Theories of Competition and the Concept of Regulating Capital: Evidence from Greek Manufacturing

by

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Abstract

The objective of this paper is twofold. First, to evaluate empirically the strength of the neoclassical, post-Keynesian, and classical core models of competition in the light of the available empirical evidence from Greek large-scale manufacturing industries. In modeling each of the theories of profit we try to single out the most important variables, which for the neoclassical theory of industrial profits refer to market structure characteristics, for the classical approach reflect production conditions and, finally, for the post-Keynesian model capture the demand conditions. Second, we discuss the long-run behavior of profits in the various theories and we examine the extend to which there is a tendential equalization of profit of each industry to the economy's average. In addition, we test the long run behavior of profits using the Marxian concept of regulating capital, since this is the unit of capital that participates in the process of the interindustry equalization of profitability.

Our results regarding the ability of the core models to explain profit differentials show that the classical and post-Keynesian models performed well, whereas the neo-classical faired last. Between the classical and post-Keynesian models, we found that the classical was more consistent with the phenomena that was designed to explain. With reference to the long-run behavior of the rate of profit, we verify the convergence hypothesis. When the concept of regulating capital and the corresponding rate of profit that is the incremental rate of profit are used, we observe convergence in the Marxian sence.

1. Introduction

The nature of competition and its consequences on key economic variables, such as prices, profits, and growth, have always been important for theoretical and empirical investigation. The neoclassical theory of competition prevails often giving the impression of being the only theory of competition. It is our contention that microeconomics is a developing discipline, and in addition to the neoclassical theory, there are two other major alternatives, the post-Keynesian and the classical. In recent years, these two alternatives have developed a growing literature on the microfoundations of economics (Shaikh, 1980; Eichner, 1985; Semmler, 1984, 1990; Ochoa and Glick, 1992).

In comparing competing theories it is difficult to single out the variables that represent each theory. It is our view, however, that we should begin by evaluating the most typical representation—what is called hard core—of each theory.[1] The justification of our view is that in discussions on questions of methodology often it is argued that "no individual scientific hypothesis is conclusively verifiable or falsifiable, because we always test the particular hypothesis in conjunction with auxiliary statements and therefore can never be sure whether we have confirmed or refuted the hypothesis itself. Since any hypothesis, if supplemented with suitable auxiliary assumptions, can be maintained in the face of contrary evidence, its acceptance is merely conventional" (Blaug, 1986, p. 237). Hence, if the hard core of a theory is proved significantly more powerful than the others, this would lend support to the claim that this is a superior theory, since it can account for much more of the observed phenomena before having to inject *ad hoc* variables and peripheral assumptions.[2]

The remainder of the paper is organized as follows: Section II highlights the most important features of the three microeconomic theories on competition and presents the theoretical model which will allow us to test the existence of the tendential equilization in the economy's rate of profit; Section III presents the definitions and the data used in our analysis; Section IV presents the econometric results and critically evaluates them. Finally, in Section VI we present our conclusions and some comments about the direction of future research efforts.

2. Competition and Profitability

In this section, we present the three alternative theories of competition, the neo-classical, the post-Keynesian and the classical. In so doing, we display the core model of each theory and we briefly analyze the nature of the key variables that each model incorporates. In turn, we present the model that is used to test the hypothesis concerning whether or not the rates of profit of each industry converge in the long run to the economy's average rate of profit. At the end of this section a brief analysis is presented referring to the concept of regulating capital and the related profitability index.

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[1] Hence, it is implicitly assumed Popper's demarcation rule: "theories are scientific if they are falsifiable in principle or in practice and not otherwise", cited by Blaug (1978, p. 697).

[2] In doing so, we want to escape from a methodological drawback called the "principle of tenacity", that is "the tendency of scientist to evade falsification of their theories by the introduction of suitable *ad hoc* auxiliary hypotheses" (Blaug, 1986, p. 235).

2.1 Three Notions of Competition

In what follows, the basic model of each of the three aformentioned microeconomic theories of competition is presented. From standard microeconomic theory it is known that the neoclassical analysis of competition is based on market structure variables, the classical on variables reflecting production conditions, and the post-Keynesian on variables capturing demand conditions.

The Neoclassical notion of competition

In neoclassical economics, the notion of competition is static meaning that competition is understood as a state (rather than as a process) that would prevail if there were free entry and exit of firms. In this static context firms are mainly seen as passive, that is—with given the consumers' preferences and the technological opportunities—they merely react to parametrically given prices. Changes are brought about exclusively by changes in the external parameters initiating a passive response of firms. The intensity of competition depends on the number of sellers and buyers and, in general, by the market structure of an industry. In this quantitative notion of competition, the firm is viewed as the legal entity that hires the services of the various factors of production and combines them to supply goods for a market. The larger the number of firms in a particular industry, the more effective their competitive behavior and, by extension, a uniform profitability is expected across industries. In this case, competition produces an equilibrium set of prices that induce a Pareto optimal allocation of the economy's goods and services. By contrast, the smaller the number of sellers and buyers, the more the oligopolistic and monopolistic behavior in the market and, by extension, the wider the differential profitability across industries.[3] In this non-competitive equilibrium some prices are above marginal cost, and society suffers from the underproduction and underutilization of available resources. Hence, within the standard microeconomic theory of the firm, the persistence of profits in excess of normal is always associated with market imperfections, and therefore, with monopoly power.[4]

The market structure of industries becomes the key element of neoclassical empirical studies with respect to observed interindustry profit rate differentials. Starting from the pioneering work of Joe Bain (1951), the neoclassical literature of profit differentials singles out 'strategic' economic variables (i.e., concentration ratio, entry barriers, collusion, etc.), whose presence signifies the appearance of imperfections in the operation of the market. Differential profitability, whenever it exists, is attributed almost entirely to market imperfections as they are captured by the 'strategic' economic variables.

The neoclassical core model used to account for profit differentials is presented below:

$$\pi = f\,(\overset{+}{c},\overset{+}{CR},\overset{-}{MP})$$

(1)

[3] In the limit there is a single seller or buyer (monopolist or monopsonist) who defines the total absence of competition.

