



Munich Personal RePEc Archive

# **Measuring the Magnitude of Significant Market Power in the Manufacturing and Services Industries: A Cross Country Approach**

Michael Polemis and Panagiotis Fotis

University of Piraeus, Department of Economics, General Directorate for Competition, Hellenic Competition Commission

5 February 2015

Online at <https://mpra.ub.uni-muenchen.de/63245/>

MPRA Paper No. 63245, posted 25 March 2015 23:26 UTC

# Measuring the Magnitude of Significant Market Power in the Manufacturing and Services Industries: A Cross Country Approach

Michael L. Polemis<sup>1</sup>, Panagiotis N. Fotis<sup>2</sup>

## Abstract

This paper provides estimates of price-marginal cost ratios for manufacturing and services sectors in the Eurozone, the US and Japan over the period 1970-2007. The estimates are obtained applying the methodology developed by Hall (1988) and extended by Roeger (1995) on the EU KLEMS March 2011 database. The major stylized facts that are emerged from the empirical results based on the Ordinary Least Squares, Two Step Least Squares and Bootstrap methods of estimation are a) there is no evidence of imperfect competition across the majority of industries in Eurozone, US and Japan, b) sectors that are more open to internationalisation, experience relatively lower mark up ratios than the ratios experienced in less open sectors to internationalisation and c) deregulated industries generally have lower mark – up ratios than regulated industries, while fragmented industries generally exhibit higher mark – up ratios than segmented ones.

**Keywords:** *Mark up Ratio; US; Eurozone; Japan; Manufacturing; Services.*

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

---

<sup>1</sup> Corresponding author University of Piraeus, Department of Economics, email: [mpolemis@unipi.gr](mailto:mpolemis@unipi.gr)

<sup>2</sup> Hellenic Competition Commission, email: [p1972fo@gmail.com](mailto:p1972fo@gmail.com)

## 1. Introduction

Estimating the degree of competition in an industry is crucial for regulatory and competition authorities as well as the policy-makers. Regulators would like to know whether current regulation is conducive to competition. Likewise, competition authorities might gauge the current competitive situation in a sector (Christopoulou and Vermeulen, 2012).

As a consequence, boosting competition in the markets for goods and services is a growing economic policy concern, as evidenced by the policies employed by the European Commission and the OECD. Specifically, the European Commission, has recently announced its intention to amend the competition law legislation by fine tuning certain regulatory measures (i.e EC merger regulation, leniency program, application of State aid rules, etc) in order to facilitate competitive conditions across the member states.

It is noteworthy, that competition, *inter alia*, enhances economic activity and increases the level of employment by improving purchasing power and spurring firms to innovate. In this context, there is a need for structural indicators allowing the researchers and the government officials to identify clearly those sectors of the economy for which competition could be increased. Among the most commonly used indicators are the degree of market concentration in the sector, such as HHI and CR<sub>4</sub> indexes, and the degree of sectoral regulation. However, these indicators do not always reflect the real degree of competition in a sector (Trésor-Economics, 2008).

An alternative approach is to use national accounts data to infer conclusions about the difference between the selling price (P) and the marginal cost (MC), since the less competition there is in a sector, the more the price can diverge from the marginal production cost. In other words, we can use the ratio between the sale price and the marginal production cost (mark up ratio) in order to gauge the intensity of competition in a sector. As a consequence, mark-up estimates of different sectors and different countries allowing for comparisons of the degree of competition, they should help in identifying which sectors and/or countries would benefit most from changes in legislation or regulation that affect competition.

The approach adopted here is to estimate econometrically the level of market power by following the methodology developed by Hall (1988) and extended 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 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 price minus marginal cost to price

$$(L = \frac{P - MC}{P}).$$

Despite the voluminous amount of work on the topic, none of these studies –to the best of our knowledge- has examined this relationship for the Eurozone countries.<sup>3</sup> Furthermore, unlike previous studies, we use an array of econometric techniques (OLS, 2SLS and bootstrap methods) to test the robustness of the results. The scope of this paper is that its empirical findings might be used as a benchmark to other European countries in order to assess the degree of competition in certain manufacturing and services sectors.

In this paper, we empirically investigate the market power of the Eurozone, the US and Japan, manufacturing and services industry at a disaggregated level. In particular, the empirical model assesses the extent of the mark - up ratio for each of the sub-sectors of the two industries over the period 1970–2007. The remainder of this paper is organised as follows: Section 2 reviews the literature, while Section 3 discusses the data and outlines the methodology applied. Section 4 illustrates and evaluates the results of the empirical analysis, while Section 5 depicts some stylized facts. Finally, Section 6 provides some conclusions and policy implications.

---

<sup>3</sup> For the purposes of this paper the Eurozone consists of the following countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain.

## 2. Survey of the literature

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. In principle, there are two different methodological approaches in assessing the level of market power. The first is a reduced form method proposed by Hall (1988) and extended by Roeger (1995) estimating the average Lerner index and the mark up ratio by relaxing the assumption of perfect competition. The second approach consists of the estimation of supply and demand relations, and can be complemented with input demand functions (Bresnahan, 1982). In other words, it aims at estimating marginal cost and in addition to the Lerner index, it incorporates the elasticity of demand and the elasticity-adjusted Lerner index as parameters to be estimated.

Based on the above, the majority of these studies apply Roeger (1995) methodology in order to estimate industry markups (see Table 1). 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; Molnar, 2010; Molnar and Bottini, 2010). This finding constitutes a major hypothesis that is empirically tested by using different econometric techniques, such as panel data methods (fixed, random effects) or cross-section analysis, in order to asses the level of competitive conditions in an industry.

**<Insert Table 1 about here>**

Considering the above, Martins et al, (1996) apply the Roeger (1995) approach extended to include intermediate goods, in order to estimate markups in the manufacturing industries for 14 OECD countries, 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 to be related to the market structure of a particular industry, while there is a considerable variation of mark-ups across countries and across industries. Wu (2009) uses the data from Martins et al. (1996) and finds insignificant effects of entry barriers on mark – up ratios. Especially, the author infers that mark – up ratios are high with high entry regulated countries and sectors with entry natural barriers. Weiss (2010) explores 299 4-digit US manufacturing industries for the period 1961 – 1989 and finds that mark – up ratios are significantly higher in concentrated and capital intensive industries with high growth rates and advertising to sales ratio. Also, he doesn't find significant differences in mark – up ratios over the business cycle.

Martins and Scarpetta (1999) estimate price mark – up ratios for a set of US manufacturing industries as well as in France, Germany, Japan, US and UK from 1970 to 1992. The authors define margins over gross output instead of value added and conclude that the estimated mark – up ratios in US manufacturing are in the range of 10 – 15 per cent, while they tend to be higher in the other countries under scrutiny within a range of 15 – 30 per cent.

Christopoulou and Vermeulen, (2012), employ 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 the examined countries, since the relevant mark-up ratios exceed unity. Furthermore, average markups are heterogenous across countries and sectors, with services having higher markups on average than manufacturing. Lastly, services sectors depict higher markups in the euro area than the US, whereas the pattern is the reverse for manufacturing. Lastly, 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 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.



Rezitis and Kalantzi (2011, 2012a, 2012b, 2013) investigate the market structure of the Greek manufacturing industry at the two-digit SIC level. 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). They consent that there is significant market power in the sectors under scrutiny.

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 ratio, 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.<sup>4</sup>

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.

Polemis, (2014) investigated the level of market power in the Greek manufacturing and services industry over the period 1970-2007. The empirical results indicate that

---

<sup>4</sup> Further evidence regarding mark – up ratios in Japan can be found in Martins & Scarpetta (1999).

the Greek manufacturing and services industries operate in non-competitive conditions. Moreover, average mark-up ratios are heterogenous across sectors, with manufacturing having higher mark ups on average than services. In contrast to other related studies, we provide sufficient evidence about the movements of mark up ratios over time. According to our findings, the mark up ratios in the manufacturing sectors are on average higher in the post European Union (EU) accession period (1982-1992), as a result of the merger wave in the manufacturing industry. However, this upward trend stopped within the period (1993-2007), and the relevant ratios have decreased substantially.

