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Panel Data Estimation Techniques and Mark Up Ratios

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Abstract:

The purpose of this paper is to evaluate the market power of the Greek manufacturing and services industry over the period 1970-2007. In particular, the empirical model, estimates the mark-up ratio following the Roeger (1995) methodology, separately for the two industries by using Ordinary Least Squares (OLS) and Two Stage Ordinary Least Squares (TSLS) in two unbalanced panel data sets. The sample comprises a total of 23 and 26 two-digit NACE codes. The empirical results indicate the existence of significant market power in the Greek manufacturing and services industry. Moreover, mark-up ratios vary significantly between the two industries, with services having higher mark ups than manufacturing.

Key Words: *Mark up Ratio, Greece, Competition, Significant Market Power.*

JEL Classification: *L13, L16, L60, D43.*

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1. Introduction

Despite the changing face of the business economy, manufacturing still plays a key role in Europe's prosperity. The manufacturing industry in Europe has for decades been through a process of structural changes. The current and sudden economic crisis that has affected the Euro zone area and especially the Mediterranean countries (i.e Greece, Spain and Portugal) during the last years has pointed more than ever before to the importance of adjustment and structural change. Indeed, there is a compelling need for a better understanding and more insight into the competitive pressure that individual economic sectors experience, the adjustment performance of sectors and countries, and the institutional framework that directly impacts the need and the capabilities of change (Fafaliou and Polemis, 2013).

The estimation of the market power has been of interest to economists for a long time and there is a substantial body of literature assessing the main elements of competition in various countries and industries. The majority of the empirical studies apply Roeger (1995) methodology in order to estimate industry markups. Most of these studies consent that mark up ratios exceed unity denoting the absence of competitive conditions in certain sectors/industries (see for example Martins et al, 1996; Christopoulou and Vermeulen, 2012; Borg, 2009; Molnar, 2010; Molnar and Bottini, 2010).

The approach adopted in this paper is to empirically estimate the level of significant market power (SMP) by adapting the methodology introduced by Roeger (1995). This methodology is based on the hypothesis that in a situation of perfect competition the selling price is equal to marginal cost. The equality of marginal cost and price is essential for the efficiency of the economy since, first, competitive markets can achieve higher productivity levels, and second, competition provides consumers with products of higher quality, increased variety and lower prices (Rezitis and Kalantzi, 2013). However, this condition does not apply in a less competitive environment (i.e oligopoly markets, monopolies), since the price deviates from marginal cost. Therefore, the ratio between the selling price and marginal cost assesses the competitiveness of the market. However, while selling price is directly observable, the marginal production cost is not. This drawback was overcome by Hall (1988) and Roeger (1995) who both showed that under a perfect competition, the nominal growth rate of the Solow residual is independent of the nominal capital productivity growth rate. It then follows that the coefficient linking the nominal growth rate of the Solow residual to the nominal capital productivity growth is the Lerner Index defined as the ratio of the difference between price and marginal cost (Borg, 2009).

Despite the great number of empirical studies devoted on this topic, few of them, have investigated the competitive conditions of the services industry. Concretely, none of the studies has examined the level of competition in the Greek services sectors. This paper aims to cover this gap in the empirical literature. This model estimates the mark up ratios for the two industries over the period 1970–2007 by applying Ordinary Least Squares (OLS) and Two Stage Least Squares (TSLS) in a panel data set.

The remainder of this paper is organised as follows. Section 2 reviews the literature on the methods of estimation of market power. Section 3 discusses the data and outlines the methodology applied. Section 4 illustrates and evaluates the results of the empirical analysis and, finally, Section 5 concludes the paper.

2. Survey of the Literature

The majority of the empirical studies apply Roeger (1995) methodology in order to estimate industry markups (see Table 1). Considering the above, Martins et al, (1996) applies the Roeger (1995) approach extended to include intermediate goods, in order to estimate markups in the manufacturing industries for 14 OECD countries including Greece as well, over the period 1970-1992 by using the OECD STAN database. According to their findings, the estimated mark-ups are positive and statistically significant in all of the countries considered. The level of mark-ups appears related to the market structure of a particular industry, while there is a considerable variation of mark-ups across countries and across industries.