[4] It is worth noting that within the neoclassical tradition there is the argument that any association among excess profits and market imperfections disappears when time, for market adjustments, is introduced. That is, profit differentials reflect the presence of disequilibrium and not necessarily the presence of monopolistic behavior (Brozen, 1971).

where π is some measure of profitability, c is the constant term, CR is a measure of the concentration ratio and MP is the imports penetration variable. The signs above the independent variables indicate the theoretically expected direction in which a change in each variable will affect the profitability of an industry. We use both domestic concentration ratios and import penetration to obtain a complete picture of the industry structure. The reason is that the domestic concentration ratio and therefore the degree of market power might be overstated when imports are not accounted for. We would expect, within the neoclassical framework, that profitability should display a direct relationship with the concentration ratio, and an inverse relationship with the imports penetration variable. A significant and positive constant term presents the normal profit in perfectly competitive conditions.[5]

The Classical notion of competition

In the writings of classical economists Adam Smith (1776), David Ricardo (1817), and Karl Marx (1894), competition is identified as a process characterized by free mobility of capital and labor, and with the concomitant tendential inter-industry equalization of the rate of profit, as well as of supply and demand. Consequently, in the industries that display profitability above the average the inflow of firms along with the inflow of investment increase the supply relative to demand and lower prices to the point that the rates of profit become approximately equal to the economy's average. In the less profitable industries, the above process works conversely, that is the reduction in supply raises prices, which in turn brings about a rate of profit closer to the average. This process, in the long run, implies a *quasi* convergence of interindustry profit rates to the economy's average (Dumenil and Levy, 1987). As a consequence, there is a long-run tendency for the elimination of inter-industry profit differentials, provided that there are no obstacles to the free operation of the market forces. Classical economists argued that in this *cross-over* dynamical equalization process—since prices react on quantities and vice versa (Flaschel and Semmler, 1990)—the most important factor for the elimination of inter-industry profit differentials and the concomitant tendential equalization of profit rates is the flow of capital and not necessarily the entry or exit of firms, which is the basis of the neoclassical theory of competition.

The classical idea of the equalization of inter-industry profit rates can also be found, to some extent, in the writings of neoclassical economists, particularly Marshall and Walras. The difference is that in the classical tradition competition is viewed as an intertemporal process, whereas in neoclassical economics the equalization process is instantaneous. For classical economists, free competition is not taken to be a highly idealized state, but as a realistic process of rivalry that can include firm behavior, i.e., advertisement, collusion, predatory pricing, etc, which might be considered incompatible with the neoclassical perfect competition.[6] In other words, the notion of competition

[5] Ideally this coefficient should be zero because in neoclassical economics we are assuming that in the long-run firms earn zero economic profits. However, in empirical studies, since the notion of economic profits is not easily amenable to quantification, researchers use the average rate of profit as a proxy to the economic profit. The validity of this assumption has been subject to a long debate, e.g. Fisher and McGowan (1983), Long and Ravenscraft (1984), and Sherer and Ross (1990).

[6] The classical notion of competition as a process of rivalry between firms continues in the works of Joseph Schumpeter (1943), who describes competition not as an equilibrating force but as a process of "creative

according to classical economists is much broader than that of neoclassical economists in that it is not limited to price and quantity adjustments, but is principally related to the evolution of capitalism. In short, the stress of the classical tradition is placed on the properties of the process and not on the characteristics of its final state.

Classical economists argued that the long-run equalization of profit rates gives rise to different profit margins across industries. Profit margins depend on differences in capital-output ratios, efficiency, unit labor costs, and in short, different production conditions.[7] The classical model employed to explain profit (margin) differentials is:

$$\pi = f\,(\overset{+}{c}, \overset{-}{MP}, \overset{+}{KS}, \overset{-}{IS}) \qquad (2)$$

where π is some measure of profitability, *MP* is the imports penetration—which is added to capture the international dimension of competition—*KS* is the capital-sales ratio, and *IS* is the input (intermediate goods) to sales ratio. The expectation is that if classical competition is working, there should be a significant relationship between profitability and the conditions of production. More specifically, the ratio of capital to sales must be directly related to profits. The reason is that the more capital tied up per unit of output or sales, the more the advancements in technology in the production process and thus the better the chances for higher profits. The ratio of intermediate consumption to sales is expected to be inversely related with profits, meaning that the smaller the input to sales ratio, the more efficient the industry and therefore the higher the profitability. The imports penetration variable should exert an independent negative influence on profitability. The positive and significant constant term represents the tendential equalization of profit rates across industries and the establishment of average profitability.

The post-Keynesian notion of competition

Post-Keynesian economists maintain the above outlined classical *cross-over* dynamical process only for the primary sector of the economy, which is characterized by a large number of producers, rigid supply in the short run, and flexible prices. For the manufacturing sector, they argue that profit differentials reflect some degree of monopoly power and therefore persist in the long run. Hence, the post-Keynesian microeconomic literature focuses its efforts to analyze the behavior of the megacorp, which dominates the manufacturing sector of the economy. This kind of new corporate organizations is managed and owned by entirely different groups of people. Managers and owners are viewed as differently motivated. Managers are mainly concerned with the expansion of the firm because their reward is tied to the company's size (as measured by the volume of sales). The owners of the firm, of course, are concerned with profits, and their maximization. However, the decisions are made by the managers, as a consequence, the primary goal of these large corporations becomes the maximization of the growth of sales, which can be achieved by maintaining at least a constant market share. Hence, the

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destruction" that can lead to instability and disequilibrium, or in marxian terms to the "anarchy of the market".

[7] In the neoclassical industrial organization literature there are studies according to which profit differentials are related to production and not to market structure conditions. Demsetz (1973) showed that profit differentials are not due to the size of firms, but rather to the firms' ability to organize efficiently the production process.

megacorp is not a passive agent of market forces but an active decision maker setting the target rate of return and making investment and pricing decisions.

Capital accumulation in post-Keynesian economics is guided by the growth of demand rather than by profitability, that is, investment moves from slower-growing industries to faster-growing industries. The level of investment is a function of anticipated industry growth and the amount of additional plant capacity needed to accommodate that growth. Changes in accumulation rates do not affect prices, which may change only by variations in cost. Firms, due to their monopoly power, can accommodate changes in costs through higher prices. Moreover, firms set their target rate of return to meet requirements for additional investment.

