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Abstract

The hypotheses of sectoral return rates on regulating capital either gravitating around or converging towards a common value is tested on data for various OECD countries by adopting two panel varying coefficient approaches. Our null hypotheses receive some empirical support, that turns out to be stronger once focusing on manufacturing industries only. We offer a meta-analytic framework to assess the results obtained in the present contribution and in the past literature as well. Finally we discuss implications for economic policies and future theoretical and empirical research.

Keywords: capital mobility, gravitation, convergence, return rates on regulating capital, varying coefficient estimator, panel data.
JEL Codes: L16, L19, L60, L70, L80, L90, B51, B52

Introduction and key concepts

The issue of the tendential equalization of industrial return rates carries a considerable interest in economics, on both theoretical and policy grounds. On the one hand, prices of production – the subject of a vast literature after the work of Piero Sraffa – are defined as those prices that are charged when industrial profit rates are equalized. On the other hand, if profit rates differ across economic sectors, it will be interesting to understand the possible sources of such difference, as it will imply that arbitrage does not take place and some profitable opportunities are left unexploited.

The present contribution has two aims. In the first place, we will make use of a new econometric approach on a dataset already used in the literature in order to make comparability easier. In the second place we will offer a meta-analytic framework within which to assess the results here achieved as well as those of previous studies.

In order to introduce our topic some definitions are useful. After D'Orlando (2007) we consider *convergence* and *gravitation* as two different kinds of tendential equalization of profit rates. We say that return rates converge when they initially differ, but they tend to collapse towards a common value, though their deviations from such a value maintain a stochastic component. Complete equalization, therefore, never takes place. On the other hand, we refer to gravitation of return rates as their random oscillation around a common value. A graphical account of this distinction is offered in Vaona (2011, Figure 1).

The fact that, in the present work, convergence does not exclude the existence of stochastic deviations of return rates from their long-run common value makes our usage of this concept different for instance by the one done by Tsoulfidis and Tsaliki (2005). There convergence denotes the actual and instantaneous equalization of profit rates that takes place under neoclassical perfect competition - a quiet state of equilibrium, where fully informed, rational and symmetric agents operate in a market without either entry or exit barriers taking prices as given. Therefore we use the term convergence in a way that is far from the neo-classical (textbook) concept of competition and closer to the one of the classical tradition, of Marx and Schumpeter, that conceive tendential equalization of return rates as a turbulent phenomenon, produced by capital moving from one sector to the other in search of the highest possible profit[2].

The literature offers various definitions of return rates. The *average profit rate* (π_t) is the ratio of total profits (P_t) over the current cost value of the capital stock (K_t):

$$\pi_t = \frac{P_t}{K_t} \quad (1)$$

Shaikh (1997), Tsoulfidis and Tsaliki (2005) and Shaikh (2008), instead, advanced the concept of *return on regulating capital*. Capital can be termed "regulating" when it embodies "the best-practice methods of production" (Tsoulfidis and Tsaliki, 2005, p. 13) or, otherwise, "the lowest cost methods operating under generally reproducible conditions" (Shaikh, 2008, p. 167). According to these authors, the tendential equalization (either convergence or gravitation) of profit rates in different sectors does not take place for average profit rates, but only for returns on regulating capital. This is because – due to some adjustment costs - individual capitals, accumulated in the past, cannot easily switch to best-practice methods of production, which are adopted only by new capitals flowing into a sector. As a consequence heterogeneous *average* profit rates both within and between sectors exist and neither gravitation nor convergence would take place among them.

Shaikh (1997) proposed the concept of incremental rate of return (IROR) as an approximation to the return on regulating capital. Within total current profits one can distinguish profits from the most recent investments ($r_{It} \cdot I_{t-1}$, where r_{It} is the return rate on previous period investments I_{t-1}) and profits from all previous investments (P^*):

$$P_t = r_{It} \cdot I_{t-1} + P^* \quad (2)$$

Subtracting from both sides of (2) profits lagged one period, it is possible to obtain

$$P_t - P_{t-1} = r_{It} \cdot I_{t-1} + (P^* - P_{t-1}) \quad (3)$$

[2] On this distinction see also Shaikh (1980) and Duménil and Lévy (1987). Duménil and Lévy (1993, 69-73) write that capital mobility can either take the form of firms' entries and exits – Marx and Adam Smith's view – or credit flows – Ricardo's view.

At this stage, it is assumed that $P^*=P_{t-1}$ on the ground that for short term horizons - up to one year according to Shaikh (1997) - current profits on carried-over vintages of capital goods (P^*) are close to last period's profit on the same capital goods (P_{t-1}). Therefore it is possible to write

$$r_{It} \approx \frac{\Delta P_t}{I_{t-1}} \equiv IROR_t \tag{4}$$

where Δ is the first-difference operator.