Table 1: Main empirical studies estimating mark-up ratios

Study	Country(ies)	Sectors	Period	Methodology/Econometric technique	Main Findings
Molnar and Bottini, (2010)	France, Germany, Italy, United Kingdom, Austria, Belgium, Czech Republic, Denmark, Finland, Greece, Hungary, Iceland, Ireland, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland	28 services sectors	1993-2006	Roeger (1995) / OLS in panel with and without fixed effects	a) The mark-ups are higher for professional services, real estate, renting and utilities b) They are lower for construction, computer services, retail and wholesale trade and catering c) There is also large variation across countries in terms of the sizes of the estimated mark-ups d) Competitive pressures should be large in the United Kingdom and most Scandinavian countries, and relatively small in Central European countries, Sweden and Italy
Rezitis and Kalantzi (2011)	Greece	Manufacturing sector	1984-2007	Hall - Roeger (1995) / panel data techniques	a) The whole Greek manufacturing industry, as well as each sector of the industry, operates in non-competitive conditions b) Labour intensity, the sector size, and the number of establishments influence the markup at the sectoral level c) Labour intensity, growth and the number of establishments affect the markup over time
Rezitis and Kalantzi (2012a)	Greece	9 sub-sectors of food and beverages industry	1984-2007	Extended Hall (1988) and Roeger (1995) / bootstrap method	a) The degree of market power is about 0.24 and the markup is about 2.44 b) The net welfare loss is 0.11% and the total welfare loss is 0.97%
Rezitis and Kalantzi (2012b)	Greece	9 sub-sectors of food and beverages industry	1984-2007	Hall - Roeger (1995) / panel data techniques	a) The whole Greek food and beverages manufacturing industry, as well as each sector of the industry, operates in non-competitive conditions b) The industry operates in non-competitive conditions for certain sub-periods of the period 1984–2007 c) The sector size, capital intensity and the number of establishments influence the markup of the industry
Rezitis and Kalantzi (2013)	Greece	Manufacturing sector	1983-2007	Bresnahan 1989 / bootstrap method	a) Each sector of the Greek manufacturing industry operate under imperfect competition, with the food and drink sector, the coke and refined sector and the communication equipment sector showing the highest degree of market power b) The transport equipment sector has the lowest degree of market power. c) There is a fluctuation in the degree of market power during the period 1983–1992

Source: Authors' elaboration

Table 1: Main empirical studies estimating mark-up ratios (cont'd)

Study	Country(ies)	Sectors	Period	Methodology/Econometric technique	Main Findings
Martins et al, (1996)	USA, Japan, Germany, France, Italy, United Kingdom, Canada, Australia, Belgium, Denmark, Finland, Netherlands, Norway, Sweden.	36 manufacturing sectors	1970-1992	Roeger (1995) / OLS in time series	a) The estimated mark-ups are positive and statistically significant in all of the countries considered b) The level of mark-ups appears related to the market structure of a particular industry. c) There is a considerable variation of mark-ups across countries and across industries.
Nishimura et al (1999)	Japan	21 manufacturing and service sectors	1971-1994	Elasticity method / Panel data techniques	a) There is strong evidence of imperfect competition. b) The mark-up rate differs considerably among firms and its distribution is skewed. c) The mark-up rate over marginal cost shows strong procyclicality, and its sensitivity is uniform within the industry.
Maioli (2004)	France	30 manufacturing and service sectors	1977-1997	a) Roeger (1995) / OLS in time series b) Lopez, et al. (2002) / nonlinear three stages least squares (N3SLS)	a) The markup ratios are generally larger than one in both methodologies. b) Average markups are heterogenous across industries.
Christopoulou and Vermeulen, (2008)	USA, Germany, France, Italy, Spain, Netherlands, Belgium, Austria, Finland.	50 manufacturing and service sectors	1981-2004	Roeger (1995) / OLS in time series	a) The markup ratios are generally larger than one. b) Average markups are heterogenous across countries. c) Markups are heterogeneous across sectors, with services having higher markups on average than manufacturing. d) Services sectors generally have higher markups in the euro area than the US, whereas the pattern is the reverse for manufacturing.
Borg (2009)	Cyprus, Lithuania, Italy, Latvia, Poland, Malta, Norway, Estonia, Austria, Slovakia, Czech, Luxemburg, France, Germany, Finland, Netherlands, Portugal, United Kingdom, Denmark, Sweden, Belgium, Switzerland.	15 manufacturing and service sectors	1990-2006	Roeger (1995) / OLS in time series	a) Mark-ups differ considerable across sectors with mark-ups being higher within services than in the manufacturing sectors b) The level of market competition is positively related to openness while it is negatively related to the size of the economy and the level of development.
Molnar, (2010)	Slovenia.	37 manufacturing and service sectors	1993-2006	Roeger (1995) / OLS in panel fixed effects	a) The mark-ups are high in some industries, such as real estate and food and beverages. b) Mark-ups also appeared high in transport, catering and professional services, c) Mark-ups are lower for most manufacturing industries, traded services and other industries (i.e construction, computer services and retail and wholesale trade).