Summarizing, the major stylized facts that are emerged from this paper are a) there is no evidence of imperfect competition across the majority of industries in Eurozone, US and Japan, b) sectors that are more open to internationalisation, experience relatively lower mark up ratios than the ratios experienced in less open sectors to internationalisation and c) deregulated industries generally have lower mark – up ratios than regulated industries, while fragmented industries generally exhibit higher mark – up ratios than segmented ones.<sup>5</sup>

### **3. Data and Methodology**

The approach used in this paper is based on a methodology developed by Hall (1988) and extended by Roeger (1995). The basic insight is that the traditional Solow residual (SR) should be independent of variation in the log-change of output in the absence of monopoly power. The main contribution of Roeger (1995) is that he

---

<sup>5</sup> Evidence of estimated mark – up ratios using firm level data may be found in Konings et al. (2005), Konings and Vandenbussche (2005) and Görg and Warzynski (2006).

showed how the differences between the production-based (primal) Solow residual (SR) and the cost based (dual) Solow residual (DSR) can be used to eliminate the unobservable productivity shock in order to obtain an unbiased estimate of market power (Rezitis and Kalantzi, 2012b).

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

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

where  $Y$  is gross 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:

$$SR = y - a_l l - a_m m - a_k k = L(y - k) + (1 - L)\theta \tag{2}$$

where SR is the (primal) Solow residual,  $y$ ,  $l$ ,  $m$  and  $k$  are the first differences of the logs of  $Y, L, M, K$  respectively,  $a_i$  is the input share of factor  $i$  and  $L$  now is the Lerner index<sup>6</sup>, which relates the mark -up ratio  $\mu$ :<sup>7</sup>

---

<sup>6</sup> The index ranges from 1 to 0, with higher numbers implying greater market power. For a perfectly competitive firm (where  $P = MC$ ),  $L = 0$ . Alternatively, the Lerner index describes the relationship between elasticity and price margins for a profit-maximizing firm.

$$L = \frac{P - MC}{P} = 1 - \frac{1}{\mu} \quad (3)$$

From the equation 3 it is evident that the mark up ratio  $\mu$  can be computed

as  $\mu = \frac{1}{1-L}$ .<sup>8</sup> Under perfect competition ( $L=0$ ) the Solow residual is identical to the

rate of technical progress ( $\theta$ ). Equation (2) becomes

$$SR = y - a_L l - a_m m - a_k k = \theta \quad (2')$$

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:<sup>9</sup>

$$SRP = a_L w + a_M p_m + a_K r - p = (1-L)\theta - L(p-r) \quad (4)$$

where  $w$  denotes the wages,  $p_m$  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 ( $\lambda=1$ ), a suitable expression of  $L$  can be obtained by the following interpretation:

$$(p+y) - a_L(w+l) - a_M(p_m+m) - (1-a_L-a_M)(r+k) = L[(p+y) - (k+r)] \quad (5)$$

---

<sup>7</sup> The lower case indicates log-differentiation.

<sup>8</sup> Due to lack of data regarding (net indirect) taxes and value added rates across industries and countries under scrutiny the estimation of mark – up ratio is possibly upward bias.

<sup>9</sup> Under perfect competition equation (4) becomes  $SRP = a_L w + a_M p_m + a_K r - p = \theta$ .

For the sake of simplicity the above equation can be re-written after adding a disturbance term ( $\varepsilon$ ) as follows:<sup>10</sup>

$$\Delta y = L\Delta x + \varepsilon \quad (6)$$

where

$$\Delta y = (p + y) - a_L(w + l) - a_M(p_m + m) - (1 - a_L - a_M)(r + k) \quad (7)$$

$$\Delta x = (p + y) - (k + r) \quad (8)$$

are the nominal Solow residual ( $\Delta y$ ) and the growth rate of the nominal output/capital ratio ( $\Delta x$ ) correspondingly.

In equation 8  $k$  is the capital compensation at basic current prices and  $r$  is the user (rental) cost of capital. Capital compensation is derived as the value added minus labour compensation, which in turns is derived by applying the ratio of hours worked by total persons engaged to hours worked by employees to compensation. Since the database does not contain a price series for capital we have to construct it, by following the Hall and Jorgensen (1967) approach. Therefore, the rental price of capital  $r$  can be computed by the following equation:

$$r = [(i - \pi_e) + \delta]P_i \quad (9)$$

---

<sup>10</sup> Essentially,  $\Delta y = [\lambda * (L - 1) + 1]\Delta x + \varepsilon$ . Under constant returns to scale ( $\lambda = 1$ ),  $\Delta y = L\Delta x + \varepsilon$ .

where  $P_i$  is the fixed asset investment deflator,  $(i-\pi_e)$  denotes the real interest rate, and  $\delta$  is the depreciation rate, which is set at 5% across all sectors (Martins et al, 1996). In other words, real interest rate is the long-term interest rate minus the expected inflation rate, which in turn is the filtered inflation rate. For  $P_i$  we use the fixed capital deflator for the total economy since sector specific deflators were not available for the sample countries,  $(i-\pi_e)$  is the real interest rate, both taken from the AMECO database. It is worth mentioning that different error terms are assumed for the sector-based estimation of mark-ups. 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).

In order to perform an in depth investigation of industry competitiveness in the sample countries (Eurozone, Japan and the US), we use an extended dataset for manufacturing and services sectors at the two and four digit level (ISIC Rev. 3 classification) covering the period 1970-2007. The data are taken from the EU KLEMS 2011 database. The interpretation of the variables which are expressed in their natural logarithms comes as follows:  $y$  and  $p$  denote the gross output volume and price indices respectively (1995=100).  $w$  measures the compensation of employees (million of Euros) and  $M$  and  $p_m$  denote the intermediate inputs indices for volume and price respectively (1995=100). Mark-up ratios are estimated by directly computing the relevant input shares (coefficients  $\alpha_l$  and  $\alpha_m$ ). This method relies on

computation of the revenue shares of factor inputs instead of econometric estimation of the production function<sup>11</sup>.

#### **4. Empirical results**

In this section we present the empirical findings of the estimation of mark - up ratios in manufacturing and services sectors in the sample countries (Eurozone, Japan and the US) over the estimated period (1970–2007).

The empirical results of the OLS estimation of equation 6 regarding Eurozone are shown in Table 2. According to the empirical findings, the estimated mark -up coefficients are on average statistically significant at any conventional level of significance. Besides, the F-statistics support the jointly statistical significance of the estimated regressions, while the error terms are not correlated over time (lack of autocorrelation). Regarding the magnitude of the relevant estimates, there is significant variation but the most of the mark -up ratios are below unity, implying the presence of competitive conditions for the manufacturing and services industry in the Eurozone over the period 1970–2007. It is worth mentioning that the magnitude of the estimations does not vary significantly<sup>12</sup> from the ones reported by the bootstrap and 2SLS methods (23 out of 29 estimations of mark –up ratios are below unity with the 3 methods) implying that the results are quite robust. In other words, the bootstrap

---

<sup>11</sup> It is noteworthy that the alternative method of computing the input factor shares by estimating the elasticities of the production function has severe problems concerning the biasness of the relevant coefficients (Basanetti et al, 2008).

<sup>12</sup> Bootstrap method involves estimating a model many times using simulated data. Quantities computed from the simulated data are then used to make inferences from the actual data. The estimation of the bootstrap method provides more accurate estimates of the Lerner indices and the mark-up ratios.

estimator reveals that the OLS findings are robust to any simultaneity bias between the control variables and the error terms.

