity, D is depreciation estimated from the net fixed standardised capital stock, N is the number of employed workers, and w is the average real wage in 2005 purchasing power parity.

The visual examination of the average profit rates for the world in total and for the developed and developing economies indicates three regularities (Figure 4). Firstly, the profit rates in the developed economies were lower on average than rates in the developing economies (19.31% for the former group, 27.57% for the latter, and 23.12% for both groups over the 1973-2003 period), the profit rate differential being one of the reasons behind the export of capital and foreign direct investment flows from high- to low-income economies. This regularity falls well in line with prior research of rates' differentials by Harberger (1978) and Peterson (1989) for the earlier decades and Udry and Anagol (2006) for recent years. Secondly, the profit rates in both economic groups appeared to co-move (the hypothesis that can be verified empirically via cointegration analysis), however there were periods when profit rate differential between the groups attenuated (the early 1980s and the late 1990s). This visual observation if verified below through sigma convergence analysis. Thirdly, the moderate decline in profit rates in all three groups in the 1970s was superseded by the revival of profit rates starting from the early 1980s. This also confirms the earlier analysis that pointed to the rise in wage share and increase in militancy of labour in the developed economies in the 1970s, and the entrenchment of neoliberal policies, demise of Keynesian economic policies and the steadfast movement towards free trade and liberalisation of foreign investment in the 1980-90s (Carter, 2003). This regularity was not confined to developed economies, but was also observed in the developing countries (where import-substitution policies of the 1970s were replaced by Washington Consensus policies and IMF-directed structural adjustment policies). Fourthly, the rates in the developing economies were likely more volatile (a reflection of higher volatility of income and GDP).

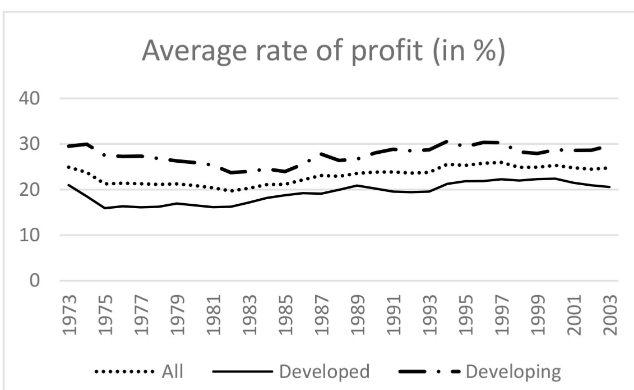

Figure 4 - Average rates of profit across the groups

The beta convergence was present in both country groups and for the aggregate of the groups (Table 7). The signs of the coefficients of the initial level of profit rate (1973) were negative in all three cases, and were the largest (in absolute terms) for the developing economies and the smallest for the developed ones. This result confirms that convergence to the steady-state level of profit was experienced not only in the high-income, but also in a low-income group of economies, as well as on a world scale. The results in Table 7 were obtained by exclusion of certain outlier economies that tended to have significantly higher growth rates of profit than group average. Inclusion of outlier economies did not dramatically alter the results, only changing the significance of the beta coefficients.

Table 7 - Unconditional beta convergence in profit rates (three groups of countries)

Models	Constant	Beta	R^2_{adj}	JB	Het
Aggregate	2.329	-7.959	0.178	0.626	HW
	(2.646)	(-2.315)		(0.731)	
Developed	2.286	-10.017	0.088	1.907	0.123
	(1.805)	(-1.711)		(0.385)	
Developing	3.590	-10.358	0.315	0.725	0.487
	(3.194)	(-2.972)		(0.696)	

Note. As per Table 1.

With regard to sigma convergence, the profit rate dispersion coefficient tended to be stable during the period or had moderate upward trend (Figure 5). Greater volatility in the dispersion was observed for the developing economies and the aggregate of economies, reflecting greater similarity of economic structures and policies and larger scale of trade and investment in the OECD group and European area.

