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"HOW TO MEASURE THE INTENSITY OF COMPETITION:
THE MARK-UP ESTIMATES FOR TURKISH MANUFACTURING
INDUSTRIES"

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To my Parents …

ABSTRACT

The intensity of competition in a specific economy is influenced by various factors such as industry concentration, regulations, subsidies, trade policies, strictness of competition policies etc. The mark-up ratio, which is the ratio of price to marginal cost, provides a quantitative measure of the intensity of competition. This measure serves as a theoretical and empirical tool for modeling market structure. In this paper, I present the methods developed for estimating the mark-up of prices over the marginal cost and do an empirical work for Turkish two-digit level manufacturing industries. I am able to classify Turkish manufacturing industries into four category of competitiveness. One major finding of this research is that industries using a large share of capital in their production process appear as the less competitive ones, which is consistent with the intuition that those industries are likely to have the largest fixed costs.

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1. INTRODUCTION

The inspiration of this paper comes from a discussion related to the links between industrial organization and macroeconomics. Hall (1986, 285) claimed that macroeconomic fluctuations reveal a good deal about market structure. Indeed, market structure has an important role in the propagation of macroeconomic shocks. The well-known Real Business Cycle Theory, under perfect competition and constant returns to scale, explained macroeconomic fluctuations as the consequences of an exogenous technological supply shock. On the other hand, Hall (1986, 304), showed some evidence of the existence of for imperfect competition and increasing returns for American industries. His results implied that firms persistently charge prices above marginal costs, making inappropriate the constant returns to scale competitive production function. According to Hall (1988, 922), productivity shocks were correlated with aggregate demand variables, implying that they were not exogenous impulses. In contrast to the Real Business Cycle Theory, these results mean that, under the presence of imperfect competition, macroeconomic fluctuations can have a demand-side explanation. His work emphasized the importance of imperfect competition for understanding the cyclical fluctuations.

In this context, macroeconomic modeling requires making specific assumption on the prevailing market structure, namely on the state of competition. In an economy there are many factors such as, the degree of industry concentration (the number of firms in the market), the existing regulations, the degree of openness to the international competitive markets, the existence of anti-competitive or collusive behavior, government subsidies, the trade policy, the strictness and enforcement of

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competition policy and others, which can affect the state of competition. Therefore, analyzing the intensity of competition in a particular industry or in an economy as a whole, becomes a complex issue. One feels the necessity of an exact measure about the state and/or intensity of competition in different markets. The mark-up ratio, which can be defined as the ratio of price to marginal cost, appears as an empirical tool that summarizes this. Under constant returns to scale and assumptions of perfect competition, a firm is expected to equalize its marginal cost to price. The supernormal profit at the industry level will be zero. In this case the mark-up ratio will be equal to one. A mark-up ratio larger than one can be an indicator either of imperfect competition or increasing returns or both.

This paper aims at discussing the different approaches in estimating the mark-up of prices over marginal costs as an indicator of the possible presence of imperfect competition and providing an empirical work using the most appropriate method.

The next section is about some information that helps to better understand the empirical side of my work. I give the details about the industries and the estimation period. In section three, I mention motivations behind the estimation of mark-up ratio. This section tries to show why the estimation of mark-up is an important topic and how it can be used in empirical works. Section four provides a theoretical discussion on methods to estimate the mark-up ratio. In this section, I present previous studies, which develop the estimation methods and their empirical results. Then in the fifth part, I explain the model that I use and the hypothesis to be tested for my empirical work. The subsequent section aims to present the data issues and the empirical results of my

estimation. In section seven, I interpret the results and compare with those of previous studies. Finally, there will be concluding remarks.