The post-Keynesian model that might be used to explain industrial profits is shown below:

$$\pi = f\,(\overset{+}{c}, \overset{+}{CR}, \overset{-}{MP}, \overset{+}{GD}, \overset{+}{IKOR}) \qquad (3)$$

where π is a measure of profitability, *CR* is the concentration ratio, *MP* is the imports penetration, *GD* represents the growth rate of demand, and *IKOR* is the incremental capital-output ratio, that is "the value of all capital inputs an industry must purchase to increase with that additional capacity" Eichner (1986, p. 50). It is expected that the ability to raise profits higher than the average will be directly related to the concentration ratio, to the growth rate of industry, and to the incremental capital-output ratio. The imports penetration should capacity by a given amount divided by the value of the output that can be produced affect inversely the profitability of domestic firms, meaning that international competition undermines the monopoly power of domestic firms. Again the positive and significant constant term stands for the positive average rate of profitability.

2.2 The Tendential Equalization of Interindustry Profit Rates

An interesting issue raised by the aformentioned theories of competition is the long run behavior of the profit rates as a concomitant result of the interindustry competition. The crucial difference between these theories is whether or not the rate of profit is tendentially equalized across industries. As we know, post Keynesians and neoclassicals to some extend would argue that such an equalization of profit rates is not possible because of the presence of monopoly, in which the market power of firms makes possible the presence of persistent profit rate differences between industries. By contrast, the classical Marxian perspective would argue that competition allows profit rates to differ. Moreover, there is a switch of ranks, that is, if industry *i* makes a rate of profit higher than industry *j* at one period of time, the site reverses at another period of time and so forth. Consequently, if a long run tendential equalization of the rate of profit across industries prevail, it will lend support to the classical Marxian view of competition.

The model

In what follows we describe the model that is used to test the hypothesis concerning whether or not the rates of profit of each industry converge in the long run. A similar formulation has been used for empirical studies for the U.S. (Glick, 1984) and for Canada (Webber and Rigby, 1989).[8]

Let $\pi^i_1, \pi^i_2, \ldots, \pi^i_n$ be the profit rate series of industry *i* for $t = 1,2, ..., n$. If $\bar{\pi}_t$ is the weighted average rate of profit of the manufacturing sector at time *t*, the $x^i_t = \pi^i_t - \bar{\pi}_t$ is the difference of the rate of profit of industry *i* from the average of the entire manufacturing at time *t*. Let us suppose that the time series of these deviations follow an autoregressive scheme

$$x_{t+1} = a + bx_t + u_{t+1} \tag{4}$$

where for simplicity's sake we ignore the superscript. Let us further suppose that the disturbance term u_t is normally distributed with zero mean and constant variance; moreover, the error terms are assumed independent of each other. Taking autoregressive schemes of higher order, we have:

$$\begin{aligned} x_{t+2} &= a + bx_{t+1} + u_{t+2} \\ &= a + ab + b^2 x_t + bu_{t+1} + u_{t+2} \end{aligned}$$

and, in general

$$x_{t+n} = a(1 + b + b^2 + \ldots + b^{n-1}) + b^n x_t + u_{t+n} + bu_{t+n-1} + \ldots + b^n u_t \tag{5}$$

We distinguish the following three cases which are related to the three terms included in equation (5):

- In the first term, $a(1 + b + b^2 + ... + b^{n-1})$, if $b \geq 1$, the term in the parenthesis will increase with *n*. If $b \leq -1$, the term in the parenthesis will increase in absolute prices with *n* and the sign outside of the parenthesis will alternate. If, finally, $-1<b<1$, the term in the parenthesis will approximate the limit $1/(1-b)$
- If $-1<b<1$, the second term $b^n x_t$ approaches zero. If $-1<b<0$ the term b^n alternates sign as *n* increases.
- Finally, the third term (the sum of error terms of equation 5), $u_{t+n} + bu_{t+n-1} + \ldots + b^n u_t$, is the error term for x_{t+n}. Since each term has a mean equal to zero, it follows that the mean of the sum of the stochastic terms will be equal to zero. In addition, each stochastic term is independent of the others and has constant variance, σ^2. Consequently, the sum of errors has a variance equal to $(1 + b + b^2 + \ldots + b^n)^2 \sigma^2$. If $-1<b<1$ and *n* increases, the above expression tends to the limit $\left(1/(1-b)\right)^2 \sigma^2$. If $b>1$ or $b<-1$, the variance of the stochastic term increases as *n* increases.

[8] There are two recent studies for the Greek manufacturing industries, by Droukopoulos and Lianos (1993a) and (1993b). In both studies, however, there is no discussion of the competitive adjustment processes that characterize profit behavior.

The above discussion, about the convergence or divergence of the deviation series of the profit rates can be summarized as follows:

- If $b>|1|$, the variance of the deviation series grows exponentially over time, that is the deviation series displays explosive behavior.

- If $b<|1|$, with the passage of time, the deviation series x_t converges to

$$\lim_{n\to\infty} x_{t+n} = \frac{a}{1-b} + u_n$$

  Since u_n is the stochastic term which is distributed with zero mean and constant variance equal to $[1/(1-b)]^2\sigma^2$, the series of differences approaches to the limit $a/(1-b)$. If b is negative, the series approaches the same limit but with alternating sign. If in this case $a=0$, the above limit equals zero indicating that the series of profit rate deviations approaches the mean profit rate of all industries. If $a>0$, the rate of profit of the industry approaches a limit which is above the manufacturing average. Finally, if $a<0$, the rate of profit of the industry approaches a limit which is below the average of manufacturing.

- If $b=1$, the deviation series is not stationary, the variance of x_t is then $t\sigma^2$ and it is thus increasing with time, provided that $a=0$. If $a\neq 0$, the difference series is explosive.

The profit rate of the regulating capital

The major drawback in the discussion of the long-run behavior of profit is that the rate of profit which is tested and has been repeatedly used in the literature is the weighted by sales average rate of profit of an industry. This index of profitability is different in general from the rate of profit that corresponds to the regulating capital.[9] As it has been pointed out, “empirical investigations attempting to utilize Marx's analysis of competition between and within industries must be careful to distinguish which profit rates are being observed - individual, regional, industry average or regulating ...” (Botwinik, 199. P. 154). Hence, the question before us is to determine the rate of profit that truly reflects the profitability conditions of the regulating capitals. Such a task can be carried out if one has detailed information of the firms that operate in an industry for a long period of time. While the identification of regulating capital in principle can be achieved, in practice becomes extremely difficult for the lack of adequate information. Anwar Shaikh (1994) proposed a method for the construction of the regulating rate of profit which he calls "incremental rate of return on capital" and he used it to predict the variation in stock prices returns. Subsequently, Cristodoulopoulos (1996) used the same formulation to test the interindustry equalization of profit rates in a selected number of industries of major industrialized countries.