In the first econometric approach of the present contribution we approximate the return on regulating capital in a different way. We do not impose $P^*-P_{t-1}=0$, instead we assume that P^*-P_{t-1} is a stationary random variable with zero mean and given variance that we call u_t. So (3) changes into

$$P_t - P_{t-1} = \rho_t \cdot I_{t-1} + u_t \tag{5}$$

where ρ_t is a time-varying coefficient and it is our approximation of the return rate on regulating capital. It is worth noting that this stationarity assumption is well rooted in the literature of reference (see, for instance, Shaikh, 1997, p. 395; Tsoulfidis and Tsaliki, 2011; Tsoulfidis, 2011, p. 130; and especially Shaikh, 2008, pp. 172-174)[3].

In our second econometric approach, instead, we proceed as follows[4]. We devide both sides of (3) by I_{t-1} and so we can write

$$IROR_t = r_{It} + \zeta_t \tag{6}$$

where $\zeta_t \equiv (P^*-P_{t-1})/I_{t-1}$ is assumed to be a stationary random variable with zero mean and given variance, while r_{It} is a time-varying coefficient about whose dynamics it is possible to implement econometric tests. We give a more detailed account of our approaches below.

Furthermore, we do not focus on profit margins on sales because we accept the point made by Tsoulfidis and Tsaliki (2005) that, if profit-capital ratios are equalized in presence of unequal capital-output ratios, it will imply different profit margins.

[3] Actually it is so rooted that it is customary to assume that P^*-P_{t-1} is a just a constant equal to zero.
[4] We thank a referee for suggesting this alternative approach to us.

We also focus on industry data and not on firm level data, though the latter have been the subject of a rather extensive literature (for a brief review see Vaona, 2011). This is because we accept the arguments advanced by Duménil and Lévy (1993, 145) and Tsoulfidis and Tsaliki (2005). The former study shows by means of numerical simulations that industry profit rates can be equalized even when individual firms have different technologies and, therefore, profit rates. In the latter study, it is argued that price equalization implies persistently unequal profit rates within sectors due to non-reproducible elements of production, such as location, climate, natural resources and innovation capabilities. As a consequence, as mentioned above, equalization can take place for returns on regulating capitals only.

Furthemore, as stressed by Malerba (2002) advancing the concept of *sectoral systems of innovation and production*, industries are populated also by non-firms organizations such as universities, financial institutions, government agencies and local authorities and their dynamics are affected by institutions like specific norms, routines, habits, established practices, rules, laws, standards and so on. As a consequence, the performance of industries carries an interest in itself and it cannot be reduced only to that of their firms.

The remaining part of this study is structured as follows. The next two sections introduce our dataset, econometric methods and results. The fourth one, instead, connects them to the previous literature within a meta-analytic framework. The last section concludes and offers implications for economic policies and both theoretical and empirical future research.

The data

As in Vaona (2011), we analyse data produced by the OECD for Austria from 1976 to 2008, Finland from 1975 to 2008, Italy from 1970 to 2008, the Netherlands from 1987 to 2008, West Germany from 1970 to 1991, Norway from 1970 to 2006, and the US from 1987 to 2007. We include in our sample only countries with at least 20 observations to increase our chances to capture long-term features of the data.

Our analysis is based on the OECD STAN industry list, which builds on the ISIC Revision 3 classification[5]. Therefore, we are concerned with the following sectors: Agriculture, hunting, forestry and fishing; Mining and quarrying; Food products, beverages and tobacco; Textiles, textile products, leather and footwear; Wood and products of wood and cork; Pulp, paper, paper products, printing and publishing; Chemical, rubber, plastics and fuel products; Other non-metallic mineral products; Basic metals and fabricated metal products; Machinery and equipment; Transport equipment; Manufacturing nec; Electricity, gas and water supply; Construction; Wholesale and retail trade, restaurants and hotels; Transport and storage and communication; Finance, insurance, real estate and business services. The advantages of these data are, in the first place, the coverage of various countries, characterized by a different degree of product market regulation and exposure to international trade (Høj et al. 2007), and, in the second place, their better quality within the OECD STAN database, which was specifically built to favour comparisons across countries and industries.

We exclude from our analysis the public sector because the motivations underlying investment choices might be different there from the quest for the maximum possible return.

After Duménil and Lévy (2002) and Vaona (2011), among others, we provide both results considering all the economic sectors and focusing on manufacturing industries only. This is because one might argue that the capital stocks of the Financial intermediation and Wholesale trade sectors are not accurately measured due to the lack of data on financial debts and assets. Furthermore, Agricultural and Construction activities might have a too large share of individual businesses, which may not respond to profit rate differentials due to either lack of information or absence of a profit maximizing behaviour. Finally, the capital stock in Mining, Transport and Electricity activities might not be properly measured due to its long duration. So we expect that restricting the analysis to manufacturing industries will provide more favourable results to the tendential equalization hypotheses.

[5] http://www.oecd.org/dataoecd/5/30/40729523.pdf.

The level of aggregation of our analysis is determined by preserving the quality of the data. However, for manufacturing industries in Austria, it is possible to provide estimates also concerning two-digit sectors and offer, therefore, some evidence regarding the existence or not of a possible aggregation bias in our results.