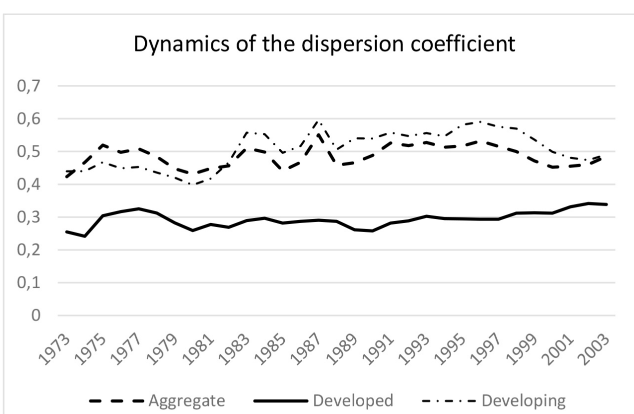

Figure 5 - Trends in the dispersion of the profit rates

A more formal analysis (Table 8) indicated nonlinearity of the dispersion coefficient of the aggregate group and developing economies and linearity of the coefficient in the developed economies. The ADF test pointed to stationarity (around constant or trend) of dispersion for the aggregate group, and unit roots in dispersion coefficient in the developed and developing economies group. On the other hand, KPSS and to lesser extent DF-GLS and Lee-Strazicich tests demonstrated stationarity across the groups and test specifications. Nonlinear KSS test indicated nonlinear stationarity for the aggregate of two groups and linear unit root for the developing economies. The structural break were identified at 1983, 1998 and 2000 for both groups of economies, corresponding to the shift in economic policy paradigm of the early 1980s, the Asian crisis of 1997-98 and the dot-com crisis and the end of speculation and bullish investment in IT sector of the early 2000s. The trend regression implemented with breaks indicated positive but insignificant trend coefficients.

Table 8 - Univariate tests of the dispersion coefficients (three groups of countries)

Test		Aggregate	Developed	Developing
BDS	d=2	0.060	0.577	0.044
	d=3	0.017	0.251	0.017
	d=4	0.004	0.373	0.035
	d=5	0.001	0.081	0.069
	d=6	0.001	0.039	0.099
KSS	Stat.	-3.785	N/A	-2.131
ADF	Stat.	-3.671	-2.017	-1.952
	Model	Constant	Constant	Constant
	Stat.	-3.542	-2.347	-1.849
	Model	Constant+trend	Constant+trend	Constant+trend
KPSS	Stat.	0.204	0.446	0.407
	Model	Constant	Constant	Constant
	Stat.	0.103	0.135	0.156
	Model	Constant+trend	Constant+trend	Constant+trend
DF-GLS	Stat.	-2.836	-1.630	-1.727
	Model	Constant	Constant	Constant
	Stat.	-3.378	-2.392	-2.023
	Model	Constant+trend	Constant+trend	Constant+trend
Bai-Perron	Stat.		20.004	66.769
	Stat.		20.004	79.346
	Break		1998	1983, 2000
LS	Stat.	-3.756	-4.060	-5.113
	Model	AA	AA	AA
	Break	1987, 1990	1984, 1988	1987, 1997
	Stat.	-6.394	-8.287	-6.086
	Model	C	CC	CC
	Break	1986	1987, 1999	1985, 1992
Trend/break	Coef-ficient	0.000	0.001	0.001
	t-stat	0.067	0.650	0.957
	Model	ARMA-CLS	ARMA-CLS	ARMA-CLS
Summary		Stationarity Stability	Stationarity with break Stability	Stationarity with break Stability

Note. As pr Table 2.

Overall, we conclude that consideration of a more inclusive group of countries does not alter the results compared to the study when limited number of more homogeneous countries (OECD or EU) is examined. The beta-convergence took place in developed and developing countries alike. Sigma-convergence analysis pointed to stability of the dispersion across the countries in a given group (i.e., neither convergence nor divergence) or moderate increase in dispersion (i.e., divergence). This result is consistent with the study of OECD profit rates: it is expected that inclusion of a greater number of diverse economies with different economic trajectories and experiences would not result in sigma convergence as was the case in same of the OECD groups.