2.   RELEVANT INFORMATION

As mentioned in the introduction, the aim of this paper is to discuss the methods for unbiased estimates of mark-up ratio and apply the most suitable method in estimating it. For the empirical side of the paper, I use data on two-digit Turkish manufacturing industries. Data are provided by State Institute of Statistics of Turkey and Central Bank of Turkey. Industries are classified according to ISIC codes. The industries with their codes are as follow:

31 - Food manufacturing

32 - Textile, wearing apparel and leather industries

33 - Manufacture of wood and wood products including furniture

34 - Manufacture of paper, paper products, printing and publishing

35 - Manufacture of chemicals and of chemical petroleum, coal, rubber and plastic products

36 - Manufacture of non-metallic mineral products except products of petroleum and coal

37 - Basic metal industries

38 - Manufacture of fabricated metal products, machinery and equipment, transport equipment, professional and scientific and measuring and controlling equipment

39 - Other manufacturing industries

The sub-industries that are aggregated under two-digit classification are provided in appendix 1. All data used include the public sector as a whole and the private firms with a size higher than 10 workers. The estimation will be based on the period 1984 to 1996 with annual data. This time period makes sense because of the fact that 1984 is the end year of the militarily managed economic regime where prices were controlled and also the beginning of economic reforms leading to a more open, less distorted economy.

3.   MOTIVATION

In the introduction I noted that, the mark-up ratio provides a measure of the state of competition, and that macroeconomic modeling of imperfect competition requires making assumptions on the market structure. In this part, I present some empirical works, which does not deal directly with the estimation of mark-up ratio, but show how and why its estimation is important.

Concerning the use of the concept of mark-up pricing behavior in macroeconomic modeling, one can find a good deal in Mercenier[1]. He constructs an applied general-equilibrium model in order to investigate the consequences of the European market unification on welfare and employment. He uses a static multicountry and multisector model with imperfect competition, increasing returns to scale and product differentiation at the firm level. He assumes that noncompetitive firms can make price-discrimination; competitive firms are unable to do so. The pricing behavior for the competitive firms consists to equalize prices to marginal costs:

$$P=MC \qquad\qquad (1)$$

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[1] Mercenier, (1995, 10)

Noncompetitive industries have increasing returns to scale and a noncompetitive firm exploits the monopoly power on each individual market. Therefore, the noncompetitive firm chooses profit-maximizing prices using the Lerner formula:

$$(P_{isj} - MC_{is}) / P_{isj} = -1 / E_{isj} \qquad (2)$$

where E_{isj} is the perceived elasticity of demand for a given market j, of the firm in the country i and the sector s. "E" reflects preferences and industry concentration. Even at this stage of modeling, we see that the knowledge of mark-up estimates could help to classify various industries into two groups as "competitive" and "non-competitive".

The expression at the left-hand side of the equation is the Lerner index. The Lerner index measures how much higher prices are from marginal costs, and it can be seen as a measure of the intensity of competition prevailing in that sector. Once "E" is calculated as a function of trade flows, preference parameters (among other, the substitution elasticities) and number of firms, it can be substituted into this formula in order to compute prices charged by firms on each national market, given marginal costs of production. In the cases where the elasticity of substitution is unknown, it would be very useful to have estimates of the Lerner index, which is nothing but another way of expression the mark-up ratio. If the mark-up ratio is known, the elasticity of demand and the elasticity of substitution can be computed.

In another applied general equilibrium model, we can once again see the importance of mark-up pricing behavior as a tool in modeling. Mercenier and Yeldan (1997, 875) modelize the welfare effects of a passage for Turkey (TR) from a customs

union with European Union to the full market integration. Full integration (EEU) suppresses the non-tariff barriers between Europe and Turkey, and leads Turkish firms to adopt a new pricing strategy. The optimal pricing strategy is defined as below;

$$(P_j \text{ TR}-MC_i) / P_j \text{ TR} = \lambda\, \partial\, (\log P_j \text{ TR}) / \partial\, (\log Z_j \text{ TR}) +$$

$$(1-\lambda)\, \partial(\log P_j \text{ EEU}) / \partial\, (\log Z_j \text{ EEU}) \qquad\qquad (3)$$

where P_j, Z_j and MC_i are respectively, price, amount sold and marginal cost for firm j of that industry to the TR market. When $\lambda=0$ the full-integration is assumed and the expression at the left hand side of the equation (Lerner index) equals to the elasticity on the right hand. In the equation above, the relation of elasticities are related to the mark-up ratio in order to construct the model. Their work has a conclusion that a Turkish monopoly, which used to charge higher price in domestic market, is forced to reduce its home price when it moves to the single-price strategy in the full-integrated market (EEU). Here again, we see that the mark-up ratio is an important modeling tool that can be used to distinguish competitive from the non-competitive industries.