From the OECD STAN database we consider the variables: Labour compensation of employees (LABR), Total employment – Persons (EMPN), Employees – Persons (EMPE), Gross operating surplus and mixed income (GOPS) and Gross Fixed Capital Formation (GFCF). Similarly to Duménil and Lévy (2002) and Shaikh (2008) among others, we proxy the wage equivalent of the self-employed by labour costs over total employment times the number of the self-employed. In the end, as in Shaikh (2008), we compute profits for industry i at time t (P_{it}) as follows

$$P_{it} = GOPS_{it} - \left[\frac{LABR_{it}}{EMPE_{it}} \cdot \left(EMPN_{it} - EMPE_{it} \right) \right] \tag{7}$$

where i denotes the sector and t the time period. Profits are net of taxes and of payments for interest, as measured by FISIM[6].

Econometric methods and results

Our econometric approaches build on panel data varying coefficient estimators (Hsiao, 1996, 2003; Hsiao and Pesaran 2008)[7]. Regarding our model specification, we start from Mueller (1986) and Vaona (2011), among others, where sectoral deviations of return rates from their cross-sectional means were modelled resorting to a third order polynomial in the inverse of a time trend:

$$\tilde{x}_{it} = \alpha_i + \frac{\beta_i}{t} + \frac{\delta_i}{t^2} + \frac{\varphi_i}{t^3} + \varepsilon_{it} \tag{8}$$

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[6] Our profit measure is an accounting one. As a consequence, it is exposed to the possible shortcomings highlighted by Fisher and McGowan (1983). However, a defence of accounting returns is offered in Muller (1986, 107) and Muller (1990, 9-14).

[7] It is worth recalling that models with time varying parameters are a special case of unobserved components models, which, in their turn, are one of the econometric tools available to analyse possibly non-stationary time series, together with differencing and cointegration analyses (Pedregal and Young, 2002, pp. 76-77 and 80). This is because they explicitely model trends and the evolution of the error variance across time. As a consequence, it is not relevant here to offer unit root and stationarity tests for I_{it} and ΔP_{it}.

where $\tilde{x}_{it}$ is the deviation of the return rate of sector i from the cross-sectional mean, ε_{it} is a stochastic error, t is time, α_i, δ_i, γ_i, and φ_i are parameters.

In this context, the starting point of our first econometric approach is an equation similar to (5), though in a panel format

$$\Delta P_{it} = \rho_{it} \cdot I_{it-1} + u_{it} \tag{9}$$

where ρ_{it} is now a coefficient that can vary across both time and cross-sectional units. Of course, there does not exist a meaningful way to estimate ρ_{it}, unless we impose some structure on it. This task is made possible combining equations (8) and (9), which in matrix form leads us to write

$$\begin{aligned} \underset{NTx1}{\boldsymbol{\Delta P}} &= \underset{NTxNT}{\boldsymbol{D(I)}} \cdot \underset{NTxNT}{\frac{1}{N}(\boldsymbol{1_N} \otimes \boldsymbol{\Im_T})} \cdot \underset{NTx1}{\boldsymbol{\rho}} + \underset{NTxNT}{\boldsymbol{D(I)}} \cdot \underset{NTxNT}{[\boldsymbol{\Im_{NT}} - \frac{1}{N}(\boldsymbol{1_N} \otimes \boldsymbol{\Im_T})]} \cdot \underset{NTx1}{\boldsymbol{\rho}} + \underset{NTx1}{\boldsymbol{u}} \\ \underset{NTxNT}{[\boldsymbol{\Im_{NT}} - \frac{1}{N}(\boldsymbol{1_N} \otimes \boldsymbol{\Im_T})]} \cdot \underset{NTx1}{\boldsymbol{\rho}} &= \left(\boldsymbol{\Im_N} \otimes \underset{Tx4}{\boldsymbol{Z}}\right) \underset{(4N)x1}{\boldsymbol{\gamma}} + \underset{NTx1}{\boldsymbol{\eta}} \end{aligned} \tag{10}$$

where subscripts denote matrix dimensions, $\Im$ is an identity matrix, ***D(I)*** is a diagonal matrix with ***I*** - the column vector containing the data on investment - on its main diagonal, ***1*** is a matrix of ones, $\boldsymbol{\rho}$ and $\boldsymbol{\gamma}$ are vectors of coefficients, ***u*** and $\boldsymbol{\eta}$ are vectors of stochastic errors and

$$\boldsymbol{Z} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ \vdots & \vdots & \vdots & \vdots \\ 1 & t^{-1} & t^{-2} & t^{-3} \\ \vdots & \vdots & \vdots & \vdots \\ 1 & T^{-1} & T^{-2} & T^{-3} \end{bmatrix}$$

where T is the last period of observation. We denoted matrices in bold characters.

As a consequence $\boldsymbol{\gamma}$ has the following structure

$$\boldsymbol{\gamma}' = [\alpha_1, \beta_1, \delta_1, \phi_1, \cdots, \alpha_N, \beta_N, \delta_N, \phi_N]$$

Note that $\underset{NTxNT}{[\boldsymbol{\Im_{NT}} - \frac{1}{N}(\boldsymbol{1_N} \otimes \boldsymbol{\Im_T})]}$ is a matrix that takes the deviations of the elements of a vector of panel data from their cross-sectional means.