Source: Authors' elaboration

Christopoulou and Vermeulen, (2012), apply the same methodology in order to provide estimates of price-marginal cost ratios or mark-ups for 50 sectors in eight euro area countries (Germany, France, Italy, Spain, Netherlands, Belgium, Austria and Finland) and the US. The data are taken from the EU KLEMS database and cover the period 1981-2004. This study concurs with the perception that perfect competition can be rejected for all sectors in all examined countries, since the relevant mark-up ratios exceed unity. Furthermore, average markups are heterogenous across countries and across sectors, with services having higher markups on average than manufacturing. Lastly, services sectors generally have higher markups in the euro area than the US, whereas the pattern is the reverse for manufacturing, while there is sufficient evidence that the magnitude of the markups does not significantly change when splitting the time span.

In a similar study (Molnar, 2010), mark-up ratios are estimated using Roeger (1995) methodology for manufacturing and service industries in Slovenia at a sectoral disaggregated level. The estimation is performed for the period 1993-2006 and uses firm level data of the Amadeus database. The empirical findings consent that the estimated mark-ups are higher for services than manufacturing industries. The same results hold in the empirical study of Molnar and Bottini, (2010). In this paper, mark-ups are estimated for the services industries in European OECD countries (including Greece) for the period 1993-2006 of the AMADEUS Database. In general, the estimated mark-ups are higher for professional services, real estate, renting and utilities, while they tend to be substantially lower for construction, computer services, retail and wholesale trade and catering. There is also large variation across countries in terms of the sizes of the estimated mark-ups. Competitive pressures according to these markups should be large in the United Kingdom and most Scandinavian countries, and relatively small in Central European countries, Sweden and Italy.

Unfortunately, there is lack of studies estimating the markup level of the Greek manufacturing and services industries. More specifically, the only recent studies which solely investigate the market structure of the Greek manufacturing industry at the two-digit SIC level are those undertaken by Rezitis and Kalantzi (2011, 2012a, 2012b, 2013). These studies consent that there is significant market power in the investigated sectors, while on the other hand the results indicate that there is a positive association between past and current price-cost margins. These studies extend the Hall (1988) and Roeger (1995) approach, in order to evaluate the degree of market power in the Greek manufacturing industries (e.g food and beverages).

On the contrary, Nishimura et al (1999), implied to a panel of 21 Japanese industries over the period 1971-1994 an alternative method based on the identity between the short-run elasticity of output to inputs, the mark-up rate, and the factor shares. They argue that, there is a strong evidence of imperfect competition, where internationally competitive industries show low mark-ups. Moreover, they conclude that the mark-up rate differs considerably among firms and its distribution is skewed, while the mark-up rate over marginal cost shows strong procyclicality.

Maioli (2004) calculates markups for 30 French manufacturing industries over the period 1977-1997 according to two different methodologies. The first is based on the classical Solow residual approach, as adapted by Roeger (1995), while the second jointly estimates mark ups and returns to scale. The results reveal the absence of competitive conditions since the mark up ratios are generally larger than one in both methodologies, while there is heterogeneity in the magnitude of the ratios across the manufacturing sectors.