5. Conclusion

This paper examined the issue of convergence in profit rates in OECD economies in recent decades. Three profit rates indicators (economy-wide, productive economy, and manufacturing rates) and three convergence concepts (beta, sigma, and stochastic convergence) were considered. It was shown that the profit rates in a cross-section of the economies converged to a single steady-state level, and a negative relationship between the initial level of the profit rates and their change rates was demonstrated (i.e., beta convergence was present). The dispersion of profit rates was stable in the case of economy-wide profit rates in 1960–2016 and manufacturing profit rates in 1977-2006 (the absence of sigma convergence or divergence). Some increase in manufacturing profit rates dispersion was indicated in the later part of the period (late 1990s and the 2000s), indicating a nascent sigma divergence tendency. Productive economy profit rates exhibited clear sigma convergence (decline in dispersion), while economy-wide rates in 1980–2016 showed clear sigma divergence (increased dispersion). On an individual country basis, stochastic convergence (conceptualised as mean reversion of the relative profit rates towards the unitary level, or trend stationarity with a negative trend coefficient) was indicated in a smaller number of cases, being most common in the case of productive economy and manufacturing profit rates. The robustness check performed on a larger set of developed and developing economies and aggregate profit rates confirmed the findings with regard to presence of beta convergence, but did not identify reduction of profit rates' dispersion (sigma convergence), given the diversity and heterogeneity of economies in the set. The study is in line with previous research efforts in the field. The identified different levels of profit rates across the developed and developing economies confirms the previous findings by Harberger (1978) and Peterson (1989). Despite theoretical predictions there was limited sigma convergence across the globe (and between developed and developing economies) thus confirming the insights by Glyn (1997) and Izyumov and Vahaly (2014). The sigma convergence in a more homogeneous groups (e.g., productive economy profit rates in OECD) falls in line results demonstrated by Floystad (1973) and Mokhtari and Rassekh (1989) for OECD and Western European economies. The beta convergence identified in nearly all cases (groups) confirms the earlier result by Pyo and Nam (1999) who examined convergence of rates of return to capital in OECD. Future research should examine the causal forces (macroeconomic, industry- and firm-specific, as well as structural) that hamper or facilitate FPC and consider convergence processes in other groups of countries or at the regional level in individual economies.

References

Aldy, J. E. 2007. "Divergence in state-level per capita carbon dioxide emissions." *Land Economics* 83, nº. 3: 353-369.

Andrews, D., Criscuolo, C., and Gal, P. 2015. "Frontier firms, technology diffusion and public policy: micro evidence from OECD countries". *OECD Productivity Working Papers nº 2*, 1-38.

Bai, C., Hsieh, C-T. and Qian, Y. 2006. "The return to capital in China." *Brookings Papers on Economic Activity*, 2: 61-100.

Bai, J., and Perron, P. 1998. "Estimating and testing linear models with multiple structural changes." *Econometrica* 66, nº 1: 47-78.

Bai, J., and Perron, P. 2003. "Computation and analysis of multiple structural change models." *Journal of Applied Econometrics* 18, nº. 1: 1-22.

Barro, R., and Sala-i-Martin, X. 1992. "Convergence." *Journal of Political Economy* 100, nº. 2: 223-251.

Basu, D. 2013. "Replacement versus historical cost profit rates: What is the difference? When does it matter?" *Metroeconomica* 64, nº. 2: 293-318.

Berger, B., and Wolff, G. 2017. "The global decline in the labour income share: Is capital the answer to Germany's current account surplus?" *Bruegel Policy Contribution nº. 12, April*, 1-17.

Berger, H., and Westermann, F. 2001. "Factor price equalization? The cointegration approach revisited." *Weltwirtschaftliches Archiv* 137, nº. 3: 525-536.

Bernard, A. B., and Durlauf, S. N. 1995. "Convergence in international output." *Journal of Applied Econometrics* 10, nº. 2: 97-108.

Bernard, A. B., and Durlauf, S. N. 1996. "Interpreting tests of the convergence hypothesis." *Journal of Econometrics* 71, nº. 1-2: 161-173.

Bernard, A. B., Redding, S., Schott, P. K., and Simpson, H. 2002. "Factor price equalization in the UK?" *NBER Working Paper nº. 9052*. Cambridge: National Bureau of Economic Research.

Bernhofen, D. M. 2009. "Multiple cones, factor price differences and the factor content of trade." *Journal of International Economics* 79, nº 2: 266-271.

Bigsten, A. 2000. "Rates of return on physical and human capital in Africa's manufacturing sector." *Economic Development and Cultural Change* 48, nº 4: 801–827.

Brock, W. A., Dechert, W. D., and Scheinkman, J. A. 1987. "A test for independence based on the correlation dimension." *Econometric Reviews* 15, nº 3: 197-235.

Bruno, M., and Sachs, J. 1985. *The economics of worldwide stagflation*. Basil Blackwell, Oxford.

Burgman, T. A., and Geppert, J. M. 1993. "Factor price equalization: A cointegration approach." *Weltwirtschaftliches Archiv* 129, nº 3: 472-487.

Carter, M. S. 2003. "Three essays on empirical patterns in functional distribution for a cross section of countries: Evidence from the extended Penn World Tables, 1963-1996." New School University, Unpublished Dissertation.