Regarding the manufacturing sectors (15 to 37 two & four digit-codes), the mark-up ratios range from 0.53 (Textile, Leather and Footwear) to 1.05 (Transport equipment). This range differs from the high mark-ups obtained in previous studies for European countries (Martins et al, 1996; Molnar and Bottini, 2010; Christopoulou and Vermeulen, 2012; Rezitis and Kalantzi, 2011, 2012a, 2012b, 2013 and Polemis, 2014). Especially, Christopoulou and Vermeulen, (2012) report that in the Euro area (Germany, France Italy, Spain, Netherlands, Belgium, Austria and Finland) the statistical significant estimated weighted average mark – up ratio is 1.37.<sup>13</sup> One explanation for this discrepancy is due to the adjustment for intermediate inputs. This adjustment tends to lower mark-ups substantially, in particular for sectors with a large share of intermediate input in total output (i.e rubber and plastics, pulp, paper, printing and publishing, etc).

On average, mark-up ratios in Eurozone industries appear particularly low in comparison with other OECD countries (Molnár, 2010; Christopoulou and Vermeulen, 2012; Maioli, 2004) but the average reveals differences across sectors (heterogeneity). This is not surprising given that on the one hand, sector specific characteristics affect the mark-up companies' pricing behaviour (prices above average costs), while on the other hand, the regulatory barriers (i.e legalities) vary considerably across sectors distorting the level of competition.

---

13



**<Insert Table 2 about here>**

In Eurozone, the statistical significant at 5% level of mark up ratio in food, beverages and Tobacco industries (code 15t16) which accounts for large portion of the total gross output in manufacturing is below unity (0.94). This outcome contradicts with previous studies regarding independent European countries (Molnár, 2010; Polemis, 2014), and indicates no evidence of market power in the specific sectors. Christopoulou and Vermeulen, (2012) state that in the Euro area the weighted average mark – up ratio in the said industries is 1.12 and 1.34 in Food and Beverage and Tobacco sectors respectively. In textile, leather and footwear industry (code 17t19) the estimated mark – up ratio (0.53) is even lower than in the aforementioned industries indicating an even more competitive environment in them. Lastly, transport equipment (34t35) and manufacturing, nec, recycling (36t37) industries are the only industries in manufacture sector in the Eurozone in which the estimated mark – up ratios exceed unity (1.05 & 10.1 respectively). However, the results are close to unity, except from the estimated mark – up ratios employed by Bootstrap and 2SLS methods in manufacturing, nec, recycling and transport equipment industries, showing modest pressures on competition.

Mark-ups are also below unity in some tradable services industries, such as electricity, gas & water supply (0.94), construction (0.82), financial intermediation (0.95), public administration and defence, compulsory social security (0.99), education (0.75) and health & social work (0.89). On the contrary, the estimated mark – up ratios exceed unity in hotel and restaurants (1.11), community, social and personal services (1.08) and other community, social and personal services (1.01) industries.

In the services industry (two & four digit codes from 50 to 74) the mark-up ratios range from 0.70 (OLS estimation in transport and storage industry) or 0.58 (2SLS estimations in Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel - Retail trade, except of motor vehicles and motorcycles; repair of household goods industries) to 0.99 (OLS estimation Post and telecommunications) or 1.64 (Bootstrap estimations in Retail trade, except of motor vehicles and motorcycles; repair of household goods). Even though transport and storage communication constitute networks industries, where in general, exhibit higher mark-ups than competitive non-network sectors owing to the large sunk and fixed costs (Molnár, 2010), the estimated mark – up ratio is the lowest in services industry indicating no evidence of market power.

On the other hand, mark-ups are close to unity in highly traded services such as sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel (0.98 OLS estimation) as well as in Post and telecommunications, Real estate activities and Renting of machinery & equipment and other business activities. These findings are supported by Christopoulou and Vermeulen, (2012). Their empirical results show that the estimated weighted average mark – up ratios are among the highest mark – up ratios in the services industry in the Euro area.

The empirical results of the OLS estimation of equation 6 regarding US are shown in Table 3. According to the empirical findings, the estimated mark -up coefficients are on average statistically significant at any conventional level of significance. Besides, the F-statistics support the jointly statistical significance of the estimated regressions,

while the error terms are not correlated over time (lack of autocorrelation). Regarding the magnitude of the relevant estimates, there is significant variation but the most of the mark -up ratios are below unity, implying the presence of competitive conditions for the manufacturing and services industry in the US over the period 1970–2007. It is worth mentioning that the magnitude of the estimations does not vary significantly from the ones reported by the bootstrap and 2SLS methods, 17 out of 30 estimations of mark -up ratios employed by the 3 methods of estimation are below unity, in 7 sectors the estimated results employed by OLS & 2SLS methods coincide, in 4 sectors the estimated results employed by OLS & Bootstrap methods coincide and in 2 sectors the results from the OLS estimation method differ from the corresponding results from 2SLS & Bootstrap methods of estimation. The above mentioned results imply that the empirical findings are quite robust, that is, the bootstrap estimator reveals that the OLS findings are robust to any simultaneity bias between the control variables and the error terms.

**<Insert Table 3 about here>**

Also, the findings do support that the majority of the sectors of the US manufacturing and services industries appears to operate under competitive characteristics for the period under consideration. The statistical significant mark up ratios employed by the three methods of estimation in food, beverages and Tobacco industries (code 15t16) which accounts for large portion of the total gross output in manufacturing is close to unity (0.97) with OLS estimation and above unity with Bootstrap & 2SLS methods of estimation (1.04 & 1.13 respectively). The estimated result from the OLS method of estimation is supported by Martins et al. (1996) and Martins and Scarpetta (1999)

regarding the Food products sector (1.05), while Christopoulou and Vermeulen, (2012) report an estimated mark – up ratio of 1.19 in Food & Beverages industry and 1.51 in Tobacco industry. Roeger (1995) has also reported an estimated mark – up ratio of 1.50 in Food & Beverages industry, while the corresponding ratio in Tobacco industry is 2.75.<sup>14</sup> The empirical results in food, beverages and Tobacco industries of this paper indicate modest pressures of completion and seem to contradict with the majority of the results of the previous studies.

The only sectors in manufacturing industries in which the estimated mark – up ratios exceed unity are those of Coke, refined petroleum and nuclear fuel (code 23), Chemicals and chemical products (code 24) and Manufacturing, nec, recycling (code 36t37). These results are supported by the papers of Roeger (1995) and Christopoulou and Vermeulen, (2012). Overall, in this paper the mark-up ratios range from 0.82 and 0.78 (OLS and Bootstrap estimations respectively in Basic metals and fabricated metal industry) or 0.60 (2SLS estimations in Textile, Leather and Footwear) to 1.16 (OLS estimation in Coke, refined petroleum and nuclear fuel) or 1.12 and 1.25 (Bootstrap and 2SLS estimations in Pulp, paper, printing and publishing and Chemicals and chemical products respectively). In the manufacturing industry as a whole the resulted mark – up ratios are all below unity (they range from 0.85 to 0.97) revealing that the said industry in US behaves in a competitive manner.

In the services industry (two & four digit codes from 50 to 74) the mark-up ratios range from 0.86 and 0.89 (OLS and 2SLS estimations in transport and storage industry respectively) or 0.85 (Bootstrap estimations in Wholesale trade and

---

<sup>14</sup> The said estimated mark – up ratio is almost the same (2.77) by the work of Hall (1990).

commission trade, except of motor vehicles and motorcycles) to 0.99 (OLS estimation in Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel) or 1.00 (2SLS estimations in Wholesale trade and commission trade, except of motor vehicles and motorcycles). The only sector in services industries in which the estimated mark – up ratio exceeds unity is this of Real estate activities (1.04). However, this result is supported only from Bootstrap method of estimation, while OLS and 2SLS methods of estimation provide quite robust results which are lower than unity (0.87 and 0.88 respectively).

On the other hand, mark-ups are close to unity in highly traded services such as sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel (0.99 OLS estimation), Wholesale trade and commission trade, except of motor vehicles and motorcycles (0.93 OLS estimation), in Renting of machinery & equipment and other business activities (0.94 OLS estimation) as well as Retail trade, except of motor vehicles and motorcycles; repair of household goods and Post and telecommunications (0.90 OLS estimations). These findings seem to contradict the empirical findings of Christopoulou and Vermeulen, (2012). Their empirical results show that the estimated mark – up ratios range from 1.19 (Retail trade, except of motor vehicles and motorcycles) to 2.98 (Renting of machinery & equipment).