Summarizing, the studies presented above conclude to the following major relationships that may constitute or augment the hypotheses of the present study: a) Estimated mark up ratios are generally larger than one denoting the absence of competitive conditions in certain sectors/industries, b) There is a considerable variation of mark up ratios across countries and industries, c) Services sectors generally have higher mark-ups compared to manufacturing, d) Mark-ups are lower for most manufacturing industries.

3. The Empirical model

Assume that the production function which is homogenous of degree λ (returns to scale) is defined by the following neoclassical equation:

$$Y = Af(L, M, K) \tag{1}$$

where Y is output, A is the multifactor productivity growth (Hicks-neutral productivity term) and there are three basic inputs in the production process. More specifically, L denotes labour, M is the intermediate inputs, and K stands for capital. The inclusion of intermediate inputs allows defining the mark-up ratios using gross output, and hence overcoming the upward bias that would result if value added were used instead (Martins et al, 1996; Molnar and Bottini, 2010). After log-differentiation and re-arranging we get the following equation:

$$SR = y - a_L l - a_m m - a_k k = B(y-k) + (1-B)a \tag{2}$$

where SR is the primal Solow residual, a_i is the input share of factor i and B is the Lerner index,1 which relates the mark up ratio μ:

$$B = \frac{P - MC}{P} = 1 - \frac{1}{\mu} \tag{3}$$

Roeger (1995) showed that an equivalent expression can be derived for the dual productivity measure (price-based Solow residual) by using the cost function associated with the production function (equation 1) as follows:

$$SRP = a_L w + a_M p_m + a_K r - p = (1-B)a - B(p-r) \tag{4}$$

where w denotes the wages, pm is the price of intermediate inputs, r is the rental price of capital and p is the price of output. By subtracting (4) from (2) and assuming constant returns to scale (λ=1), a suitable expression of B can be obtained by the following interpretation:

$$(p+y) - a_L(w+l) - a_M(p_m+m) - (1-a_L-a_M)(r+k) = B[(p+y)-(k+r)] \tag{5}$$

For the sake of simplicity the above equation can be re-written after adding a disturbance term (ε) as follows:

$$\Delta y = B\Delta x + \varepsilon \tag{6}$$

where

$$\Delta y = (p+y) - a_L(w+l) - a_M(p_m+m) - (1-a_L-a_M)(r+k) \text{ and}$$
$$\Delta x = (p+y) - (k+r)$$

As the unobservable productivity term, a cancels out with this subtraction, equation (6) is relatively easy to estimate by applying econometric techniques. The estimation of equation (2), in contrast, would result in bias and inconsistency of the mark-up estimates as the input variables are correlated with the productivity shocks (Molnar and Bottini, 2010).

The data are taken from the EU KLEMS database. The interpretation of the variables which are expressed in their natural logarithms comes as follows: y and p denotes the gross output volume and price indices respectively (2005=100). L denotes the number of employees and w measures the compensation of employees (million of Euros). M and pm denote the intermediate inputs indices for volume and price respectively (2005=100). K is the capital compensation at basic current prices and r is the user (rental) cost of capital. Since the database does not contain a price series for capital we have to construct it, by lowing the Hall and Jorgensen (1967) approach. Therefore, the rental price of capital r can be computed by the following equation:

$$r = \left(i - \pi_e + \delta\right)P_i \tag{7}$$

where Pi is the fixed asset investment deflator, (i-πe) denotes the real interest rate, and δ is the depreciation rate, which is set at 5% across all sectors (Martins et al, 1996). For Pi we use the fixed capital deflator for the total economy since sector specific deflators were not available for Greece and for (i-πe) the real interest rate, both taken from the AMECO database. Mark-up ratios are estimated by directly computing the relevant input shares (coefficients αl and am). This method (see Görg and Warzynski, 2003) relies on computation of the revenue shares of factor inputs instead of econometric estimation of the production function.

4. Data and empirical methodology

In this section, we present the econometric methodology we have followed. In order to perform an in depth investigation of industry competitiveness in Greece, we used data at for 23 and 26 manufacturing and services subsectors respectively covering the period 1970-2007. All variables are in their natural logarithms and except for the Producer Price Index (deflator)2 are taken from the EU-KLEMS3 database.