In the industrial organization literature, studies analyzing interindustry differences in profitability used profitability rates as a proxy for the "Price-Cost Margin" (PCM). Domowitz et al. (1986a, 1-17; 1986b, 13-33) is a good example of an effort to estimate PCM with pooled cross-sectional data in order to analyze cyclical

behavior of profitability and to test concentration-margins relationship. They define PCM[2] as;

$$PCM = (\text{Value Added} - \text{Payroll}) / (\text{Value Added} + \text{Cost of Materials}) \qquad (4)$$

Although this measure can explain the differences between prices and costs, it does not capture the marginal costs, and appears rather as an average measure of the relation between price and costs. In this case, although it can be used in explaining the effects of the market structure on the profitability of industries, it does not provide an exact measure for the mark-up of prices over the marginal cost. Therefore, this proxy cannot unambiguously indicate if a firm should be categorized as competitive or noncompetitive. This type of computation, even for a competitive firm, would indicate a positive level of profit, which is actually the normal rate of return on the capital. Therefore we should deal with another type of measure in order to make the distinction between the competitive and noncompetitive industries. This measure will be the mark-up ratio.

The computation of the mark-ups could also be useful for investigating the effects of various economic conditions on market imperfections. As I noted in the introduction, the state of competition for a given economy can be influenced by many different variables such as the degree of openness, the strictness of competition policy, the subsidies, industry concentration, the regulations, unionization etc. Domowitz et al. (1988, 62) look at the effects of unionization and the concentration on the market

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[2] PCM can also be defined as the ratio of the sum of (Value of Sales+ΔInventories-Payroll-Cost of Materials) to the sum of (Value of Sales+ΔInventories). This is identical to the former PCM in the text.

structure. One potential research can be modeled with cross-sectional data, as regressing the mark-up ratios on the dummy variables created for the competition policy and trade policy (and possibly other related variables) in order to evaluate the implications of these policies on the market structure for different type of industries such as durable/non-durable, consumer goods/producer goods etc. Much other research can be done with a similar logic, but which is essential in these researches is, first of all, to generate unbiased mark-up ratio estimates in the aim of obtaining meaningful interpretations about these regressions.

4.   PREVIOUS RESEARCH

In the previous section, I presented the reasons for which PCM cannot be used in order to make an industry competitiveness classification and the importance of an estimation of the mark-up ratio. Therefore we need some other models for estimating the mark-up ratio. Hall (1986, 291) developed a method of indirect estimation of the mark-up ratio by using the short-run fluctuations of output and inputs by sector. I first present Hall's method and then other methods developed using his method as a departure point.

4.1.   Hall's method

Hall's first aim is to explain the observed procyclical behavior of total productivity.[3] He departs from the concept of Solow residuals (SR) developed by Solow[4]. SR can be simply defined as a productivity measure. Solow (1957, 312-20)

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[3] Hall (1986, 287)
[4] Solow (1957, 312-20)

presents a method for computing the "Total Factor Productivity" directly from data. According to this method, under constant returns to scale and perfect competition, SR are expected to be uncorrelated with an exogenous variable, which is neither a cause of a productivity shift nor caused by a productivity shift. This is referred to as "*Invariance Property of the Solow Residual*". Hall proceeds by testing the correlation of SR with an exogenous instrumental variable under the joint hypothesis of constant returns to scale and perfect competition. The joint hypothesis seems reasonable because perfect competition is inconsistent with increasing returns and vice versa. Then he measures the same correlation value under the hypothesis of market power and constant returns. The presence of the correlation is a suggestion of the existence of market power.