Mark-ups are also below unity in the majority of some other tradable services industries, such as electricity, gas & water supply (0.91), construction (0.95), Hotels and restaurants (0.99) and financial intermediation (0.92). However, the ratios exceed unity in education (1.03), health & social work (0.06) and other community, social and personal services (1.01) industries.

The empirical results of the OLS estimation of equation 6 regarding Japan are shown in Table 4. According to the empirical findings, the estimated mark -up coefficients are on average statistically significant at any conventional level of significance. Besides, the F-statistics support the jointly statistical significance of the estimated regressions, while the error terms are not correlated over time (lack of autocorrelation). Regarding the magnitude of the relevant estimates, there is significant variation but the majority of the mark -up ratios estimated by OLS and Bootstrap methods are below unity (18 out of 30 industries), implying the presence of competitive conditions for the manufacturing and services industry in the Japan over the period 1970—2007. It is worth mentioning that the magnitude of the estimations does not vary significantly from the ones reported by the bootstrap, 24 out of 30 estimations of mark –up ratios employed by the 2 methods of estimation are moving in the same direction (below or above unity) The above mentioned results imply that the empirical findings are quite robust, that is, the bootstrap estimator reveals that the OLS findings are robust to any simultaneity bias between the control variables and the error terms.

**<Insert Table 4 about here>**

Also, the findings do support that the majority of the sectors of the US manufacturing and services industries appears to operate under competitive characteristics for the period under consideration. The statistical significant mark up ratios employed by the OLS and Bootstrap methods of estimation in food, beverages and Tobacco industries (code 15t16) which accounts for large portion of the total gross output in

manufacturing is close to unity (0.93) with OLS estimation and below unity with Bootstrap method of estimation (0.74). The estimated results from both methods of estimation do not supported by Martins and Scarpetta (1999) regarding the Food products sector (1.32) and the Beverages sector (1.26). The empirical results in food, beverages and Tobacco industries of this paper indicate no evidence of market power.<sup>15</sup>

The only sectors in manufacturing industries in which the estimated mark – up ratios exceed unity and the empirical results are robust, that is they employed by both OLS and Bootstrap methods of estimation, are those of Wood and of wood and cork (3.38 - code 23), Pulp, paper, printing and publishing (2.31 - code 21t22) and Chemicals and chemical products (1.48 - code 24). These results are supported by the paper of Martins and Scarpetta (1999) and as it concerns Chemicals and chemical products industry by the paper of Nishimura et al., (1999). The Textile, Leather and Footwear industry (code 17t19) depicts the lowest mark – up ratio employed by OLS and Bootstrap methods of estimation in Japanese manufacturing sector (0.81 and 0.60 respectively).

In the services industry (two & four digit codes from 50 to 74) almost all the mark-up ratios rely below unity implying that there is no evidence of market power. They range from 0.88 (Renting of m&eq and other business activities – code 71t74) to 1.00 (Transport and storage – 60t63). The only sector in services industries in which the estimated mark – up ratio exceeds unity is this of Real estate activities (2.15 and 1.23 with OLS and Bootstrap estimators respectively – code 70).

---

<sup>15</sup> Nishimura et al. (1999) report that in Food processing industry the estimated average mark – up ratio exceeds unty.

The majority of mark-ups are close but below unity in other tradable services industries, such as electricity, gas & water supply (0.90), Construction (0.90), Hotels and restaurants (0.72), Financial intermediation (0.97), Community, social and personal services (0.87), Other community, social and personal services (1.82) and Private households with employed persons (0.74). However, the ratios exceed unity in education (1.95) and health & social work (1.25) industries.

## 5. Stylized facts

From the empirical findings of the previous section some stylized facts are emerged. A first stylized fact that may be derived is that *there is no evidence of imperfect competition across the majority of industries in Eurozone, US and Japan*. It is evident from Tables 2, 3 and 4 that the majority of the estimated mark – up ratios are statistically significant below unity. Table 5 categorizes the sectors in Eurozone, US and Japan into competitive and less competitive ones.

**<Insert Table 5 about here>**

Table 5 reveals that almost 75% of the sectors under scrutiny across Eurozone, US and Japan are characterised as competitive and the remaining percentage (25%) are characterized as less competitive. In 18 sectors we cannot draw a final conclusion regarding the degree of competition on them since the empirical findings of Bootstrap method of estimation do not coincide with the corresponding findings of OLS and 2SLS methods of estimation.



A second stylized fact that may be derived is that *mark – up ratios are heterogeneous across industries with services having higher mark – up ratios than manufacturing industries*. Interestingly, estimated mark – up ratios are higher in services industry than in manufacturing industry. In the Eurozone the statistically significant at 5 per cent level of significance estimated mark – up ratio in total manufacturing industry is 0.88. The average mark – up ratio in services industry is 0.93 indicating that manufacturing industry is exposed more to competition than services industry. The same argument holds in US, the estimated mark – up ratio in total manufacturing industry is 0.94 and the average mark – up ratio in services industry is 0.96 as well as in Japan where the estimated mark – up ratio in total manufacturing industry is 0.99 and the average mark – up ratio in services industry is 1.09.<sup>16</sup>

A third stylized fact that may be derived is that *mark – up ratios are heterogeneous across industries and countries*. It is evident from tables 2, 3 and 4 and second stylized fact that the estimated mark – up ratios in manufacturing and services industries are higher than the corresponding ratios in US which in turn are higher than the corresponding ratios in Eurozone. Therefore, Eurozone exhibits the lowest mark – up ratios both in manufacturing and services industries.

A fourth stylized fact that may be derived is that *sectors that are more open to internationalisation, experience relatively lower mark up ratios than the ratios experienced in less open sectors to internationalisation*. The textile sector is a interesting example. In Eurozone the estimated mark – up ratio is 0.53 while in Japan

---

<sup>16</sup> The estimated mark – up ratios in total manufacturing is given by EU KLEMS March 2011 database, while the averages mark – up ratios in services industries across countries and Eurozone are calculated given the sectors under scrutiny in this paper.

is 0.81. These ratios are the lowest among the estimated mark – up ratios in manufacturing industry in Japan and Eurozone. In the US the estimated ratio is 0.90 which is among the five lowest ratios in the manufacturing industry. Another interesting example is the Electrical and optical equipment sector in Eurozone and US. The estimated mark – up ratios in these two sectors are among the three and six lowest ratios in the manufacturing industry Eurozone and US respectively.

A fifth stylized fact that may be derived is that *deregulated industries generally have lower mark – up ratios than regulated industries, while fragmented industries generally exhibit higher mark – up ratios than segmented ones*. In Table 2 the mark – up ratio in Post and telecommunications industry (code 64) is 0.99 (OLS estimation), 1.14 (Bootstrap estimation) and 0.92 (2SLS estimation). These estimated mark – up ratios are close to unity and depict no competitive pressures in the specific industry. Christopoulou and Vermeulen (2012) have stated that the mark – up ratio in the same industry in the Euro area over the period 1980 – 2004 is 1.48, but this ratio may not reflect the deregulation mechanism that took place in that industry recently. Taking account the latter our estimation fully reflects the dynamics of deregulation in Post and telecommunications industry across major European countries (12) over the scrutinized period. In the US the corresponding ratios are lower than the ones reported in the Eurozone indicating that the deregulation mechanism that took place there earlier has stronger effects, in terms of competition, than in the Eurozone.

In addition, the mark – up ratio in Coke, refined petroleum and nuclear fuel (code 23) ranges from 0.94 (OLS estimation) to 1.37 (Bootstrap estimation). The latter estimate clearly depicts the existence of major players in the wholesale oil market and the

possible fragmentation of that industry (Polemias and Fotis 2013; 2014, Martins and Scarpetta 1999). The same argument holds in the US, even though the magnitude of the estimated ratio is lower it is supported by the three methods of estimation, but the same cannot be argued in favour of the corresponding industry in Japan since the empirical findings are not robust.