Chan-Lee, J., and Sutch, H. 1985. "Profits and rates of return in OECD countries". *OECD Economics Department Working Papers nº. 20.* Paris: OECD Publishing.

Chong, T., Hinich, M., Liew, K., and Lim, K. 2008. "Time series test of nonlinear convergence and transitional dynamics." *Economic Letters* 100, nº 3: 337-339.

Chou, N.-T., Izyumov, A., and Vahaly, J. 2015. "Rates of return on capital across the world: Are they converging?" *Cambridge Journal of Economics* 40, nº 4: 1149-1166.

Deardorff, A. 1994. "The possibility of factor price equalization, revisited." *Journal of International Economics* 36, nº 1-2: 167-175.

Dickey, D. A., and Fuller, W. A. 1981. "Likelihood ratio statistics for autoregressive time series with a unit root." *Econometrica* 49, nº 4: 1057-1072.

Dollar, D., and Wolff, E. 1988. "Convergence of industry labor productivity among advanced economies, 1963-1982." *Review of Economics and Statistics* 70, nº 4: 549-558.

Duménil, G., and Lévy, D. 2004a. "The real and financial components of profitability (United States, 1952-2000)." *Review of Radical Political Economy* 36, nº 1: 82-110.

Duménil, G., and Lévy, D. 2011. *The crisis of neoliberalism*. Cambridge: Harvard University Press.

Elliott, G., Rothenberg, T., and Stock, J. 1996. "Efficient tests for an autoregressive root." *Econometrica* 64, nº 4: 813-836.

Emmanuel, A. 1972. *Unequal exchange: A study in the imperialism of trade*. London: New Left Books.

Floystad, G. 1974. "Factor-price equalization in theory and practice: A study of mainly Norwegian data." *Weltwirtschaftliches Archive* 109: 554-578.

Glyn, A. 1997. "Does aggregate profitability r*eally* matter?" *Cambridge Journal of Economics* 21, nº 5: 593-619.

Glyn, A. 2004. "The assessment: How far has globalization gone?" *Oxford Review of Economic Policy* 20, nº 1: 1-14.

Harberger, A. C. 1978. "Perspectives on capital and technology in less-developed countries". In Artis, M. J., Nobay, A. R. (Eds.) *Contemporary Economic Analysis*. London: Croom Helm.

Hernan Vallejo, G. 2004. "A formal proof of the factor price equalization theorem". Universidad de los Andes, *CEDE 2004-05*, 1-18.

Izyumov, A. and Alterman, S. 2005. "The general rate of profit in a new market economy." *Review of Radical Political Economy* 37, nº 4: 476-493.

Izyumov, A., and Vahaly, J. 2014. "Recent trends in factor income shares: A global perspective." *Journal of Economic Studies* 41, nº 5: 696-707.

Kapetanios, G., Shin, Y., and Snell, A. 2003. "Testing for a unit root in the nonlinear STAR framework." *Journal of Econometrics* 112, nº 2: 359-379.

Kemp, M. C. 2001. "Factor price equalization when the world equilibrium is not unique." *Review of Development Economics* 5, nº 2: 205-210.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., and Shin, Y. 1992. "Testing the null hypothesis of stationarity against the alternative of a unit root." *Journal of Econometrics* 54, nº 1-3: 159-178.

Lee, J., and Strazicich, M. 2003. "Minimum Lagrange multiplier unit root test with two structural breaks." *The Review of Economics and Statistics* 85, nº 4: 1082-1089.

Lee, J., and Strazicich, M. 2004. "Minimum Lagrange multiplier unit root test with one structural break". *Appalachian State University, Department of Economics, Unpublished Manuscript*.

Lucchese, M., Nascia, L., and Pianta, M. 2016. "Industrial policy and technology in Italy". *ISIGrowth Working Paper*, 1-26.

Mankiw, G., Romer, D., and Weil, D. 1992. "A contribution to the empirics of economic growth." *Quarterly Journal of Economics* 107, nº 2: 407-437.

Mokhtari, M., and Rassekh, F. 1989. "The tendency towards factor price equalization among OECD countries." *The Review of Economics and Statistics* 71, nº 4: 636-642.

Ng, S., and Perron, P. 2001. "Lag length selection and the construction of unit root tests with good size and power." *Econometric*a 69, nº 6: 1519-1554.