Industries with market power are expected to have high profit rates. However, Hall observes low profit rates in American industries and explains these low profits by the presence of increasing returns and the excess capacity in these industries:

"The basic finding is that profit is nowhere near as high as it would be under full exploitation of market power with constant returns. My interpretation is that firms face setup costs, advertising costs or fixed costs that absorb a good part of the latent monopoly power profit. In this interpretation, firms frequently operate on the decreasing portions of their average cost curves. Marginal cost is consequently well below average cost, and zero or low levels of actual pure profit are the result."[5]

The marginal cost of a firm that uses capital and labor can be defined as follow;

$$MC = (W*\Delta L + R*\Delta K) / \Delta Q - \theta Q \qquad (5)$$

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[5] Hall (1986, 300)

where Q is real value added, W and R are the wage rate and the rental price of capital, respectively. θ is the rate of technical progress. In the denominator, The change of output is adjusted for the amount by which output would rise if there were no increase in the production inputs. By noting lowercase K and L as the log-levels and rearranging the formula above gives,

$$\Delta q = \mu \, \alpha \, \Delta l - (1-\mu\alpha) \, \Delta k + \theta, \tag{6}$$

where, μ is the mark-up ratio as $\mu = P/MC$, α is the labor share in the value added. SR can be obtained by subtracting $\alpha(\Delta k - \Delta l)$ from each side :

$$SR = \Delta q - \alpha \, \Delta l - (1-\alpha) \, \Delta k = (\mu-1) \, \alpha(\Delta l - \Delta k) + \theta \tag{7}$$

According to the "*Invariance Property of the Solow Residual*", if there is perfect competition, SR should not be correlated with the explanatory variable capital/labor ratio and it will be identical to the rate of technical growth.

Under the assumption of perfect competition, the shares of the capital and labor in output valued at marginal cost are also the elasticity of output with respect to inputs. Under constant returns to scale, these shares sum to one (A property of the Cobb-Douglass production function). Equation (7) shows that under perfect competition ($\mu=1$), SR should be equal to the rate of technical progress. That means SR represents the part of output growth not explained by the growth of inputs. This suggests a method

to calculate total productivity. However, the *invariance property* of the SR does not always hold. Hall (1986, 291) indicates that the observed SR show correlation with the fluctuations. Under perfect competition, the output and the inputs grow proportionally with demand. SR can be computed by subtracting the growth rate of inputs multiplied by their relative shares from the output growth. The relative shares will show the true input-elasticity of output. However under imperfect competition, these elasticities will be underestimated and output growth will be higher than input growth. This means that with imperfect competition, in the presence of a demand shock, SR residual will fluctuate, instead of staying constant. This procyclical behavior of productivity is explained by Hall as evidence of imperfect competition. In other words, the assumption of perfect competition can be rejected and the estimation of the productivity term is biased.

If the rate of technical progress is known, then mark-up ratios can be directly calculated from the equation (7) for each year. However, it is not observable and it can be written in the form of a constant and a random variation as : $\theta_t = \theta + u_t$

In this case, after a rearrangement the equation becomes,

$$\Delta(q - k) = \mu\, \alpha\, \Delta(l\text{-}k) + \theta + ut \tag{8}$$

Hall (1988, 926) estimates equation (8) between years 1953-1984, in order to find the mark-up coefficient μ. Variables as L, K and Q are observable. α can be computed from the data. He uses the exogenous instrumental variables for labor/capital ratio, which is supposed to be correlated with the productivity residual. A direct estimation with OLS

would give inconsistent estimates. The exogenous instruments that are supposed to be uncorrelated with the productivity term, are the U.S. military expenditure, the world oil price and a dummy for the political party. If there exist a correlation between the instrument and the SR, this means the rejection of the joint hypothesis of the perfect competition and the constant returns.

Among two-digit industries, Hall (1988, 941) finds that there is just one industry (apparel and other textile products) whose mark-up ratio is below one. Seven other industries such as lumber and wood products, furniture and fixtures, rubber and plastic products, fabricated metal products, machinery (except electrical), instrument, motor vehicles and equipment have mark-up ratios between one and two. Other industries have higher mark-ups than two. Among the latter, communication industry and chemicals industry have huge mark-ups, 36.3 and 20.12 respectively.

Norrbin (1993, 1150) claimed that Hall's estimates are subject to a bias from the use of value added rather than production data. In addition, Norrbin pointed that Hall's estimation ignores the intermediate inputs and takes into account just labor and capital.