In order to achieve an estimable equation we can first substitute the second equation in (10) into the first one.

$$\boldsymbol{\Delta P} = \boldsymbol{D(I)} \cdot \frac{1}{N} (\boldsymbol{1}_N \otimes \boldsymbol{\Im}_T) \cdot \boldsymbol{\rho} + \boldsymbol{D(I)} \cdot (\boldsymbol{\Im}_N \otimes \boldsymbol{Z})\boldsymbol{\gamma} + \boldsymbol{D(I)\eta} + \boldsymbol{u}$$

Further note that by the properties of the Kronecker product

$$\boldsymbol{1}_N \otimes \boldsymbol{\Im}_T = \boldsymbol{\iota}_N \boldsymbol{\iota}'_N \otimes \boldsymbol{\Im}_T = (\boldsymbol{\iota}_N \otimes \boldsymbol{\Im}_T)(\boldsymbol{\iota}'_N \otimes \boldsymbol{\Im}_T)$$

where $\boldsymbol{\iota}_N$ is a column vector of ones.

So one can write

$$\boldsymbol{\Delta P} = \boldsymbol{D(I)} \cdot (\boldsymbol{\iota}_N \otimes \boldsymbol{\Im}_T) \cdot \frac{1}{N} \underset{Tx1}{\bar{\boldsymbol{\rho}}} + \boldsymbol{D(I)} \cdot (\boldsymbol{\Im}_N \otimes \boldsymbol{Z})\boldsymbol{\gamma} + \boldsymbol{D(I)\eta} + \boldsymbol{u} \qquad (11)$$

where $\underset{Tx1}{\bar{\boldsymbol{\rho}}}$ is a vector of coefficients that are constant across cross-sectional units. Thanks to these passages the number of parameters to be estimated shrinks from *NT* to *T+4N*. Futher note that, under the assumption of u_{it} being stationary, homoskedastic and uncorrelated across time and cross-sectional units, (11) can be estimated by using a weighted least squares (WLS) approach. One first estimates

$$\boldsymbol{\Delta P} = \boldsymbol{D(I)} \cdot (\boldsymbol{\iota}_N \otimes \boldsymbol{\Im}_T) \cdot \frac{1}{N} \underset{Tx1}{\bar{\boldsymbol{\rho}}} + \boldsymbol{D(I)} \cdot (\boldsymbol{\Im}_N \otimes \boldsymbol{Z})\boldsymbol{\gamma} + v$$

by OLS and then uses the square roots of the fitted values of a regression of the squares of the elements of $\boldsymbol{v}$ over a constant and the squares of the elements of $\boldsymbol{D(I)}$ as weights in a WLS regression (Greene 2003, p. 228).

At this stage, it is possible to test the convergence hypothesis of industry returns on regulating capitals which entails

$$\alpha_i = 0 \text{ and } \beta_i \text{ or } \gamma_i \text{ or } \delta_i \neq 0 \text{ for all } i \qquad (12)$$

and the gravitation hypothesis which implies

$$\alpha_i = \beta_i = \gamma_i = \delta_i = 0 \text{ for all } i \qquad (13)$$

We test (12) and (13) by means of Wald tests.

Regarding our second econometric approach, we begin with equation (6) in panel format

$$IROR_{it} = r_{I,it} + \zeta_{it} \qquad (14)$$

We add and subtract from the left hand side of (14), the average $r_{I,it}$ at time t, $\bar{r}_{I,.t}$, and we use equation (8) to write

$$IROR_{it} = \alpha_i + \frac{\beta_i}{t} + \frac{\delta_i}{t^2} + \frac{\varphi_i}{t^3} + \bar{r}_{I,.t} + \varepsilon_{it} + \zeta_{it} \tag{15}$$

$\bar{r}_{I,.t}$ can be estimated by inserting time dummies in the model and $\varepsilon_{it} + \zeta_{it}$ is a random variable with zero mean and given variance. In the end, (15) can be estimated by resorting to a two-way error component model with a third order polynomial in the inverse of the time trend. Our graviation and convergence tests are as in (12) and (13), but we rely on F tests in this case.

Table 1 sets out our results regarding our first approach. Since the gravitation hypothesis is more restrictive than the convergence one, in case both are accepted we will concentrate on the former one only. Again, we run our tests both considering all private economic sectors and focusing on manufacturing industries only. In the first case, the gravitation hypothesis cannot be rejected for Norway, West Germany and Finland, while estimated returns on regulating capital are on converging trends in US and not even converging in Austria, Italy and the Netherlands. In the second case, the gravitation hypothesis is not rejected in all the countries considered with the exception of the US - as a likely consequence of the fact that the cross-sectional averages of return rates of private economic sectors were far from those of manufacturing industries only, so that the former and not the latter ones were working as poles of attraction. Once focusing on 2 digits manufacturing industries in Austria, both the convergence and the gravitation hypotheses cannot be rejected, as the χ^2 statistics with respectively 21 and 84 degrees of freedom have p-values of 0.10 and 0.99.