4.1. The pooled OLS methodology

Consider the multiple linear regression model for country or bank i = 1,…, N that is observed at several time periods t = 1,…, T:

$$Y_{it} = \alpha + \beta_{it} X'_{it} + \gamma_i + \varepsilon_{it} \qquad (1)$$

where i = 1,2,…N and t = 1,2,…, T. The N cross sectional countries are observed over T time periods. α is the intercept in the panel model, while γi is an individual specific effect, which can be fixed or random, respectively. Yit represents the dependent variable and Xit is a k-vector of explanatory (control) variables. Finally, εit are the disturbance terms. The vector β may be divided into sets of common, period specific and cross-section specific regressor coefficients, allowing the b coefficients to differ across periods or cross sections.

The fixed effects formulations or within estimations use orthogonal projections which involve a proper approach to remove cross section means from the dependent variable and exogenous regressors. Given that in the estimation procedure

[2] The producer price index for the EU-15 is taken from the European Central Bank.

[3] The EU-KLEMS project, which was funded by the European Commission (Research Directorate General), aims to create a database on measures of economic growth, productivity, employment creation, capital formation, and technological change at the industry level for all EU member states from 1970 onwards (from 1990 for the recently acceded Member States). The database uses a 63-industry breakdown for the major of the EU's 25 Member States as well as for the US, Japan, and Canada. For more information visit the website http://www.euklems.net.

instrumental variables are formulated with fixed effects, orthogonal projections are also applied to instruments. In order to estimate the model, we average equation (1) over time for each i (between transformations). Then we get the following equation:

$$\bar{Y}_i = \alpha + \beta_{it}\bar{X}_t^{'} + \gamma_i + \bar{\varepsilon}_t \qquad (2)$$

Subtracting equation (2) from equation (1) for each t (within transformation) yields:

$$Y_{it} - \bar{Y}_i = \beta_{it}(X_{it}^{'} - \bar{X}_i^{'}) + \varepsilon_{it} - \bar{\varepsilon}_i \qquad (3)$$

This model can be estimated by pooled-OLS (fixed-effects estimator). The important issue is that γi has disappeared rendering that time-constant unobserved heterogeneity is no longer a problem. Therefore, we do not need the assumption that γi is uncorrelated with xit. In addition, only the within variation is considered, because we subtracted the between variation. But here all information is used and the within transformation is more efficient than differencing. Therefore, this estimator is also called the within estimator.

Next, we obtain consistent estimates by using pooled-OLS. However, we have now serially correlated error terms unit, and the standard errors are biased. Using a pooled-GLS estimator provides the random-effects estimator. It can be shown that the estimator is obtained by applying pooled-OLS to the data after the following transformation:

$$(Y_{it} - \theta\bar{Y}_{it}) = a(1-\theta) + \beta_{it}(X_{it}^{'} - \theta\bar{X}_{it}^{'}) + (1-\theta)\gamma_i + (\varepsilon_{it} - \theta\bar{\varepsilon}_{it}) \qquad (4)$$

where $\theta = 1 - \sqrt{\dfrac{\sigma_e^2}{T\sigma_v^2 + \sigma_\varepsilon^2}}$

If θ = 1 the random effects estimator is identical with the fixed effects estimator. If θ = 0 the random effects estimator is identical with the pooled OLS-estimator. Normally, θ will be lying between 0 and 1. If Cov(xit,γi) = 0 the random effects estimator is unbiased and efficient, while if Cov(xit,γi) ≠ 0, the random effects estimator will be biased and the degree of the bias depends on the magnitude of θ. If $\sigma_v^2 \geq \sigma_\varepsilon^2$. then θ will be close to 1 and the bias of the estimator will be low.