As I pointed before, Hall used instrumental variables instead of OLS estimation. Martins et al.(1996, 6) argued that in the small samples a very small correlation between the instruments and productivity growth will bring more problems than a bias emerging from the OLS estimation. Roeger (1995, 325) argues that poor instruments could be a main reason for positive upward bias with Hall's method. Hall's method relies on choosing instruments that are uncorrelated with the sectoral technology shocks. According to Roeger (1995, 325), the instruments that Hall used

(the world oil price and the military purchases) may not constitute pure demand shocks but may in fact be correlated with supply. If we consider energy as an additional production factor for total output, the oil price may be more directly linked to the supply disturbance. The dummy variable used by Hall for the political party implies that the government demand is different from one government to another. However, the military purchases are not always determined by the political objectives. Therefore this dummy is not a truly exogenous demand shock. One should therefore be careful to find suitable instruments.

We conclude that, although Hall develops an important method to estimate the mark-ups and to show evidence for imperfect competition, his method brings also some identification problems.

4.2. Norrbin's Method

As mentioned above, Norrbin (1993, 1150) argues that Hall's estimates are biased because of the use of value added instead of production value. Norrbin uses Hall's same theoretical method with an extended data set which includes production value, intermediary inputs and some taxes adjustments.

He estimates the following equation;

$$\Delta q - [\alpha\, \Delta l - \gamma\, \Delta m - (1-\alpha-\gamma)\, \Delta k] \; = \; (\mu-1)\, [\alpha(\Delta l-\Delta k) +\gamma\, (\Delta m-\Delta k)] + \theta + u_t \qquad (9)$$

where "m" corresponds to the intermediary inputs and "γ" is its relative share in output. In contrast to Hall's estimates of large persistent mark-ups, Norrbin shows (1993, 1161) that production-based mark-ups are relatively small and insignificant when intermediate

inputs are used. Norrbin finds statistically significant mark-ups only for two industries, namely for petroleum and coal products (0.64) and electric equipment (1.379). However, the mark-up for petroleum industry is below one. He concludes that constant returns to scale and perfect competition might be a good characterization of technologies and firms' behavior in the economy. However, Norrbin does not modify the instrumental variables used by Hall, therefore he faces the same identification problem.

4.3.   Roeger's Method

Roeger (1995, 316) by following Hall, introduces another concept in the issue of measuring total factor productivity. This concept is the *"residual of the cost function"* and it can be noted as SRP (or price-based Solow residual). It is very similar to the SR that can be also understood as "the residual of the production function". The change in total factor productivity can be computed by using the input and output prices. Under constant returns to scale and perfect competition, both measure of productivity should be correlated. The observed lack of correlation can be either explained by the presence of fixed factor of production or the presence of mark-up type pricing behavior. Roeger (1995, 317) argues for the presence of positive mark-up of prices over marginal cost in explaining the lack of correlation between SR and SRP. Roeger first, derives an expression for the SRP, then construct a model with the difference of the two residuals. Using these differences he estimates the mark-up directly by OLS estimation.

SRP can be defined as;

$$SRP = \alpha\, \Delta w + (1-\alpha)\, \Delta r - \Delta p = -B(\Delta p - \Delta r) + (1-B)\theta \qquad (10)$$

where w, r are the prices of labor and capital respectively, p is the output price in log-levels. B is the Lerner index that can be defined as a transformation of the mark-up ratio;

$$B = (P-MC)/P = 1 - 1/\mu \quad \text{or} \quad \mu = 1/1-B \tag{11}$$

In this case we can rewrite the quantity-based SR as follows;

$$SR = \Delta q - \alpha \Delta l - (1-\alpha)\Delta k = B (\Delta q - \Delta k) + (1-B)\theta \tag{12}$$

In order to investigate for the presence of imperfect competition, Roeger (1995, 321) suggests to use the difference of the two residuals. This difference, augmented by an error term has the following form;

$$SR\text{-}SRP = (\Delta q + \Delta p) - \alpha(\Delta l + \Delta w) - (1-\alpha)(\Delta k + \Delta r) = B[(\Delta q + \Delta p) - (\Delta k + \Delta r)] + u_t \tag{13}$$

The expression at the left-hand side is the nominal SR and the right hand expression is the growth rate of the nominal output/capital ratio.