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[9] Regulating capital refers to the unit of capital which participates in the formation of the general rate of profit across industries. For detail analysis on the meaning and use of regulating capital see Shaikh, (1980), Semmler (1984), Ochoa and Glick (1992).

The same formulation is carried out to test the validity of the classical Marxian thesis of the interindustry tendential equalization of profit rates in the case of Greek large scale industry. For the construction of the incremental rate of return on capital (IROC) we express current profits (Π_t) that accrue to a firm as the sum of profit from the most recent investment (ρI_{t-1}) and profits that accrue to the firm from previous investments (Π^*) or what amounts to the same thing the current profits in the absence of investment (I_{t-1}). Consequently, we write

$$\Pi_t = \rho I_{t-1} + \Pi^*$$

If we subtract profits of the past period from both sides of the above equation we get

$$\Pi_t - \Pi_{t-1} = \rho I_{t-1} + (\Pi^* - \Pi_{t-1})$$

$$\Delta\Pi_t = \rho I_{t-1} + (\Pi^* - \Pi_{t-1})$$

The term in the parenthesis is expected to be very small in comparison to ρI_{t-1} and for practical purposes it can be ignored. The justification is the view that the shorter the evaluation horizon, the closer will be the current profit on carried-over vintages Π_t to last period's profit on the same capital goods (Π_{t-1}). We will assume that in the relevant short-term horizon (up to a year) the difference between these two is negligible. Consequently, the current rate of return on new investment is

$$\rho_t = \frac{\Delta\Pi_t}{I_{t-1}}$$

In our empirical analysis since profits and investment are gross of depreciation the above ratio gives the gross incremental rate of return. Clearly, investment flows are conditioned more by short-run rate of return such as the incremental rate of profit than the rate of profit over the lifetime of investment. Thus, the IROC approximates better than any other measure of profitability the rate of profit of the regulating capitals, and as such is qualified as the most appropriate measure for the study of the tendential equalization of the industrial rates of return.

3. Definitions and Data Sources

The data employed in the analysis of the tendential equalization of profits across industries for the Greek large scale manufacturing are drawn from the annual publications of the National Statistical Service of Greece (NSSG), from unpublished data on capital stock in constant prices of 1975 (Handrinos and Altinoglou, 1993) of the Center of Planning and Economic Research of Greece, and from the annual publications of the Federation of Greek Industrialists for the years 1960 to 1992.[10]

The rate of profit is estimated by dividing the profits of each industry by its capital stock, both expressed in current prices. The capital stock series is measured in current

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[10] The NSSG includes in the large scale industry firms that employ at least ten workers.

prices by using a price index for capital goods for the entire manufacturing (large and small scale) from OECD (Tsaliki and Tsoulfidis, 1994). For the estimation of profits of each industry we subtracted from the gross value added (gross output) at producer's prices the wages of production workers. It is important to point out that we chose not to estimate a wage equivalent for the self-employed population mainly because of their small number. In most years they account for about 3% of the employed population of the entire large scale industry and the nature of their work is mainly supervisory.

Depreciation is another component of value added which, in principle, must be subtracted to get accurate figures of the true profits. However, in the official statistics there are no estimates of depreciation at the industry level. As a result, the usual practice of researchers is that they either take into account the legal depreciation charges or they assume that the different assets that form the fixed capital stock depreciate at a constant rate. Since there are no official data, the inclusion of depreciation in the estimates of profits gives a more accurate index of profitability than those that come from rather *ad hoc* estimates of depreciation.

The alternative models of competition (equations 1, 2 and 3) presented in section 2.1 are tested using panel data from the Greek large-scale manufacturing industries. The data are taken for the census years 1969, 1973, 1978 and 1984.[11] The variables entering these models are constructed as follows: as a measure of profitability we used the profit margin on sales (m),

$$m = \frac{PQ - MQ - wL}{PQ}$$

where PQ is total sales, MQ is intermediate input costs, and wL is wage costs.[12] From a neo-classical as well as post-Keynesian perspective the profit margin on sales is a measure of the imperfections of competition, while in the classical perspective the profit margin on sales is a quite regular phenomenon of competition and must differ across industries according to the prevailing conditions of production.[13] This set of data is taken from publications of the National Statistical Service of Greece (NSSG). All variables are in current prices.

The concentration ratio (*CR*) is a variable widely used in studies of industrial organization as a summary measure of the structure of an industry. The CR is defined as the portion of a base such as sales, employment, assets, etc., that a small number of the largest (usually the top four or eight) firms controls over the total amount available in the whole industry. In this study, we used the *CR* of the eight largest firms in employment in

[11] The employment data of the census year 1958 are not comparable to those of other years and thus, the year 1958 was excluded from our estimations.

[12] This is an approximation of Lerner's index defined as *(P-MC)/P*, where *P* is the price and *MC* is the marginal cost. Under conditions of perfect competition *P=MC* and thus profit margin is equal to zero. Hence, the higher the profit margin, the more imperfect the market. This approximation to Lerner's index is good, so long as the average cost remains constant.

[13] For further reading on the classical perspective of profit margin and in general of inter-industry and intra-industry competition see Shaikh, (1980), Semmler (1984), Ochoa and Glick (1992).

each industry (CR_8), and the ratio was constructed from census data on manufacturing contacted by the NSSG.[14]

The imports penetration (*MP*) is a variable that serves as a proxy for the effect of foreign competition on the domestic economic environment and is measured as the ratio imports/(imports+sales). Data on imports for the years 1969, 1973 and 1978 were taken from the input-output tables of Greece (Skoutzos and Matheos, 1980), whereas data for the year 1984 were kindly supplied to us by Ms. Altinoglou of Center of Planning and Economic Research of Greece (KEPE).