Table 2 shows our results regarding our second approach. The null of gravitation was never rejected with the exception of Italy, whose return rates were not converging, when considering all the private economic sectors. They were converging, instead, when focusing on manufacturing industries only.

Connection to the literature

The present section is devoted to a quantitative assessment of the literature. We define the relevant literature as that adopting similar data and definitions than ours. So we focus on studies concerning the dynamics of industry profitability, defined with some reference to the advanced capital in the production process as in equations (1) and (4). Table 3 sets out the studies here considered.

Our aim is to test whether the results obtained by the literature are driven by some of its characteristics, namely the country analysed, the length of the time period, the aggregation level, the method of analysis, the definition of return rate (either on all the capital stock or on regulating capital), the type of equalization (either convergence or gravitation), the publication status, the adopted econometric model, the statistic of the return rates under analysis – namely whether the level of the return rates, their deviations from their cross-sectional means or their dispersion are analysed - and the coverage - namely if the study considers all the private economic sectors, a selected number of theirs or manufacturing industries only.

The country analysed is important because there might be differences in the degree of competition within countries. We consider the time period length to verify the hypothesis whether analysing longer time periods makes it easier to find evidence in favour of tendential equalization. If results differ in terms of aggregation level, we might be in presence of an aggregation bias. The adopted method of analysis, definitions and statistics of return rates, in their turns, might drive the conclusions of a given study. Furthermore, given that the gravitation hypothesis is more restrictive than the convergence one, it might be easier to find support for the latter than for the former one. Focusing either on a selected number of sectors or on manufacturing sectors only might make a difference in the results, for the reasons explained above. We also want to control whether each study was unpublished, published as either a book chapter or as a journal article, in order to account for possible publication biases. Finally, regarding the adopted explanatory model for the target statistics of the return rates, we distinguish seven cases: the adoption of no model, of the autoregressive model with and without a trend, a trend model as in (8) independently of the degree of the polynomial in the trend, a two-way component model with trend, a plain two-way component model and a two-way autoregressive component model. The last two cases aim at decomposing the dependent variable into two components, being them either sector and time specific or sector and region specific, as in Rigby (1991). The last case additionally considers the fact that the stochastic error of the model might be autocorrelated.

Our dependent variable is a binary one, which assumes a value equal to 1 if there is evidence in favour of tendential equalization and zero if there is not such evidence. Our unit of observation is each analysis carried out within a study. So for instance, if a study first considers all the sectors of a country and then manufacturing sectors only, it will have two entries in our dataset: one for the former results and the other for the latter ones. A similar approach was adopted when, for instance, different countries, return rates' definitions, methodologies and aggregation levels were considered in the same study. In the end we have 137 observations. In 51.8% of the cases, there was not evidence of tendential equalization, while in the remaining 48.2% there was.

Regarding the length of the time period considered, it ranges from 10 to 53 years, with an average of 28.4. Some descriptive statistics of the other explanatory variables are set out in Table 4. With the exception of a few analyses concerning India, Brazil and Turkey, most of the studies concentrated on developed countries, especially European ones. The industries analysed tend to be rather large ones, as the most widespread aggregation level is 1 digit sectors or even greater. We found that 10 different econometric/statistic methods were used in this literature, among which the most adopted were SURE robust to autocorrelation and the least squares approach. The 62% percent of the analyses were conducted for the gravitation hypothesis and about 38% for the convergence one. There is also a tendency to focus more on manufacturing industries than on all the private sectors. Most of the results are contained in published material, mainly in the form of journal articles, and a large majority of them concerns return rates on regulating capital as opposed to average profits. Finally, about 49% of the results were obtained for models including some form of autoregression.

Upon regressing our dependent variable on the explanatory ones, we consider as control group the analyses carried out for the US, for 1 digit or greater industries, adopting descriptive statistics, defining tendential equalization as gravitation and the return rate as the average profit, including all the private sectors, published in book chapters, not using any model, and explaining the level of the return rate. In the end, these analyses are those contained in Shaikh (2008).

We first started with several probit and logit regressions. However, given that the time period length was never significant, we dropped this variable and we switched to a linear probability model which can be used with a binary dependent variable when all the regressors are dummy variables (Wooldridge, 2001, 456-457). The insignificance of the time period length is a result in itself, though. Duménil and Lévy (1993, p.155) showed by means of numerical simulations that limitations to capital mobility can produce highly persistent deviations in industry profit rates. Inspecting their results it is possible to infer that, observing industry profit rates for periods of 10-50 years, one might find that profit rates do not seem to gravitate and they appear to follow trends which might or might not converge, as shocks to profitability tend to vanish very slowly. On one side it might be possible to observe the gravitation of profit rates once having data for a much longer time span than that usually considered in the literature. On the other, in case of repeated shocks, even longer time series might not help.