If the difference between the two residuals is not significantly different from zero, the observed differences can be attributed to errors of measurements. However, if the difference is explained significantly by the growth rate of the capital/output ratio (B is different from zero), it can be thought that we are far from "ideal conditions". This suggests that the assumptions of perfect competition should be rejected.

In the equation, variables such as output, labor and capital are in nominal terms. What is interesting in this model is that it allows a direct OLS estimation because the productivity residual vanishes when the difference between SR and SRP is taken

into account. Another advantage of this method is that the variables are the nominal terms, and this feature helps to overcome problems associated with price data.

Roeger (1995, 321) estimates the coefficient B in order to get the mark-up ratios for U.S. manufacturing industries with Hall's data set. The data cover the period 1953-1984 and industries are classified with two-digit level. Roeger (1995, 325) shows that 90% of the difference between SR and SRP is explained by the imperfection in U.S. industries. This means that significant mark-ups exist. His mark-up estimates are smaller that those of Hall. Only one industry shows a mark-up higher than three (electric, gas and sanitary services μ=3.14), for which Hall estimated 12.59. Mark-up ratios for industries as tobacco, chemicals, motor vehicles and equipment are between 2 and 3. The rest of industries have mark-up ratios higher than one but inferior to two.[6] In table 1, I present the results obtained by three different approaches. Norrbin and Roeger use Hall's data set for the period 1953-1984, therefore comparing their results make sense.

Roeger's approach seems quite practical because it allows a direct estimation with OLS instead of using instrumental variables. In addition, the use of nominal values facilitates the empirical work. However, like Hall's estimation, it fails to the use intermediate inputs in the model. This could cause an upward bias in the coefficient estimated B and the mark-up ratio.

Roeger, (1995, 325)

Table 1: Mark-up Estimates with different methods, using the same data set and period

1953-1984

Industry	Hall[ọ] (1988)	Norrbin[1] (1993)	Roeger[2] (1995)
Food and Kindred Products	5.291	1.239	1.50
Tobacco manufactures	2.766	2.150	2.75
Textile	2.587	1.324	1.34
Apparel and other textile products	0.824	0.924	1.15
Leather and leather products	2.100	-2.314	1.19
Lumber and wood products	1.801	1.057	1.75
Furniture and fixtures	1.977	1.257	1.28
Paper and allied products	3.716	1.672	1.57
Printing and publishing	*14.263*	1.269	1.40
Chemicals and allied products	*20.112*	1.225	2.11
Rubber and miscellaneous plastic products	1.508	0.909	1.36
Petroleum and coal products	-139.478	0.64*	-
Stone, clay, and glass products	2.536	1.132	1.59
Primary metal industries	2.172	1.261	1.58
Fabricated metal products	1.649	1.114	1.33
Machinery except electrical	1.429	1.121	1.41
Electric and electronic equipment	3.086	1.379*	1.34
Instruments and related products	1.397	1.212	1.47
Motor vehicles and equipment	1.763	1.140	2.06
Other transportation equipment	.095	0.978	1.22
Miscellaneous manufacturing	4.491	.987	1.62

Note: Norrbin's results are statistically insignificant, except industries indicated by a symbol (*)

Sources:

[ọ] Hall (1988, 941),

[1] Norrbin (1993, 1158),

[2] Roeger (1995, 326)

5.   MODEL

In the previous section, we saw that Hall used instrumental variables, but did not incorporate the intermediate inputs in his model. Norrbin followed the same model while taking into account the intermediate inputs. Their results were quite different from each other. Roeger developed a different approach, free of the identification problem. He allowed for a direct OLS estimation with nominal values of variables. He found lower mark-ups than Hall's results. However, like Hall, he ignored the intermediate inputs. This could induce a bias in mark-up ratio estimates. In this part, I present a model that is a combination of three previous works. This model borrows the idea of direct estimation from Roeger and adds to it the use of intermediate inputs suggested by Norrbin. This model has been proposed by Martins et al.[7]

Equation (13) can be modified by adding the intermediate input with its relative share in output. A different nominal SR is then obtained, and it is regressed on the nominal capital/output ratio.