## **6. Conclusions and policy implications**

The aim of this study is to investigate the level of market power of the manufacturing and services industries in Eurozone, US and Japan over the period 1970-2007. The empirical analysis was performed at a disaggregated level (two and four digit code), with the aim of investigating possible heterogeneity across different subsectors of the above industries.

The empirical findings indicate that the majority of manufacturing and services industries operate in competitive conditions during the investigated period since the estimated mark up ratios are generally lower than unity in all of the specifications. Average mark-up ratios are heterogeneous across sectors, with services having higher mark – up ratios on average than manufacturing. Also, mark – up ratios are heterogeneous across countries with Eurozone exhibiting the lowest mark – up ratios both in manufacturing and services industries among the scrutinized countries. The econometric results do not dramatically change when the Bootstrap and the 2SLS methods of estimation are applied implying the robustness of the results.

From the empirical findings it is evident that sectors that are more open to internationalisation such as textiles, experience relatively the lowest mark up ratios revealing no evidence of “collusion”. In order to enhance the level of internationalisation in the manufacturing sectors, the policy makers and the governments’ officials could pursue horizontal strategies focusing on the further opening of the markets.

Furthermore, policy makers should enhance their policy in fragmented industries in which profitability indicators of market players may indicate evidence of imperfect competition. A further segmentation of such industries may increase the degree of competition in upstream oil markets around the world.

To sum up, our analysis will be a useful policy tool to achieve structural micro-economic goals in light of the existing financial crisis. Firstly, given the primarily indications regarding the high mark - up ratios in selected industries in manufacturing and services industries, a suitable ex ante policy is linked with a thorough investigation of mergers and acquisitions. Secondly, in order to enhance the level of internationalisation in manufacturing, the government could pursue horizontal strategies focusing on the further opening of the markets.

Given the above considerations, our analysis can be further extended in order to tackle a number of constraints which may be addressed in future work. An analysis using more disaggregated firm level data may enrich our conclusions. Given the validity of the econometric results, the mark up ratios may be improved with the addition of new parameters especially those regarding price formulation. Furthermore, as more

information and data become available, especially at the firm level, and more companies enter the sample, more in-depth analysis should be made in order to examine aspects that are not covered by the existing database, since it may not collect information from all the new small entrants. Such a consideration will better capture the dynamism of the manufacturing and services industries and lead the research to further outcomes on developing a consumer policy.

Finally, the methodology applied could be further refined, by estimating the input coefficients of the production function (shares) or by incorporating the role of returns to scale in the estimation of mark – up ratios. These are important issues and remain the subject of future research.

## List of Tables and Figures

**Table 1:** Main empirical studies estimating mark-up ratios.

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.
Martins and Scarpetta (1999)	Germany, France, Japan, United Kingdom, USA	36 manufacturing sectors	1970-1992	Roeger (1995) – gross output / OLS in time series	a) Mark – up ratios in USA manufacturing are in the range of 10 – 15 per cent. b) Mark – up ratios tend to be higher in Germany, France, Japan and United Kingdom than in USA within a range of 15 – 30 per cent.
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, (2012)	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.
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.

**Table 1:** Main empirical studies estimating mark-up ratios (continued).

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	<p>a) The mark-ups are higher for professional services, real estate, renting and utilities</p> <p>b) They are lower for construction, computer services, retail and wholesale trade and catering.</p> <p>c) There is also large variation across countries in terms of the sizes of the estimated mark-ups.</p> <p>d) Competitive pressures should be large in the United Kingdom and most Scandinavian countries, and relatively small in Central European countries, Sweden and Italy.</p>
Rezitis and Kalantzi (2011)	Greece	Manufacturing sector	1984-2007	Hall - Roeger (1995) / panel data techniques	<p>a) The whole Greek manufacturing industry, as well as each sector of the industry, operates in non-competitive conditions</p> <p>b) Labour intensity, the sector size, and the number of establishments influence the markup at the sectoral level.</p> <p>c) Labour intensity, growth and the number of establishments affect the markup over time.</p>
Rezitis and Kalantzi (2013)	Greece	Manufacturing sector	1983-2007	Bresnahan 1989 / bootstrap method	<p>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</p> <p>b) The transport equipment sector has the lowest degree of market power.</p> <p>c) There is a fluctuation in the degree of market power during the period 1983–1992.</p>
Polemis (2014)	Greece	Manufacturing and services sector	1970-2007	Roeger (1995) / OLS, 2SLS and bootstrap in panel with and without fixed effects	<p>a) The Greek manufacturing and services industries operate in non-competitive conditions.</p> <p>B) Average mark-up ratios are heterogenous across sectors, with manufacturing having higher mark ups on average than services.</p> <p>c) The mark up ratios in the manufacturing sectors are on average higher in the post European Union (EU) accession period (1982-1992), as a result of the merger wave in the manufacturing industry.</p> <p>d) This upward trend stopped within the period (1993-2007), and the relevant ratios have decreased substantially.</p>

Source: Authors' elaboration

**Table 2:** Estimation of mark up ratios by sector in Eurozone, 1970-2007

ISIC	Sector	OLS			BOOTSTRAP			2SLS		
		Mark-up ratio	Adjusted R <sup>2</sup>	F-statistic	Mark-up ratio	Adjusted R <sup>2</sup>	Quasi-LR stat	Mark-up ratio	Adjusted R <sup>2</sup>	J-Statistic
D	Total Manufacturing	0.88**	0.15	4.15* [0.04]	1.11*	0.05	1.96 [0.16]	0.56*	-0.93	0.52 [0.47]
15t16	Food, Beverages and Tobacco	0.94**	0.27	7.92* [0.01]	1.00**	0.13	3.66*** [0.05]	0.78*	0.12	0.92 [0.34]
17t19	Textile, Leather and Footwear	0.53*	-0.10	0.47 [0.53]	0.52***	-0.19	-	0.50**	-0.98	1.00 [0.32]
20	Wood and of wood and cork	0.84**	0.14	4.00*** [0.06]	0.85***	0.06	2.09 [0.15]	0.88*	0.28	0.13 [0.72]
21t22	Pulp, paper, printing and publishing	0.84***	0.23	7.31* [0.01]	0.81**	0.13	3.86** [0.05]	0.50*	-2.63	0.00 [0.99]
23	Coke, refined petroleum and nuclear fuel	0.94*	-0.13	0.32 [0.60]	1.37*	-0.11	-	-	-	-
24	Chemicals and chemical products	0.96*	0.45	15.01* [0.00]	1.14*	0.24	5.43** [0.02]	1.22**	0.51	3.07*** [0.08]
25	Rubber and plastics	0.91*	0.36	14.04* [0.00]	0.98*	0.16	5.23** [0.02]	0.90**	0.14	2.73** [0.10]
26	Other non-metallic mineral	0.86*	0.43	10.02* [0.01]	0.79**	0.24	3.85** [0.05]	0.74*	0.86	0.15 [0.70]
27t28	Basic metals and fabricated metal	0.96**	0.16	4.46** [0.05]	0.95**	0.03	1.39 [0.24]	1.27***	0.79	5.79*** [0.02]
29	Machinery, nec	0.85**	0.16	5.89** [0.02]	0.96*	0.01	1.23 [0.27]	0.88***	0.14	6.56** [0.01]
30t33	Electrical and optical equipment	0.86***	0.25	8.27* [0.01]	0.98**	0.17	5.40** [0.02]	0.51*	-1.05	0.10 [0.75]
34t35	Transport equipment	1.05**	0.31	9.66* [0.01]	1.06***	0.13	3.79** [0.05]	1.27**	0.31	0.89 [0.35]
36t37	Manufacturing, nec, recycling	1.01*	0.10	3.30*** [0.08]	1.35**	0.18	6.16** [0.01]	-	-	-
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	0.98*	0.18	6.56** [0.02]	0.91*	0.10	3.73** [0.05]	0.58**	-0.50	2.36 [0.12]
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.87*	0.24	8.70* [0.01]	0.84**	0.12	0.02 [0.04]	0.58**	-1.02	0.02 [0.87]
52	Retail trade, except of motor vehicles and motorcycles; repair of household goods	0.91*	-0.11	0.02 [0.89]	1.64*	-0.09	0.13 [0.71]	0.93*	0.13	0.15 [0.69]
60t63	Transport and storage	0.70**	-0.04	0.00 [0.98]	0.83**	-0.01	0.70 [0.40]	0.58***	-0.25	0.99 [0.32]
64	Post and telecommunications	0.99*	0.36	14.33* [0.00]	1.14*	0.16	5.45* [0.02]	0.92***	0.45	0.43 [0.51]
70	Real estate activities	0.96*	0.41	24.37* [0.00]	0.95*	0.30	17.02* [0.00]	0.66*	-0.33	0.00 [0.98]
71t74	Renting of machinery & equipment and other business activities	0.98*	0.73	85.54* [0.00]	0.97***	0.47	30.70* [0.00]	0.88*	0.61	0.03 [0.87]
E	Electricity, Gas & Water Supply	0.94**	0.36	13.74* [0.00]	0.85*	0.13	4.64** [0.03]	-	-	-
F	Construction	0.82**	0.14	4.67** [0.04]	0.93*	0.10	2.77*** [0.10]	0.46*	-2.32	0.25 [0.62]
H	Hotels and restaurants	1.11*	0.26	3.43 [0.11]	1.52**	0.10	1.06 [0.30]	1.08**	0.38	0.08 [0.77]
J	Financial intermediation	0.95*	0.05	2.46 [0.13]	1.14*	0.05	2.42 [0.12]	0.34**	-1.80	0.18 [0.67]
L	Public administration and defence; compulsory social security	0.99*	0.48	31.97* [0.00]	0.93*	0.21	10.17* [0.00]	0.36*	-8.71	0.37 [0.55]
LtQ	Community, social and personal services	1.08*	0.77	114.37* [0.00]	1.12**	0.55	26.94* [0.00]	0.48**	-3.99	0.04 [0.85]
M	Education	0.75**	-0.03	0.36	0.96**	-0.01	0.86	0.65**	-0.08	1.50