Table 5 shows our results concerning the other explanatory variables, once dropping the time period length and shifting to a linear probability model. It is more likely to find evidence in favour of tendential equalization in Denmark, Finland, Norway and West Germany than in the US. This might entail that limitations to capital mobility might be weaker there than in the other countries analysed. Aggregation does not appear to have any statistically significant effect, ruling out the presence of aggregation biases. No estimation method and no specific model has a significantly different probability of finding evidence in favour of either gravitation or convergence of profit rates compared to descriptive analyses adopting no model. This implies that most of the econometric methods and models presented in the literature would not *per se* lead scholars in the field to reach different conclusions than descriptive statistics.

Defining tendential equalization as either convergence or gravitation does not seem to make any difference. Focusing only on either manufacturing or selected industries significantly increases the chances to find evidence in favour of return rates' tendential equalization. Results are affected in a similar way by considering return rates' dispersion instead of their deviations from the cross-sectional mean or defining them as return rates on regulating capital instead of average profit rates. This last result can be interpreted as a consequence of the presence of adjustment costs when adopting best practice methods of production. Finally, there does not appear to exist any publication bias.

Conclusions

The present communication is devoted to testing the hypotheses of gravitation and convergence of industrial rates of returns, by making use of a varying coefficient approach. The results obtained are then included in a meta-analytic exercise together with previous contributions to the literature. Our analysis has important implications not only for both theoretical and empirical research, but also for economic policy making.

In the first place we highlighted that considering longer time spans does not increase the chances of producing results in favour of the tendential equalization of sectoral return rates. This was interpreted as the outcome of limitations to capital mobility. The fact that considering return rates on regulating capital significantly increases the probability of finding evidence of either gravitation or convergence of return rates suggests that adjustment costs when adopting best practice reproducible methods of production can offer some explanation to the lack of mobility of capital. However, as stressed by Vaona (2011), one cannot in principle exclude that other kinds of limitations to capital mobility might be at stake as well, such as investors' lack of information, an uneven distribution of the abilities of firms across economic industries to innovate and, finally, structural differences across sectors affecting their ability to attract credit flows.

These four kinds of limitations to capital mobility point to four possible directions for policy interventions. In the first place, if policy makers were able to quantify adjustment costs to adopt best practice methods of production and supposing they were free from lobbying pressures, it might be desirable to subsidize those sectors where such costs are higher so that the diffusion of best practice methods of production can proceed faster. In the second place, it could be beneficial to create institutions able to spread information regarding profitable opportunities to agents not acquainted with the dynamics of given economic industries, in order to remove possible information obstacles to arbitrageurs. This result could also be obtained by favouring the inflow of credit into more profitable sectors, if this was hampered by structural factors, such as the inability of small firms to offer some collateral. Finally, when industrial return rates vary due to different innovative performances, it might be the case that sectoral systems of innovation are working well in some industries and less so in others. In other words, the evolving interaction of actors and their networks with ever-changing, sector specific institutions, knowledge bases, technologies and inputs might produce different economic outcomes (Malerba, 2002, 2005). Under such circumstances, comparisons of under-performing and over-performing sectoral systems of innovation can lead to policy recommendations able to take into account the specificities of each industry.

The fact that considering all the private economic sectors entails a significantly lower probability to find evidence of the tendential equalization of return rates stresses the importance for models - not focusing only on either manufacturing sectors or on a fraction of the private economy - to include barriers to capital mobility and allow for heterogeneous industrial profit rates such as those, for instance, in Duménil and Levy (1993, p. 155) and Semmler (1984, pp. 147-151).

Our analysis also points to some fruitful directions for future empirical research in the field. In the first place we highlighted how most of the literature focused on developed countries, either in Europe or in North America. So it would be interesting to analyse either developing countries or industrialized countries belonging to other geographical areas. While doing so different approaches should be considered at the same time and results should be included in meta-analytic exercises to check whether the apparent irrelevance of using most of the econometric methods and models proposed in the literature instead than descriptive statistics is robust to the inclusion of new observations.

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Table 1 – Econometric tests for convergence and gravitation of return rates on regulating capital.
Estimation method: varying coefficient weighted least squares

	All private sectors			Manufacuring sectors only		
	χ^2	degrees of freedom	p-value	χ^2	degrees of freedom	p-value
Convergence hypothesis						
Austria	45.03	17	0.00	2.29	10	0.99
Finland	16.73	17	0.47	7.63	10	0.66
Italy	82.94	17	0.00	14.45	10	0.15
The Netherlands	319.58	17	0.00	2.66	10	0.99
Norway	3.51	17	0.99	4.01	10	0.95
US	24.07	17	0.12	19.88	10	0.03
West Germany	16.90	17	0.46	2.04	10	0.99
Gravitation hypothesis						
Austria	124.03	68	0.00	18.88	40	0.99
Finland	48.86	68	0.96	31.82	40	0.82
Italy	192.01	68	0.00	38.26	40	0.55
The Netherlands	726.76	34	0.00	23.89	40	0.98
Norway	15.43	68	1.00	13.55	40	1.00
US	102.41	68	0.00	75.83	40	0.00
West Germany	63.91	68	0.62	10.15	40	1.00