The growth rate of demand (*GD*) is captured by the growth rate of sales (*S*) of each industry, that is $GD = ln(S_t / S_{t-1})$. The sales of each industry are expressed in constant prices of 1970, and are provided in the annual publications of the NSSG. Another variable that is expected to capture variations in demand is the incremental capital-output ratio (IKOR), which is defined as the ratio of annual investment to annual changes in value-added, both variables measured in constant prices. Data on investment are from the annual publications of the NSSG.[15]

The capital-sales ratio (*KS*) of each industry expressed in current prices is used to represent the conditions of production. Data on capital stock are taken from an unpublished study by Handrinos and Altinoglou (1993), both of KEPE. Another variable related to the conditions of production is the input to sales ratio (*IS*). Hence, input represents the raw materials used up in the production of a unit of gross output (sales). Input and sales are both expressed in current prices and are taken from the NSSG annual publications.

4. Empirical Findings

This section is divided in two parts. The first reports the econometric results from the three competing models on profit differentials. The pooled regressions that are employed here mainly capture the effects of long-run disequilibrium. The purpose of this part is not to show whether profit differentials exist in the long-run, that is to say whether there is convergence of industries' profit rates to the economy's average one, but rather to show which theory of competition can better explain the existing profit differentials. The second part reports the econometric results of our analysis concerning the long-run behavior of profits, and we investigate to what extend profit differentials exist in the long-run, that is, whether there is convergence of industries' profit rates to the economy's average one.

4.1 Results on profit differentials

Table 1 presents the results of the pooled regressions on the two-digit panel data described above. Because of the possible presence of heteroscedasticity we followed the White's

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[14] The data refer to the entire manufacturing and they report the number of establishments, the number of workers that they employ, and the installed horsepower. In constructing the CR_8 of large-scale industry, we subtracted the employment corresponding to firms that employ less than ten workers.

[15] The NSSG data series on value-added and wages discontinued for the years 1978 and 1979, thus our data on concentration ratio of 1978 were used for the year 1977 and when we use growth rates or changes in variables, we take data from the year 1976.

method of estimation based on heteroscedasticity consistent covariance matrix (Ramananthan, 1992).

(INSERT TABLE 1 -- HERE)

From Table 1, we observe that the neoclassical model—equation (a)—is not consistent with its own theoretical requirements. The low $\overline{R}^2$ indicates that there is a lot of variation in profit margins unaccounted for by the model specification. The concentration ratio exerts a negative and insignificant effect on the dependent variable which contradicts the neoclassical theory according to which high concentration ratio indicates imperfect competition and the presence of monopoly power resulting in higher profit margins.[16] Moreover, the imports penetration, which was introduced to capture the impact of the international competition, was found insignificant and with the wrong sign; so it was dropped out of the regressions.[17] However, it is possible (and in fact this is what happens) the relationship between profit margins on sales and concentration to be non-linear. As a consequence, by including in our regressions *CR*s raised to the second and third power the fit of the neoclassical model improved substantially. On closer examination, we observe that profit margins and *CR* are directly related when we move from low *CR* to higher *CR* until we reach the medium *CR*, where the relation becomes negative and then becomes positive again as we move to higher *CR*. Even in this case, however, the explanatory power of the model is extremely low ($\overline{R}^2$<10%). Clearly, the CR affects the profit margins, but we cannot ascertain the exact direction. From Figure 1, we could derive that high CR—in most cases—leads to more vigorous competition.

(INSERT FIGURE 1 -- HERE)

The classical model—equation (e)—displays a fairly good fit judged by the adjusted coefficient of determination. The variables used have the expected from the theory signs. The negative sign of the square of the *KS* ratio indicates that the relationship between profit margins and the *KS* ratio is curvilinear rather than linear, which means that too high *KS* ratios may act as a barrier to exit and firms may develop X-inefficiencies, thereby reducing their profit margin. The import penetration variable has the expected from the theory sign. The key variable of the classical model, *IS,* is significant and of the right sign.

The performance of the post-Keynesian model—equations (c) and (d)—falls between the neoclassical and the classical models. As it was expected the growth of demand (captured either by the *GD* or *ICOR*) is always significant and of the right sign.

The neoclassical, classical, and post-Keynesian models are special cases of the hybrid model, equation (f). As a result, the hybrid model is *nested* with each one of the three models. The fact that the hybrid model displays the highest $\overline{R}^2$ clearly indicates its superior explanatory power. The riddle, however, is to select the right core model on which one may add variables in an effort to increase its explanatory power.

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[16] To the extent that we know the literature, similar results were reported for the developing economies, e.g., Barbados (Whitehall, 1986), as well as for advanced economies such as of W. Germany (Sass, 1975) for the U.S. (Asch, 1967), and for the Dutch economy (Prince and Thurik, 1994).

[17] This might be due to the collinearity between CR and MP, so the separate effect of these variables cannot be detected.

A comparative appraisal

In comparing the neoclassical and post-Keynesian core models we observe that the first can be seen as a special case of the latter model. Judging from the value of the $\bar{R}^2$, the post-Keynesian model clearly, outperforms the neoclassical. In contrast, the classical model is neither a special case of the post-Keynesian nor of the neoclassical model of competition. In other words, the classical model of competition is *non-nested* to the two other models. Under these circumstances the ranking which results by simply comparing $\bar{R}^2$ is not entirely reliable.

In the econometric literature there is a plethora of statistical tests that judge models based on a trade off between 'goodness of fit' and an appropriate allowance made for 'parsimony', in the sense that having to choose between two 'rival' models the simple one receives more credence than the complicated one. Thus, researchers, besides the adjusted R^2, use other more general criteria for evaluating the relative explanatory power of the rival models.[18] In what follows we attempt various *non-nested* hypotheses tests of the three models whose results are presented in Table 2.[19]

(INSERT TABLE 2 -- HERE)

A comparison between the classical and neoclassical models (Table 2A) reveals that the classical model is better by far. The test statistics significance levels clearly show that the neoclassical model must be rejected in favor of the classical, while we cannot reject the classical model in favor of the neoclassical, when the classical is adopted as the null hypothesis model. Finally, the *AIC* and *SBIC* statistics favored the classical model.