4.2. The pooled TSLS methodology

Consider a dynamic panel data model with random individual effects:

$$y_{it} = \gamma y_{i,t-1} + \beta' x_{it} + \rho' z_i + a_i + \varepsilon_{it} \qquad (5)$$

for i = 1, ..,N and t = 1, ..,T. a_i^* are the (unobserved) individual effects, x_{it} is a vector of K1 time-invariant explanatory variables, zi is a vector of K2 time-invariant explanatory variables and εit is the error (idiosyncratic) term with E (εit) = 0, and E (εit εjs) = σ_{ε}^2 if j = i and t = s, and E (εit εjs) = 0 otherwise. We assume that E (ai) = 0, E (ai xit) = 0 and E (εit xit) = 0

In a vectorial form, we have:

$$y_{it} = y_{i,t-1} + X_i\beta' + ez_i'\rho + ea_i + \varepsilon_{it} \qquad (6)$$

with Xi now denoting the T x K1 time-varying explanatory variables, zi being the 1 x K2 time-invariant explanatory variables including the intercept term, and E (ai) = 0, E (ai x_{it}') = 0 and E (ai z_i') = 0

The idea behind instrumental variables is to find a set of variables (e.g instruments), that are both: a) correlated with the explanatory variables in the equation, and b) uncorrelated with the disturbance term. These instruments are used to eliminate the correlation between right-hand side variables and the disturbances.

Two Stage Least Squares (TSLS) is a special case of instrumental variables regression. More specifically, there are two distinct stages in two-stage least squares. In the first stage, TSLS finds the portions of the endogenous and exogenous variables that can be attributed to the instruments. This stage involves estimating an OLS regression of each variable in the model on the set of instruments. The second stage is a regression of the original equation, with all of the variables replaced by the fitted values from the first-stage regressions. The coefficients of this regression are the TSLS estimates.

More formally, let be Z the matrix of instruments, and let y and X be the dependent and explanatory variables. Then the coefficients computed in TSLS are given by the following equation

$$\hat{\beta}_{TSLS} = \left(X'Z(Z'Z)^{-1}Z'X\right)^{-1} X'Z(Z'Z)^{-1}Z'y \qquad (7)$$

5. Econometric results

The empirical results are provided by Econometric Views (ver. 7) and presented in Table 2. More specifically, the estimated mark up ratio in the Greek manufacturing is statistically significant and exceeds unity in all of the alternative methodologies, implying that the manufacturing industry in Greece is characterized by SMP. This result coincides with other empirical studies (Rezitis and Kalantzi 2011). However, the magnitude of the relevant coefficients varies significantly ranging from 1.10 to 1.36. This may be attributed to the different econometric methodologies (OLS vs TSLS) applied for the panel data models. Regarding the relevant diagnostics tests, it is evident that the Hausman statistic, which tests the null hypothesis that the individual effects are uncorrelated with the explanatory variables, supports the FE estimations in all of the specifications. In addition, the Wald statistic (WF) for testing the hypothesis that the Lerner index is equal to zero (L=0) indicates that the null hypothesis can be rejected at any conventional level of significance implying the presence of non competitive conditions for the Greek manufacturing industry over the investigated period.

The results do not vary significantly, when the analysis is focused on the competitive conditions in the services industry. The magnitude of the mark up ratios is larger than one and ranges from 1.11 to 1.14. This result coincides with the previous empirical findings for each of the services sub sector implying that the econometric findings are quite robust. Comparing the two industries, it is evident that services industry has higher mark up ratios than manufacturing in all but one specification (see column 3). The relevant estimations pass a series of diagnostic tests (i.e jointly significance of the control variables, absence of autocorrelation). In addition, the Hausman test supports the FE approach as opposed to the RE approach at any conventional level of significance. In addition, the Wald statistic (WF) rejects the null hypothesis at any conventional level of significance, confirming the existence of SMP in the services industry.

Table 2: Panel estimation of mark-up ratios, 1970-2007

Manufacturing (23 two-digit sectors)				
Values	**FE_OLS** (1)	**RE_OLS** (2)	**FE_TSLS** (3)	**RE_TSLS** (4)
Lerner index (L)	0.09* (4.53)	0.08*** (1.84)	0.26* (4.25)	0.10** (1.90)
Mark-up ratio	**1.10**	**1.07**	**1.36**	**1.12**
Observations	452	452	365	365
Adjusted R^2	0.11	0.03	-	-
F-statistic	3.53* [0.00]	17.16* [0.00]	4.40* [0.00]	0.08 [0.77]
Redundant effects	1.75** [0.02]	-	-	-
Hausman test	-	11.11*	-	-