				[0.56]			[0.35]			[0.22]
<b>N</b>	Health and social work	0.89**	0.53	37.76* [0.00]	0.93**	0.29	15.77* [0.00]	0.85**	0.50	0.26 [0.61]
<b>O</b>	Other community, social and personal services	1.01*	0.68	69.88* [0.00]	1.03***	0.41	24.35* [0.00]	0.86**	0.55	1.46 [0.23]
<b>P</b>	Private households with employed persons	-	-	-	-	-	-	-	-	-

Figures in square brackets are the reported p-values. Significant at \*1%, \*\*5% and \*\*\*10% respectively. Lerner Indexes are available upon request. “-” indicates that no data were available or estimates are statistical insignificant. Standard errors were computed by the delta method. For all the 2SLS regressions the Instrument Rank is bigger than the slope coefficients of the regression included constant.

Source: Authors’ calculations based on EU-KLEMS database.

**Table 3: Estimation of mark up ratios by sector in USA, 1970-2007**

ISIC	Sector	OLS			BOOTSTRAP			2SLS		
		Mark-up ratio	Adjusted R <sup>2</sup>	F-statistic	Mark-up ratio	Adjusted R <sup>2</sup>	Quasi-LR stat	Mark-up ratio	Adjusted R <sup>2</sup>	J-Statistic
<b>D</b>	Total Manufacturing	0.94***	0.83	126.44* [0.00]	0.97**	0.57	34.86* [0.00]	0.85*	0.75	2.16 [1.08]
<b>15t16</b>	Food, Beverages and Tobacco	0.97***	0.71	42.20* [0.00]	1.04*	0.49	15.11* [0.00]	1.13*	0.33	0.28 [0.09]
<b>17t19</b>	Textile, Leather and Footwear	0.90**	0.46	20.81* [0.00]	1.04**	0.31	11.41* [0.00]	0.60***	0.21	0.38 [0.93]
<b>20</b>	Wood and of wood and cork	0.85*	0.77	34.41 [0.00]	0.88*	0.48	8.64* [0.00]	0.64**	0.34	0.04 [0.62]
<b>21t22</b>	Pulp, paper, printing and publishing	0.91***	0.25	5.89** [0.03]	1.12**	0.20	4.77** [0.03]	0.61**	0.13	0.05 [0.93]
<b>23</b>	Coke, refined petroleum and nuclear fuel	1.16*	0.78	67.83 [0.00]	1.05**	0.59	24.94* [0.00]	1.09**	0.69	0.15 [0.38]
<b>24</b>	Chemicals and chemical products	1.03*	0.02	1.12 [0.32]	0.91**	0.10	0.19 [0.66]	1.25***	0.20	0.16 [0.45]
<b>25</b>	Rubber and plastics	0.93**	0.46	17.02 [0.00]	0.94*	0.25	6.77* [0.00]	0.82***	0.25	0.17 [0.51]
<b>26</b>	Other non-metallic mineral	1.00**	0.79	74.20 [0.00]	0.92***	0.53	19.14* [0.00]	1.02**	0.84	1.27 [0.95]
<b>27t28</b>	Basic metals and fabricated metal	0.82**	0.49	12.49 [0.00]	0.78*	0.25	4.69** [0.03]	0.79**	0.38	0.51 [0.21]
<b>29</b>	Machinery, nec	0.92*	0.23	5.71** [0.03]	0.82**	0.13	3.56* [0.05]	0.69*	0.13	1.21 [0.95]
<b>30t33</b>	Electrical and optical equipment	0.84*	0.54	18.47* [0.00]	0.90*	0.43	14.93* [0.00]	0.97*	0.90	1.15 [0.94]
<b>34t35</b>	Transport equipment	0.85**	0.61	22.80* [0.00]	0.92**	0.39	9.33* [0.00]	1.08*	0.82	0.84 [0.66]
<b>36t37</b>	Manufacturing, nec, recycling	1.11*	0.69	27.89* [0.00]	1.03**	0.47	9.68* [0.00]	1.27**	0.65	0.98 [0.81]
<b>50</b>	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	0.99**	0.61	33.53* [0.00]	0.93*	0.44	16.86* [0.00]	0.83**	0.62	0.74 [0.11]
<b>51</b>	Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.93*	0.59	26.47* [0.00]	0.85**	0.29	8.05* [0.00]	1.00**	0.42	1.85 [0.47]
<b>52</b>	Retail trade, except of motor vehicles and motorcycles; repair of household goods	0.90***	0.57	26.95* [0.00]	0.90*	0.34	10.15* [0.00]	0.98**	0.53	1.42 [0.94]
<b>60t63</b>	Transport and storage	0.86*	0.66	56.63* [0.00]	0.91*	0.43	27.40* [0.00]	0.89**	0.63	4.47 [1.98]
<b>64</b>	Post and telecommunications	0.90*	0.70	53.74* [0.00]	0.98*	0.48	20.45* [0.00]	0.90*	0.64	1.59 [0.88]
<b>70</b>	Real estate activities	0.87*	0.66	48.90* [0.00]	1.04**	0.44	20.44* [0.00]	0.88**	0.47	0.42 [0.26]
<b>71t74</b>	Renting of machinery & equipment and other business activities	0.94*	0.58	34.17* [0.00]	0.95**	0.41	16.65* [0.00]	0.91**	0.75	2.46 [1.05]
<b>E</b>	Electricity, Gas & Water Supply	0.91*	0.83	83.47* [0.00]	0.97*	0.56	22.16* [0.00]	0.82***	0.13	0.22 [0.93]
<b>F</b>	Construction	0.95**	0.32	7.21* [0.00]	0.95**	0.16	3.12* [0.08]	0.79*	0.28	1.90 [0.54]
<b>H</b>	Hotels and restaurants	0.99*	0.52	24.99* [0.00]	0.80*	0.30	9.50* [0.00]	0.72*	0.22	2.99 [1.23]
<b>J</b>	Financial intermediation	0.92*	0.72	51.33* [0.00]	0.95**	0.42	15.45* [0.00]	0.87**	0.68	0.42 [0.31]
<b>L</b>	Public administration and defence; compulsory social security	0.86***	0.94	444.26* [0.00]	1.07***	0.77	98.85* [0.00]	0.99**	0.91	5.38 [1.68]