Turning to a comparison between the classical and the post-Keynesian (Table 2B), we observe that the results are not that clear. The null hypothesis that the post-Keynesian model is the true model of the economy is strongly rejected by all the statistical tests. In contrast, the null hypothesis that the classical model is the true model of the economy is not always possible to be rejected in favor of the alternative. For example the W-test rejects the null hypothesis for p=0.003 while the JA-test at p=0.263. Overall, the statistics that we find, when the roles are reversed (null hypothesis is the classical), are much smaller. In addition, both the *AIC* and the *SBIC* statistics, once again, favored the classical model.

4.2 Empirical evidence on the tendential equalization of interindustry profit rates

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[18] These criteria include *Akaike's Information Criterion* (*AIC*), which is applicable to both kinds of hypotheses tests. For the *non-nested* models, however, the usual statistics are *N-test* or Cox-test, the *NJ* or adjusted Cox test, The Wald test (*W-test*), the *J-test*, the *JA-test*, and the *Schwartz's Bayesian Information Criterion* (*SBIC*), among others. It is important to note at this juncture that all the different test procedures are viewed as complementary rather than competitive.

[19] *Non-nested* regression models are tested in a pairwise sequential fashion. Specifically, it is initially assumed that the model H_o is true and is been asked to what extend explains the findings of an alternative model H_A. The procedure is reversed with H_A as the maintained hypothesis. Significant values for the test statistic indicate that the alternative model fits worse under the null than we would expect implying rejection of the maintained hypothesis. It is therefore possible to reject all models.

While the econometric tests gave support to the classical Marxian and the post Keynesian theories of competition over the neoclassical, it could be argued that when we are to choose between the classical Marxian and post Keynesian models it is not certain which of the two prevails over the other. Both models display a high R^2, and the coefficients of key explanatory variables are statistically significant and of the expected sign. The subsequent non nested hypotheses tests did not give overwhelming support to either of the models. On closer examination, it turns out that the crucial difference between the two models is whether or not the rate of profit is tendentially equalized across industries. According to post Keynesians such an equalization of profit rates is not achieved because of the presence of monopoly and the market power of firms which make possible the presence of persistent profit rate differences between industries. In contrast, in the classical Marxian perspective there are differences of profit rates over time which are not always on the same side. That is there is a switch of ranks; if industry *i* makes a rate of profit higher than industry *j* at one period of time the situation reverses at another period of time and so forth. Consequently, if our empirical results show a long run tendential equalization of the rate of profit across industries, it would lend support to the classical Marxian view over the post Keynesian.

The empirical work that follows about the large-scale Greek manufacturing industries has been guided by the theoretical considerations in the section III. For each industry's deviation series an estimate of *a* and *b* was obtained from the autoregressive equation (5), which was estimated by ordinary least squares. The value of $a/(1-b)$ is calculated as the best estimate of a long run projected profit rate. The significance of the difference of this limit from *zero* is the significance of the difference of *a* and *b* from zero, as well as their covariance.[20]

Table 3 contains the estimates of the parameters of equation (5) for the deviation series of profitability for the twenty manufacturing industries. The results show that the autoregressive equation used in the analysis is statistically significant in all industries with the exception of only the leather industry, whose profit rate deviation series displays an almost perfectly gravitational pattern around a rate of profit higher than the manufacturing average. Furthermore, in only four (food, footwear, leather, and metal products) out of the twenty industries, the value of R^2 is less than 0.30 indicating that the autoregressive scheme explains a high proportion of the variance of industries' profit rate deviations.

(INSERT TABLE 3 -- HERE)

From Table 3 we observe that the estimates on *b* are significantly different from *zero* at $p=1\%$ in all of the twenty industries. From the values on *b* we can argue that the deviation series of all twenty industries converge to their limit $a/(1-b)$, since the estimate of *b* lies between $-1<b<1$. In the theoretical exposition of the model we showed that the deviation series will converge to the average profit rate only when the limit $a/(1-b)$ to which the series converges becomes statistically equal to zero. However, since the limit $a/(1-b)$ is a ratio of two estimated parameters, its standard error must be calculated from the

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[20] Following Kmenta (1991, p. 487) the standard error of the projected rate of profit is approximated by taking the square root of

$$Var\left(\frac{a}{1-b}\right) \approx \left(\frac{1}{1-b}\right)^2 Var(a) + \left(\frac{a}{(1-b)^2}\right)^2 Var(b) + 2\left[\frac{1}{1-b}\right]\left[\frac{a}{(1-b)^2}\right] Cov(a,b)$$

covariance matrix of the coefficients (Kmenta, 1991: 485-491). From Table 3 we observe that six industries (clothing and footwear, furniture, leather, non-metallic mineral products, basic metal and the transport equipment) out of the twenty industries display a value of *a/(1-b)* statistically significant at *p=5%*. From those six industries the profit rate deviation series of the non-metallic mineral products, basic metal and the transport equipment industry converge to a rate of profit below the average, whereas in the others the difference series converges to a rate of profit above the average. From these six industries, only in three (clothing and footwear, leather and printing and publishing) the projected rate of profit differs from zero in an empirically significant way, whereas in the remaining industries the difference of the projected rate of profit from zero is less than ten percent.

4.3 Empirical evidence on the tendential equalization of incremental profit rates

Our empirical analysis on to what extend the incremental profit rates converge to the economy's average in the large-scale Greek manufacturing industries has been guided by the theoretical considerations in section II. For each industry's deviation series an estimate of *a* and *b* was obtained from the autoregressive equation (5), which was estimated by ordinary least squares. Here again, the value of *a/(1-b)* is calculated as the best estimate of a long run projected incremental profit rate. The significance of the difference of this limit from *zero* is the significance of the difference of *a* and *b* from zero, as well as their covariance.[21]

Table 4 contains the estimates of the parameters of equation (5) for the deviation series of incremental profitability for the twenty manufacturing industries. The results show that the autoregressive equation used in the analysis is statistically significant in all industries and the autoregressive scheme explains a high proportion of the variance of industries' incremental profit rate deviations.