		[0.00]		
WF (L=0)	20.52* [0.00]	3.39*** [0.06]	18.13* [0.00]	3.62** [0.05]
Instruments	-	-	ΔX(-1), ΔY(-1)	ΔX(-1), ΔY(-1) ΔX(-2), ΔY(-2) ΔX(-3), ΔY(-3) ΔX(-4), ΔY(-4) ΔX(-5), ΔY(-5)
Instrument rank	-	-	22	10
D-W statistic	0.80	0.86	1.36	1.08
Services (26 two-digit sectors)				
Lerner index (L)	0.10* (6.55)	0.12* (2.59)	0.11* (6.94)	0.12* (5.58)
Mark-up ratio	**1.11**	**1.14**	**1.13**	**1.14**
Observations	452	452	365	365
Adjusted R^2	0.04	0.01	0.005	-
F-statistic	2.20* [0.00]	9.36* [0.00]	5.65* [0.00]	0.20 [0.65]
Redundant effects	1.55** [0.04]	-	-	-
Hausman test	-	3.00*** [0.08]	-	87.56* [0.00]
WF (L=0)	42.99* [0.00]	6.72* [0.00]	48.29* [0.00]	31.14* [0.00]
Instruments	-	-	ΔX(-1), ΔY(-1)	ΔX(-1), ΔY(-1) ΔX(-2), ΔY(-2) ΔX(-3), ΔY(-3)
Instrument rank	-	-	25	7
D-W statistic	2.11	1.98	2.22	1.86

Notes: FE_OLS and RE_OLS denote the ordinary least squares panel data estimations with fixed and random effects respectively. FE_TSLS and RE_TSLS provide fixed and random effects estimations when applying the two stage least squares method. The F test evaluates the joint significance of the fixed or random effects estimates. WF is the Wald F-statistic which is used to test the hypothesis that the Lernex index (L) is equal to zero. Hausman test evaluates the null hypothesis that there is no misspecification in the random effects estimation. Redundant effects follows the F-distribution and tests the joint significance of the fixed effects estimates in least squares specifications. Rejection of the null means that the effects are redundant. D-W is the Durbin-Watson statistic for first order autocorrelation. Figures in parentheses denote t-ratios, while figures in square brackets are the reported p-values. Significant at *1%, **5% and ***10% respectively. Reported mark-ups estimates are statistically significant at 5% level.

6. Conclusion

Greece's manufacturing sector is of great importance to the EU's competitiveness and sustainability. Its high performance levels can lead to increases in the EU's GDP and, thus, to employment growth. However, the recent recession has dramatically affected its industrial activity. This calls for additional research efforts in order to facilitate manufacturing way out of current decline. The present paper contributes to such endeavours by highlighting the importance of incorporating into an analysis of industry competitiveness alternative approximations to the concept of market power.

To attain our objective, in the present empirical research we applied panel data techniques in order to assess the significant market power of the Greek manufacturing and services industry over the period 1970-2007. Based on the well known Roeger (1995) methodology, the empirical model estimated the mark-up ratio separately for the two industries by using two different econometric techniques (OLS and TSLS). The empirical results which are in alignment with other related studies indicate that both the Greek manufacturing and services industry operate in non-competitive conditions over the sample period. The findings also support the view that mark-up ratios vary significantly between the two industries, with services having higher mark ups than manufacturing.

Given the above contribution, the analysis could be further expanded in order to tackle a number of constraints which may be addressed in a future work. In particular, an analysis using more disaggregated data (i.e. three digit NACE codes) may reach different conclusions. In other words, an extension of the current study might be the investigation of market power for the Greek manufacturing and services industry using firm level data. Then, the results of both studies could be compared and contrasted. Such a consideration would capture better the industrial competitive dynamism in Greece and lead relevant research to further outcomes concerning industrial policy.

Further research should examine other methods such as the Rosse-Panzar H statistic or the Lerner index to calculate the industrial competition in Greece, and other determinants of manufacturing performance and compare them with these results could provide useful insights into the impact of manufacturing competitiveness.

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