<b>LtQ</b>	Community, social and personal services	1.06**	0.78	77.26* [0.00]	0.89*	0.56	27.86* [0.00]	0.84*	0.72	4.16 [1.96]
<b>M</b>	Education	1.03**	0.70	67.30* [0.00]	1.05**	0.56	45.46* [0.00]	0.84*	0.45	1.40 [0.31]
<b>N</b>	Health and social work	1.06*	0.91	303.18* [0.00]	1.08*	0.72	83.18* [0.00]	0.97**	0.85	2.21 [1.08]
<b>O</b>	Other community, social and personal services	1.01*	0.89	234.52* [0.00]	1.04*	0.70	63.26* [0.00]	0.92*	0.80	2.10 [1.54]
<b>P</b>	Private households with employed persons	0.98**	0.77	100.67* [0.00]	1.01***	0.57	46.62* [0.00]	0.95*	0.76	1.54 [0.98]

Figures in square brackets are the reported p-values. Significant at \*1%, \*\*5% and \*\*\*10% respectively. Lerner Indexes are available upon request. “-” indicates that no data were available. Standard errors were computed by the delta method. For all the 2SLS regressions the Instrument Rank is bigger than the slope coefficients of the regression included constant.

Source: Authors' calculations based on EU-KLEMS database.

**Table 4:** Estimation of mark up ratios by sector in Japan, 1970-2007

ISIC	Sector	OLS			BOOTSTRAP			2SLS		
		Mark-up ratio	Adjusted R <sup>2</sup>	F-statistic	Mark-up ratio	Adjusted R <sup>2</sup>	Quasi-LR stat	Mark-up ratio	Adjusted R <sup>2</sup>	J-Statistic
D	Total Manufacturing	0.99**	0.48	21.43* [0.00]	0.79***	0.39	17.38* [0.00]	1.04*	0.54	2.58 [0.11]
15t16	Food, Beverages and Tobacco	0.93***	0.43	13.24* [0.00]	0.74**	0.27	8.38* [0.05]	1.16**	0.34	3.49*** [0.06]
17t19	Textile, Leather and Footwear	0.81*	0.25	5.11** [0.05]	0.60*	0.10	2.57 [0.11]	-	-	-
20	Wood and of wood and cork	3.38***	0.78	28.71* [0.00]	1.33***	0.42	4.21** [0.04]	0.97*	0.96	1.00 [0.32]
21t22	Pulp, paper, printing and publishing	2.31**	0.54	6.77** [0.06]	1.22*	0.12	-	0.72**	-	-
23	Coke, refined petroleum and nuclear fuel	1.41*	0.43	10.65* [0.00]	0.93**	-0.02	0.68 [0.61]	0.55*	-0.16	0.01 [0.94]
24	Chemicals and chemical products	1.48**	0.31	5.07** [0.06]	2.63**	0.23	2.45 [0.12]	-	-	-
25	Rubber and plastics	0.85**	0.06	1.77 [0.21]	0.62***	-0.03	0.54 [0.46]	1.85*	-2.66	0.29 [0.59]
26	Other non-metallic mineral	0.91**	0.49	17.17* [0.00]	0.79*	0.35	11.24* [0.00]	0.88**	0.37	0.00 [0.99]
27t28	Basic metals and fabricated metal	1.03*	0.43	9.91* [0.01]	0.71***	0.20	4.46** [0.03]	-	-	-
29	Machinery, nec	1.43*	0.12	2.20 [0.18]	0.98*	0.02	0.80 [0.37]	0.23*	-0.66	0.38 [0.54]
30t33	Electrical and optical equipment	1.18*	0.56	20.28* [0.00]	0.86**	0.38	12.53* [0.00]	2.27*	0.46	0.46 [0.50]
34t35	Transport equipment	0.99**	0.53	20.16* [0.00]	0.86**	0.36	15.18* [0.00]	1.02**	0.53	0.07 [0.79]
36t37	Manufacturing, nec, recycling	1.05***	0.31	8.68* [0.01]	0.89*	0.21	7.37* [0.01]	-	-	-
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	1.37*	0.55	16.84* [0.00]	0.81**	0.38	11.89* [0.00]	0.71**	0.58	0.22 [0.64]
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.94*	0.27	4.36** [0.07]	0.68*	0.06	1.62 [0.20]	0.68*	0.50	1.55 [0.21]
52	Retail trade, except of motor vehicles and motorcycles; repair of household goods	0.99**	0.56	24.15* [0.00]	0.78*	0.40	16.45* [0.00]	0.68**	0.61	2.16 [0.14]
60t63	Transport and storage	1.00**	0.61	34.50* [0.00]	0.88**	0.41	19.22* [0.00]	1.23**	0.45	2.26 [0.13]
64	Post and telecommunications	0.98*	0.47	14.96* [0.00]	0.86**	0.42	18.85* [0.00]	0.92***	0.81	1.78 [0.18]
70	Real estate activities	2.15*	0.75	47.84* [0.00]	1.23*	0.45	15.95* [0.00]	1.52**	0.67	1.20 [0.27]
71t74	Renting of machinery & equipment and other business activities	0.88*	0.28	8.34* [0.01]	0.79***	0.16	5.47** [0.02]	-	-	-
E	Electricity, Gas & Water Supply	0.90***	0.18	3.57*** [0.09]	0.74***	0.06	2.13 [0.14]	0.69*	0.01	0.08 [0.77]
F	Construction	0.90**	0.20	4.19** [0.06]	0.68*	0.01	1.17 [0.28]	0.69*	-0.41	0.10 [0.75]
H	Hotels and restaurants	0.72*	0.16	3.29*** [0.10]	0.75*	0.07	2.36 [0.12]	0.58*	-0.15	1.09 [0.30]
J	Financial intermediation	0.97***	0.24	5.33 [0.04]	0.92*	0.09	1.91 [0.17]	0.53*	-0.36	2.23 [0.14]
L	Public administration and defence; compulsory social security	1.08*	0.73	76.63* [0.00]	1.00**	0.63	104.90* [0.00]	0.83**	0.83	4.48** [0.03]
LtQ	Community, social and personal services	0.87*	0.48	19.61* [0.00]	0.74**	0.28	10.15* [0.00]	0.74*	0.62	0.01 [0.94]
M	Education	1.95***	0.50	24.36*	1.54*	0.43	33.66*	0.59*	-0.08	0.48

				[0.00]			[0.00]			[0.49]
<b>N</b>	Health and social work	1.25**	0.60	32.29* [0.00]	1.20*	0.43	22.86* [0.00]	1.00*	0.67	1.07 [0.30]
<b>O</b>	Other community, social and personal services	0.82***	0.43	22.05* [0.00]	0.82**	0.24	12.26* [0.00]	0.57**	-0.53	0.06 [0.81]
<b>P</b>	Private households with employed persons	0.74**	0.17	5.16** [0.03]	0.83**	0.17	7.87* [0.01]	0.56***	-1.74	0.03 [0.87]

Figures in square brackets are the reported p-values. Significant at \*1%, \*\*5% and \*\*\*10% respectively. Lerner Indexes are available upon request. “-” indicates that no data were available or estimates are statistical insignificant. Standard errors were computed by the delta method. For all the 2SLS regressions the Instrument Rank is bigger than the slope coefficients of the regression included constant.

Source: Authors’ calculations based on EU-KLEMS database.