(INSERT TABLE 4 -- HERE)

From Table 4 we observe that the estimates on *b* are significantly different from *zero* at *p=1%* in all of the twenty industries. From the values on *b* we can argue that the deviation series of all twenty industries converge to their limit *a/(1-b)*, since the estimate of *b* lies between $-1<b<1$. In the theoretical exposition of the model we showed that the deviation series will converge to the average profit rate only when the limit *a/(1-b)* to which the series converges becomes statistically equal to zero. However, since the limit *a/(1-b)* is a ratio of two estimated parameters, its standard error must be calculated from the covariance matrix of the coefficients (Kmenta, 1991: 485-491). From Table 4 we observe that only one industry (clothing and footwear) display a value of *a/(1-b)* statistically significant at *p=5%*, and its incremental profit rate deviation series converge to a rate of profit above the average.

5. Conclusions

[21] See footnote 20.

In this paper we described the principle variables of each of the three models of competition presented in section II. Each model was tested with panel data taken from large-scale Greek manufacturing industries for the census years 1969, 1973, 1978, and 1984, for which there are available data for the construction of CRs. Our results showed that the classical and post-Keynesian models performed well, whereas the neo-classical faired last. Between the classical and the post-Keynesian models, we found that the classical was more consistent with the phenomena that was designed to explain. The econometric analysis shows that a hybrid model that would combine the production conditions of the classical model, the demand conditions of the post-Keynesian model, and the market structure variables of the neoclassical model would constitute a very fruitful synthesis in accounting for the existence of profit differentials. However, the statistical tests, regardless of their sophistication, do not lend overwhelming support to a single theory; and therefore, one should not rely on statistical tests alone to judge the relative strength of each model. It seems that Blaug is correct when he states that "any period of scientific development is marked by a large number of overlapping and interpenetrating 'paradigms'; some of these may be incommensurable but certainly not all of them are; 'paradigms' do not replace each other immediately and, in any case, new 'paradigms' do not spring up full-blown but instead emerge as victorious in a long process of intellectual competition" (Blaug, 1986, p.237).

To our view the test that would land the decisive support to either the post-Keynesian theory or the Marxian is whether or not there is a tendential equalization of interindustry profit rates. We showed in section IV that such a tendential equalization can be verified on the basis of data that come from the Greek large-scale manufacturing industries. Our empirical analysis referring to the long run behavior of profit rates fully supports the classical Marxian theory of the tendential equalization of profit rates across industries. Profit rates display a gravitational behavior around the economy’s average. The use of the incremental rate of profit, as the most appropriate index of profitability, lends even stronger support to classical Marxian notion of interindustry competition.

Table 1: Empirical evidence of the three core models of competition[22]

Variables	(a) Neo-Classical	(b) Neo-Classical	(c) Post-Keynesian	(d) Post-Keynesian	(e) Classical	(f) Hybrid
Constant	0.241 (16.1)*	0.110 (2.50)	0.105 (2.88)	0.093 (2.33)	0.495 (12.1)	0.421 (7.97)
CR_8	-0.045 (0.88)	1.200 (3.00)	1.097 (3.00)	1.166 (3.03)		0.548 (2.34)
CR_8^2		-3.161 (3.01)	-2.887 (2.80)	-3.046 (2.86)		-1.504 (2.27)
CR_8^3		2.284 (2.83)	2.029 (2.38)	2.139 (2.46)		1.191 (2.27)
MS					-0.030 (1.37)	-0.051 (2.86)
GD			0.270 (3.61)	0.269 (3.73)		0.183 (4.20)
IKOR				0.003 (1.12)		
KS					0.140 (1.65)	0.140 (2.04)
KS^2					-0.108 (1.63)	-0.109 (2.03)

[22] Ordinary Least Squares Estimation Based on Adjusted White's Heteroscedasticity- Consistent S.E.'s

IS					-0.485 (10.1)	-0.467 (8.24)
$\bar{R}^2$	0.005	0.096	0.282	0.300	0.573	0.692
S.E.	0.065	0.062	0.055	0.055	0.043	0.036

* In parenthesis are the absolute values of *t-ratios*.

Table 2: Hypotheses Testing

A Neoclassical vs. Classical Model		
Test Statistic	Neoclassical vs. Classical	Classical vs. Neoclassical
N-Test	-32.65 [0.000]	-0.081 [0.935]
NT-Test	-18.99 [0.000]	0.224 [0.823]
W-Test	-12.85 [0.000]	0.225 [0.822]
J - Test	10.39 [0.000]	1.050 [0.293]
JA-Test	8.69 [0.000]	-0.976 [0.329]
AIC of Neoclassical vs. the classical is -29.56 and favors the classical model SBIC of Neoclassical vs. the classical is -28.38 and favors the classical model		

B Post-Keynesian vs. Classical Model		
Test Statistic	Post-Keynesian vs. Classical	Classical vs. Post-Keynesian
N-Test	-17.927 [0.000]	-4.252 [0.000]
NT-Test	-14.067 [0.000]	-3.354 [0.001]
W-Test	-9.725 [0.000]	-3.019 [0.003]
J - Test	9.959 [0.000]	4.520 [0.000]
JA - Test	6.378 [0.000]	1.119 [0.263]
AIC of post-Keynesian vs. the classical is -20.296 and favors the classical model SBIC of post-Keynesian vs. the classical is -21.487 and favors the classical model		