Table 2 – Econometric tests for convergence and gravitation of return rates on regulating capital.
Estimation method: two-way least squares dummy variables

	All private sectors				Manufacuring sectors only			
	F	degrees of freedom		p-value	F	degrees of freedom		p-value
Convergence hypothesis								
Austria	0.80	17	448	0.69	0.75	10	252	0.67
Finland	0.60	17	464	0.89	0.89	10	261	0.55
Italy	1.74	17	544	0.03	0.78	10	306	0.65
The Netherlands	0.65	17	256	0.85	0.43	10	144	0.93
Norway	0.74	17	512	0.76	1.11	10	288	0.35
US	1.11	17	256	0.35	1.37	10	159	0.20
West Germany	0.54	17	272	0.93	0.32	10	153	0.95
Gravitation hypothesis								
Austria	0.81	65	448	0.85	18.88	37	252	0.81
Finland	0.60	65	464	0.99	31.82	37	261	0.83
Italy	2.62	65	544	0.00	38.26	37	306	0.00
The Netherlands	0.80	65	256	0.85	23.89	37	144	0.90
Norway	0.43	65	512	1.00	13.55	37	288	0.99
US	0.80	65	256	0.85	75.83	37	159	0.28
West Germany	0.54	65	272	0.99	10.15	37	153	0.99

Table 3 – Empirical studies on the tendential equalization of industry return rates

Study	Country	Time period length	Aggregation level	Method of analysis	Definition of return rates	Type of tendential equalization	Industry coverage	Publication status	Model specified for the profit rate	Explained statistic of the return rate
Glick and Ehrbar (1988)	France, Germany, Italy, UK and US	From 10 to 30 years	1 digit or greater industries	Maximum likelihood robust to autocorrelation	Average	Gravitation	Manufacturing and selected industries	Journal Article	Two way autoregressive components model	Return rate levels
Glick and Ehrbar (1990)	US	19	2 digits industries	Weighted least squares robust to autocorrelation	Average	Gravitation	Manufacturing industries	Journal Article	Two way autoregressive components model	Return rate levels
Rigby (1991)	Canada	24	2 digits industries	ANOVA and OLS	Average	Gravitation	Manufacturing industries	Journal Article	Autoregressive model and two way components model	Return rate levels and deviations from the cross-sectional means
Lianos and Droucopoulos (1993a)	Greece	26	2 digits industries	OLS	Average	Convergence	Manufacturing industries	Journal Article	Trend model	Profit rate dispersion
Lianos and Droucopoulos (1993b)	Greece	26	2 digits industries	SURE	Average	Gravitation	Manufacturing industries	Journal Article	Autoregressive	Deviations from the cross-sectional means
Kambhampati (1995)	India	16	3 digits industries	OLS robust to autocorrelation	Average	Gravitation and Convergence	Manufacturing industries	Journal Article	Autoregressive models with trend	Deviations from the cross-sectional means
Maldonhado-Filho (1998)	Brazil	13	3 digits industries	OLS	Average	Gravitation	Manufacturing and selected industries	unpublished	Autoregressive models	Deviations from the cross-sectional means
Zacharias (2001)	US	52	2 digits industries	Unit root/cointegration approach	Average	Gravitation	Manufacturing industries	unpublished	Autoregressive models	Deviations from the cross-sectional means
Duménil and Lévy (2002)	US	53	1 digit or greater industries	Descriptive stat.	Average	Gravitation	All private and selected industries	Journal Article	No Model	Return rate levels

(continues)

Table 3 – Empirical studies on the tendential equalization of industry return rates (continued)

Duménil and Lévy (2004)	US	49	1 digit or greater industries	Descriptive stat.	Average	Gravitation	Selected industries	Journal Article	No Model	Return rate levels
Tsoulfidis and Tsaliki (2005)	Greece	31	2 digits industries	OLS	Return rate on regulating capital	Gravitation	Manufacturing industries	Journal Article	Trend model	Deviations from the cross-sectional means
Shaikh (2008)	Aggregate OECD and US	From 18 to 31 years	From 2 digits industries to greater than 1 digit industries	Descriptive statistics	Average and on regulating capital	Gravitation	Manufacturing and selected industries	Book Chapter	No Model	Return rate levels and deviations from the cross-sectional means
Bahçe and Eres (2011)	Turkey	From 19 to 21	3 digits industries	Unit root approach and OLS	Average and on regulating capital	Gravitation	Manufacturing industries	unpublished	Autoregressive model	Deviations from the cross-sectional means
Tsoulfidis and Tsaliki (2011)	Greece	From 30 to 32	2 digits industries	OLS	Average and on regulating capital	Gravitation	Manufacturing industries	unpublished	Autoregressive model	Deviations from the cross-sectional means
Vaona (2011)	Italy, Finland, Denrmak, Netherlands, Norway, US, West Germany, Austria	From 20 to 50	1 digit or greater industries	Robust SURE	Average and on regulating capital	Gravitation and Convergence	All private, selected and manufacturing industries	Journal Article	Autoregressive model with trend	Deviations from the cross-sectional means
Present study	Italy, Finland, Netherlands, Norway, US, West Germany, Austria	From 20 to 38	From 2 digits to greater than 1 digit industries	Varying coefficient model	Return rate on regulating capital	Gravitation and Convergence	All private and manufacturing industries	Journal Article	Trend model and twoway error components model with trend	Deviations from the cross-sectional means and return rate levels