O'Rourke, K., and Williamson, J. K. 1994. "Late nineteenth-century Anglo-American factor-price convergence: were Heckscher and Ohlin right?" *The Journal of Economic History* 54, nº 4: 892-916.

Peterson, W. 1989. "Rates of return on capital: An international comparison." *Kyklos* 42, nº 2: 203-217.

Phillips, P. C. B., and Perron, P. 1988. "Testing for a unit root in time series regression." *Biometrica* 75, nº 2: 335-346.

Pyo, H. K., and Nam, K. 1999. "A test of the convergence hypothesis by rates of return to capital: Evidence from OECD countries". *University of Tokyo, Center for International Research on the Japanese Economy Series, CIRJE-F-15*.

Rassekh, F. 1993. "International trade and the relative dispersion of industrial wages and production techniques in 14 OECD countries, 1970-1985." *Open Economies Review* 4, nº 3: 325-344.

Romano, L. 2016. "Understanding structural divergence in European manufacturing." *Intereconomics, Review of European Economic Policy* 51, nº 5: 288-294.

Sabatino, M. 2016. "The de-industrialization process in South Italy and the new industrial policies in Europe". *European Regional Science Association 56th Conference paper, 23-26 August, Vienna.*

Schmidt, P., and Phillips, P. C. B. 1992. "LM tests for a unit root in the presence of deterministic trends." *Oxford Bulletin of Economics and Statistics* 54, nº 3: 257-287.

Shaikh, A. 2010. "The first great depression of the 21st century". In Panitch, L., Albo, G., Chibber, V. (Eds). *The Crisis This Time: Socialist Register 2011*. London: The Merlin Press.

Silverman, B. W. 1986. *Density estimation for statistics and data analysis*. London: Chapman and Hall.

Slaughter, M. 1997. "Per capita income convergence and the role of international trade." *American Economic Review* 87, nº 2: 194-199.

Taylor, A. M., and Williamson, J. G. 1994. "Convergence in the age of mass migration". *NBER Working Paper nº. 4711.* Cambridge: National Bureau of Economic Research.

Tescari, S., and Vaona, A. 2014. "Regulating rates of return do gravitate in US manufacturing." *Metroeconomica* 65, nº 3: 377-396.

Trefler, D. 1993. "International factor price differences: Leontief was right!" *Journal of Political Economy* 101, nº 6: 961-987.

Tsoulfidis, L., and Tsaliki, P. 2005. "Marxian theory of competition and the concept of regulating capital: Evidence from Greek manufacturing." *Review of Radical Political Economic*s 37, nº 1: 5-22.

Vaona, A. 2011. "An empirical investigation into the gravitation and convergence of industry return rates in OECD countries." *International Review of Applied Economics* 25, nº 4: 465-502.

Udry, C., and Anagol, S. 2006. "The return to capital in Ghana." *American Economic Review* 96, nº 2: 388-393.

Weeks, J. 1981. *Capital and exploitation.* Princeton: Princeton University Press.

Weeks, J. 1999. "The expansion of capital and uneven development on a world scale". *School of Oriental and African Studies, Centre for Development Policy & Research (CDPR) Discussion Paper nº. 0999*.

Young, A. T., Higgins, M. J., and Levy, D. 2008. "Sigma convergence versus beta convergence: Evidence from US county-level data." *Journal of Money, Credit and Banking* 40, nº 5: 1083-1093.

Endnotes

[1] In the case of capital, the developed economies with abundant capital and low returns experience capital outflow to developing economies, characterised by capital scarcity and high capital returns, thereby leading to profit rate equalisation across economies (Chou et al., 2015: 1150).

[2] Another notable study conducted by Pyo and Nam (1999) examined convergence of rates of return to capital to the steady-state in OECD economies.

[3] The first group (1960–2016) based on AMECO includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, the UK, the USA. The second group (1980–2016) based on AMECO additionally includes Iceland and Japan. The two groups (1977-2006) based on KLEMS database include Australia, Austria, Denmark, Finland, Germany, Japan, Italy, Netherlands, Spain, the UK, and the USA.

[4] Bernard and Durlauf (1996) denote the former case as conditional convergence or catching up, when the differential between the series attenuates but does not disappear completely.

[5] The increase of labour share in the mid-1970s is documented by Bruno and Sachs (1985) and Chan-Lee and Sutch (1985), among others.

[6] The database is available at https://sites.google.com/a/newschool.edu/duncan-foley-homepage/home/EPWT