Figure 1: Profit Margins on Sales vs. Concentration Ratio

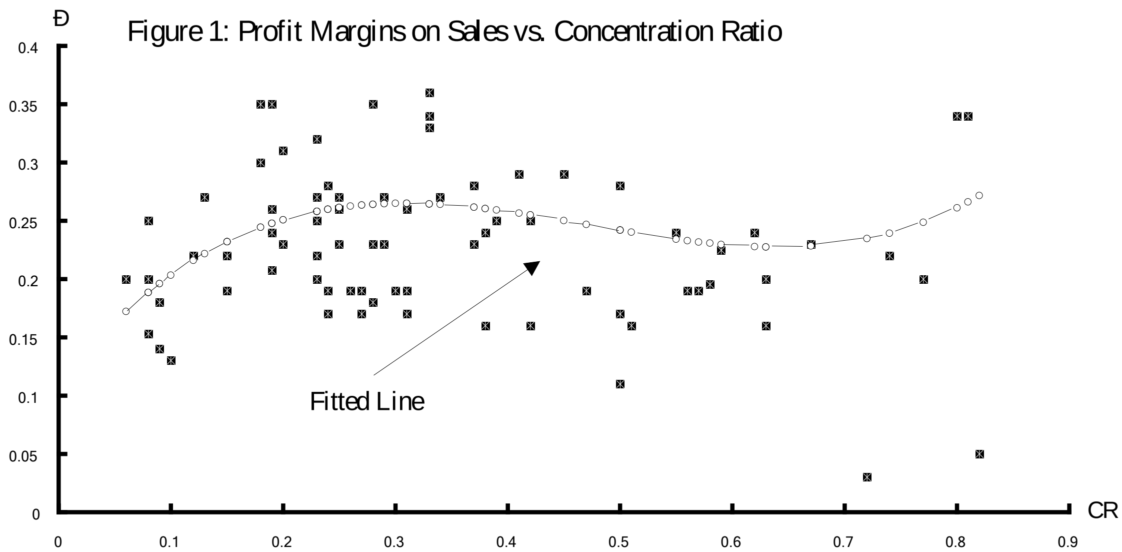

Table 3: Convergence/Divergence of the Profit Rate Deviations in the Greek Large-Scale Manufacturing Industries, 1962-1990

Industry	**a**	**$t_{(a)}$**	**b**	**$t_{(b)}$**	**a ------- (1-b)**	**$t_{(a/(1-b))}$**	**R^2**
20. Food	0.00	1.00	0.63	4.44	0.02	1.06	0.39
21. Beverages	0.00	0.61	0.66	4.95	0.01	0.62	0.44
22. Tobacco	0.03	1.31	0.77	6.39	0.14	1.75	0.57
23. Textiles[23]	0.01	1.01	0.73	4.97	0.04	1.46	0.45
24. Clothing and Footwear	0.07	2.12	0.84	10.5	0.48	4.25	0.78
25. Wood and cork	0.00	0.19	0.66	5.00	0.00	0.19	0.45
26. Furniture	0.04	1.75	0.83	9.15	0.25	3.32	0.73
27. Paper	-0.01	-0.50	0.84	6.91	-0.06	-0.70	0.61
28. Printing and publishing	0.01	0.50	0.93	14.2	0.24	0.71	0.86
29. Leather	0.18	3.95	0.45	3.28	0.34	8.68	0.26
30. Rubber	0.02	1.41	0.63	4.34	0.05	1.60	0.38
31. Chemicals	0.01	1.40	0.94	12.3	0.20	0.70	0.83
32. Petroleum and coal	0.03	0.55	0.69	5.25	0.11	0.58	???
33. Non-metallic mineral products	-0.04	-2.72	0.52	3.39	-0.09	-6.98	0.27
34. Basic metal industries	-0.03	-1.66	0.77	6.89	-0.14	2.72	0.61

23 In regressions that we tried with a second order autoregressive scheme the overal results were the same: y_t=0.0261(2.23)+0.981 (5.75) -0.458(-2.42) and 1/(1-b-c)=0.054 (3.74) and R^2=0.555. In parentheses are the t-ratios of the coefficients.

35. Metal products	0.02	1.42	0.56	3.90	0.05	1.58	0.33
36. Machinery	0.01	1.10	0.79	6.94	0.09	1.54	0.61
(non-electrical)							
37. Electrical supplies ***	0.02	0.88	0.90	12.12	0.26	1.25	0.83
38. Transport equipment	-0.03	-1.54	0.68	5.63	-0.11	-2.10	0.51
39. Miscellaneous manufacturing	0.037	0.29	0.82	12.32	0.21	0.30	0.83

Table 4: Convergence/Divergence of Marginal Profit Rate Deviations in the Greek Large-Scale Manufacturing Industries, 1962-1990

Industry	**a**	$t_{(a)}$	**b**	$t_{(b)}$	**a / (1-b)**	$t_{(a/(1-b))}$	R^2
20. Food	0.004	(0.03)	-0.690	(-4.86)	0.020	(0.03)	0.476
21. Beverages	0.264	(1.29)	-0.645	(-4.31)	0.160	(1.30)	0.417
22. Tobacco	-0.240	(-0.66)	-0.606	(-3.85)	-0.149	(0.51)	0.457
23. Textiles	-0.083	(0.33)	-0.477	(-2.77)	-0.056	(0.33)	0.228
24. Clothing and Footwear	0.655	(2.44)	0.391	(-2.18)	0.470	(2.56)	0.155
25. Wood and cork[24]	0.153	(0.76)	-0.631	(-4.17)	0.094	(0.76)	0.401
26. Furniture	0.085	(0.37)	-0.515	(-3.03)	0.085	(0.37)	0.269
27. Paper	0.114	(0.40)	-0.599	(-3.80)	0.071	(0.40)	0.357
28. Printing and publishing	0.223	(0.97)	-0.496	(-3.05)	0.149	(0.97)	0.263
29. Leather	0.404	(1.00)	-0.383	(-2.09)	0.292	(1.00)	0.144
30. Rubber	-0.001	(-0.05)	-0.744	(-5.69)	-0.005	(-0.05)	0.330
31. Chemicals	0.073	(0.35)	-0.660	(-4.48)	0.044	(0.35)	0.435
32 Petroleum and coal[25]	0.010	(0.035)	0.539	(3.10)	0.023	(0.03)	0.291

[24] A second order autoregressive scheme gave a better statistical fit but by no means qualitative different results, specifically we got: a=16.1 (0.83), b1=-0.866 (4.47), b2==-0.377 (-1.91) and 1/(1-b1-b2)=0.071 (0.817), R^2=47.6.

[25] We used 3-year moving averages.

33. Non-metallic mineral products	-0.097	(-0.67)	-0.793	(-6.73)	-0.054	(-0.67)	0.635
34. Basic metal industries	-0.003	(-0.01)	-0.659	(-4.30)	-0.001	(-0.01)	0.416
35. Metal products	-0.021	(0.084)	-0.600	(-3.83)	-0.013	(-0.08)	0.361
36. Machinery (non-electrical)	0.117	(0.73)	-0.547	(-3.32)	0.076	(0.74)	0.298
37. Electrical supplies	0.235	(0.94)	-0.519	(-3.10)	0.155	(0.94)	0.270
38. Transport equip	0.074	(0.33)	-0.462	(-2.9*8)	0.051	(0.33)	0.255
39. Miscellaneous manufacturing[26]	-0.010	(-0.07)	0.500	(3.39)	(-0.02)	(-0.07)	0.324

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