Table 4 – A statistical description of the literature

	Freq.	Percent
Countries		
Austria	12	8.76
Brazil	2	1.46
Canada	2	1.46
Denmark	4	2.92
Finland	16	11.68
France	1	0.73
Germany	1	0.73
Greece	5	3.65
India	5	3.65
Italy	17	12.41
The Netherlands	12	8.76
Norway	12	8.76
OECD	2	1.46
Turkey	4	2.92
UK	1	0.73
US	29	21.17
West Germany	12	8.76
Total	137	100
Aggregation levels		
1 digit or greater	111	81.02
2 digits industries	15	10.95
3 digits industries	11	8.03
Total	137	100

(continues)

Table 4 – A statistical description of the literature
(continued)

	Freq.	Percent
Estimation methods		
ANOVA	1	0.73
Descriptive stat.	11	8.03
Maximum likelihood robust to autocorr.	8	5.84
Least squares	37	27.01
OLS autocorr.	2	1.46
SURE robust to autocorr.	42	30.66
SURE	1	0.73
Unit root/cointegration	6	4.38
Varying coeff. WLS	28	20.44
Weighted least squares robust to autocorr.	1	0.73
Total	137	100
Type of equalization		
Convergence	52	37.96
Gravitation	85	62.04
Total	137	100
Industry coverage		
All private sectors	49	35.77
Manufacturing	76	55.47
Selected	12	8.76
Total	137	100
Publication status		
Book chapters	8	5.84
Journal Articles	120	87.59
Unpublished	9	6.57
Total	137	100

Notes: varying coeff. WLS: varying coefficient weighted least square estimator.

(continues)

Table 4 – A statistical description of the literature
(continued)

	Freq.	Percent
Models		
Autoregressive model	11	8.03
Autoregressive model with trend	47	34.31
No model	11	8.03
Trend model	30	21.9
Twoway autoregressive components model	9	6.57
Twoway components model	1	0.73
Twoway components model with trend	28	20.44
Total	137	100
Explained statistics of the return rate		
Deviations from cross-sectional mean	89	64.96
Level	47	34.31
Dispersion	1	0.73
Total	137	100
Return rate definition		
Average profit rate	45	32.85
Return rate on regulating capital	92	67.15
Total	137	100

Table 5 – A quantitative assessment of the literature.
Method: linear probability model with robust standard errors. Dependent variable: probability of finding evidence in favour of the tendential equalization of return rates. Observations: 137.

	Coefficients	t-stat.	p-values
Country dummies			
Austria	0.07	0.43	0.67
Canada	-0.43	-0.80	0.43
Denmark	0.42	2.50	0.01
Finland	0.40	2.94	0.00
France	-0.30	-1.30	0.20
Germany	-0.30	-1.30	0.20
Greece	0.22	0.69	0.49
Italy	0.01	0.06	0.95
The Netherlands	0.15	0.93	0.36
Norway	0.40	2.69	0.01
OECD	0.13	0.44	0.66
Turkey	0.40	1.57	0.12
UK	-0.30	-1.30	0.20
West Germany	0.40	2.53	0.01
Aggregation level dummies			
2 digits industries	-0.10	-0.23	0.82
3 digits industries	-0.27	-0.48	0.63
Estimation method dummies			
Maximum likelihood robust to autocorrelation	0.20	0.40	0.69
Least squares	0.65	1.02	0.31
OLS autocorr.	0.41	0.52	0.60
Robust SURE	-0.15	-0.11	0.92
Unit root/cointegration	0.65	0.83	0.41
Varying coefficient weighted least squares	0.32	0.27	0.79

(continues)

Table 5 – A quantitative assessment of the literature.

(continued)

	Coefficients	t-stat.	p-values
Type of equalization			
Convergence	0.11	1.48	0.14
Industry coverage			
Manufacturing	0.26	3.37	0.00
Selected	0.61	2.99	0.00
Publication status dummies			
Journal Article	0.42	1.41	0.16
Unpublished	0.00	0.00	1.00
Model dummies			
Autoregressive	-0.52	-0.87	0.39
Autoregressive with trend	-0.59	-0.44	0.66
Trend	-0.72	-0.62	0.54
Twoway autoregressive component model	-0.43	-0.80	0.43
Twoway components model with trend	-0.96	-1.32	0.19
Explained statistic of the return rate			
Level	0.13	0.44	0.66
Dispersion	0.45	3.52	0.00
Return rate definition			
Return rate on regulating capital	0.55	5.04	0.00
Constant	-0.29	-0.75	0.46
R^2		0.63	

Notes: the dummies for Brazil, India, for the methods analysis of variance, SURE, weighted least squares robust to autocorrelation and for the two-way components model were dropped due to collinearity.