**Table 5:** Estimated mark up ratios\* & degree of competition in Eurozone, US and Japan, 1970-2007

ISIC	Sector	Eurozone			US			Japan		
		Mark-up ratio	Competitive**	Less competitive***	Mark-up ratio	Competitive**	Less competitive***	Mark-up ratio	Competitive**	Less competitive***
D	Total Manufacturing	0.88**	-	-	0.94***	✓		0.99**	✓	
15t16	Food, Beverages and Tobacco	0.94**	✓		0.97***		✓	0.93***	✓	
17t19	Textile, Leather and Footwear	0.53*	✓		0.90**	-	-	0.81*	✓	
20	Wood and of wood and cork	0.84**	✓		0.85*	✓		3.38***		✓
21t22	Pulp, paper, printing and publishing	0.84***	✓		0.91***	-	-	2.31**		✓
23	Coke, refined petroleum and nuclear fuel	0.94*	✓		1.16*		✓	1.41*	-	-
24	Chemicals and chemical products	0.96*		✓	1.03*	-	-	1.48**	✓	
25	Rubber and plastics	0.91*	✓		0.93**	✓		0.85**	✓	
26	Other non-metallic mineral	0.86*	✓		1.00**	✓		0.91**	✓	
27t28	Basic metals and fabricated metal	0.96**	✓		0.82**	✓		1.03*	-	-
29	Machinery, nec	0.85**	✓		0.92*	✓		1.43*	-	-
30t33	Electrical and optical equipment	0.86***	✓		0.84*	✓		1.18*	-	-
34t35	Transport equipment	1.05**		✓	0.85**	✓		0.99**	✓	
36t37	Manufacturing, nec, recycling	1.01*		✓	1.11*		✓	1.05***	-	-
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	0.98*	✓		0.99**	✓		1.37*	-	-
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.87*	✓		0.93*	✓		0.94*	✓	
52	Retail trade, except of motor vehicles and motorcycles; repair of household goods	0.91*	-	-	0.90***	✓		0.99**	✓	
60t63	Transport and storage	0.70**	✓		0.86*	✓		1.00**	✓	
64	Post and telecommunications	0.99*	-	-	0.90*	✓		0.98*	✓	
70	Real estate activities	0.96*	✓		0.87*	-	-	2.15*		✓
71t74	Renting of machinery & equipment and other business activities	0.98*	✓		0.94*	✓		0.88*	✓	
E	Electricity, Gas & Water Supply	0.94**	✓		0.91*	✓		0.90***	✓	
F	Construction	0.82**	✓		0.95**	✓		0.90**	✓	
H	Hotels and restaurants	1.11*		✓	0.99*	✓		0.72*	✓	
J	Financial intermediation	0.95*	-	-	0.92*	✓		0.97***	✓	
L	Public administration and defence; compulsory social security	0.99*	✓		0.86***	-	-	1.08*	✓	
LtQ	Community, social	1.08*		✓	1.06**	✓		0.87*	✓	

	and personal services									
<b>M</b>	Education	0.75**	-	-	1.03**		✓	1.95**		✓
<b>N</b>	Health and social work	0.89**	✓		1.06*		✓	1.25**		✓
<b>O</b>	Other community, social and personal services	1.01*		✓	1.01*		✓	0.82***	✓	
<b>P</b>	Private households with employed persons	-	-	-	0.98**	-	-	0.74**	✓	

\* Based on OLS Estimations. \*\* A competitive sector is defined when the estimated mark – up ratio is lower than unity by both OLS and Bootstrap methods of estimation or Bootstrap and 2SLS estimations move in the same direction (below unity). \*\*\* A less competitive sector is defined the estimated mark – up ratio is higher than unity by both OLS and Bootstrap methods of estimation or Bootstrap and 2SLS estimations move in the same direction (above unity). Dashes imply that the estimated mark – up ratio of Bootstrap method of estimation does not coincide with the corresponding ratios of OLS and 2SLS methods of estimation.





## References

- Bresnahan, T.F. 1982. The oligopoly solution concept is identified. *Economics Letters* 10: 87-92.
- Christopoulou, R., and F. Vermeulen. 2012. Markups in the Euro area and the US over the period 1981-2004: A comparison of 50 sectors. *Empirical Economics* 421: 53-77.
- Dobbelaere, S. 2004. Estimation of price-cost margins and union bargaining power for Belgian manufacturing. *International Journal of Industrial Organization* 22: 1381-1398.
- Görg, H., and F. Warzynski. 2006. The Dynamics of Price Cost Margins in UK Manufacturing: 1989-1996. *Revue de l'OFCE, Special Issue*, 303-318.
- Hall, R.E. 1988. The Relation between price and marginal cost in U.S. industry. *Journal of Political Economy* 96: 921-947.
- Hall, R.E. and D.W. Jorgenson. 1967. Tax policy and investment behaviour. *American Economic Review* 57: 391-414.
- Konings, J., Van Cayseele, P., and F. Warzynski. 2005. The Effects of Privatization and Competitive Pressure on Firms. Price-Cost Margins: Micro Evidence from Emerging Economies. *The Review of Economics and Statistics*, vol 87(1): 124-134.
- Konings, J., and H. Vandenbussche. 2005. Antidumping Protection and Markups of Domestic Firms. *Journal of International Economics*, vol 65(1): 151-165.
- Maioli, S. 2004. A joint estimation of markups and returns to scale in 30 French industries: A structural approach. Mimeo.
- Martins, J.O., Scarpetta, S., and D. Pilat. 1996. Mark-up ratio in manufacturing industries: Estimation for 14 OECD countries. OECD Working paper 162.
- Martins, J.O., and Scarpetta, S. 1999. The Levels and Cyclical Behaviour of Mark-ups across Countries and Market Structures. OECD Working paper 213.
- Molnár, M. 2010. Measuring competition in Slovenian industries: Estimation of mark-ups, OECD Economics Department, Working Papers, No. 787, OECD Publishing <http://dx.doi.org/10.1787/5kmd41bjwr0q-en>.
- Molnar, M., and N. Bottini. 2010. How large are competitive pressures in services markets? Estimation of mark-ups for selected OECD countries” *OECD Journal: Economic Studies*.

- Nishimuraa G.K. Ohkusab, Y., and K. Arigac. 1999. Estimating the mark-up over marginal cost: a panel analysis of Japanese firms 1971–1994. *International Journal of Industrial Organization* 17: 1077–1111.
- OECD 2013. Competition Assessment Reviews Greece: Competition assessment of laws and regulations in Greece – Preliminary version.
- Polemis, M. 2014. Measuring market power in the Greek manufacturing and services industries *International Review of Applied Economics* DOI: 10.1080/02692171.2014.923386
- Polemis, M., and P. Fotis. 2014. Does gasoline price asymmetry exist? Evidence from both sides of the Atlantic. *Energy Policy*, <http://dx.doi.org/10.1016/j.enpol.2014.05.026i>
- Polemis, M., and P. Fotis. 2013. Do gasoline prices respond asymmetrically in the euro zone area? Evidence from cointegrated panel data analysis. *Energy Policy* 56: 425–433.
- Rezitis, A., and M. Kalantzi. 2011. Investigating market structure of the Greek manufacturing industry: A Hall-Roeger approach. *Atlantic Economic Journal* 39(4): 383-400.
- Rezitis, A., and M. Kalantzi. 2012a. Assessing competitive conditions and welfare losses in the Greek food and beverages manufacturing industry: An extended Hall-Roeger approach. *Economics Bulletin* 32(2): 1413-1427.
- Rezitis, A., and M. Kalantzi. 2012b. Investigating market structure of the Greek food and beverages manufacturing industry: A Hall-Roeger approach. *Agricultural Economics Review* 13(1): 49-65.
- Rezitis, A., and M. Kalantzi. 2013. Measuring the degree of market power in the Greek manufacturing industry. *International Review of Applied Economics* 27(3): 339-359.
- Roeger, W. 1995. Can imperfect competition explain the difference between primal and dual productivity measures? Estimates for U.S. manufacturing. *Journal of Political Economy* 103: 316-331.
- Trésor-Economics, 2008. Competition within sectors in France. Treasury and Economic Policy. General Directorate.
- Weiss, C., R. 2010 Mark-ups, industry structure and the business cycle. *Applied Economics Letters* 7: 189-191.
- Wu, H. 2009. Entry barriers and markup ratios: evidence from OECD countries. *Applied Economics Letters* 16: 125-130.