The model can be written as,

$$\Delta Y_t = B\,\Delta X_t + u_t \qquad (14)$$
  where

$$\Delta Y_t = [(\Delta q^{\,o} + \Delta p^{\,o}) - \alpha(\Delta l + \Delta w) - \beta(\Delta m + \Delta p_m) - (1-\alpha-\beta)(\Delta k + \Delta r)] \qquad (15)$$
$$\Delta X_t = [(\Delta q^{\,o} + \Delta p^{\,o}) - (\Delta k + \Delta r)] \qquad (16)$$

The lower case letters in the equation represent above are in log-level variables. Variables $q^{\,o}$ and $p^{\,o}$ are the gross output and its respective price. In the Roeger's and Hall's method 'q' was corresponding to the value added. m and p_m correspond to

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[7] Martins et al. (1996, 7)

intermediate inputs and their prices, l and w are respectively labor input and its wage. The variables k and r are capital input and its rental price, respectively.

The null hypothesis to be tested is that B in equation (14) is not significantly different from zero (Ho: B=0). If this hypothesis cannot be rejected in statistically significant levels, it means that perfect competition cannot be rejected in a particular industry. The alternative hypothesis is the evidence for the imperfect competition. In this case, the value of the coefficient B will be transformed into the mark-up ratio value by a simple formula: $\mu = 1/1$-B.

Theoretically, if the value of gross output includes certain taxes such as the value-added tax and other indirect taxes, the estimation will result in biased estimates. Therefore an adjustment concerning these two taxes is necessary. Martins et al. (1996, 10) suggested that, if a constant rate of indirect taxes is known the estimated mark-up ratio can be deflated by this amount. This means,

$$\mu = \mu^{\char`\^}/(1+\tau) \tag{17}$$

where $\mu^{\char`\^}$ is the estimated mark-up ratio the equation (14). However, in case data is available, I suggest to making an adjustment directly on the values of gross output and the value added by subtracting tax amounts from these variables. The same kind of adjustment must be done concerning the value-added tax. The value added tax rate must be multiplied by the ratio of value added to gross output and then must be subtracted from the gross output. These adjustments would avoid a possible bias in estimates.

6. ESTIMATION

6.1. Content of variables

This section will define the contents of the variables used in the mark-up estimation with the model above. Although the estimation period is 1984-1996, data I use include information for 1950-1996, for the manufacturing industries of the public sector as a whole, as well as for private firms with more than 10 workers.

The content of the variables is as follows:

Gross Output $[(\Delta q^o + \Delta p^q)]$: It includes the revenues from the sales, plus the changes in stocks in a year. It is in nominal value for each year Turkish Lira (TL).

Payroll $[(\Delta l + \Delta w)]$: It includes total gross wages paid to workers before income tax, plus overtime payments, compensations, incentive payments and payments in kind, in nominal value for each year (TL).

Intermediary Inputs $[(\Delta m + \Delta p_m)]$: It includes goods, services and energy purchased by firms during the year. It is in nominal value (TL).

Capital Costs $[(\Delta k + \Delta r)]$: This variable shows the change in capital stock valued at its rental price. Because of the difficulty of observing the capital stock, I to generate the capital stock from the gross fixed investment, since this is the difference between capital stocks of two successive years $(K_t - K_{t-1} = I_t)$. I used a capital /output ratio of 2.8 in order to generate the capital stock of the beginning year 1950, using the available data on output and gross fixed investment. I used the depreciation rate of 10% for each year. I first computed the stock of capital for the year 1950 by using the formula $K_o = 2.8 \cdot Q_o$, and then I generated the stock of capital for the subsequent years by adjusting the depreciation rate and adding gross fixed investments by the relation,

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$$K_t = [(1-\delta) \cdot K_{t-1}] + I_t, \tag{18}$$

where $K_{t-1} = K_0$ for $t = 1951$[8]. Given that my estimation period begins in 1984, I assumed that, the use of a proxy for the 1950's capital stock is harmless, because the error (difference between the proxy and the true but unobservable value of the capital stock) will have converged to zero in 34 years.

As mentioned before, the rental price of capital is computed separately using:

$$R = [(i-\pi_e) + \delta] \, p_k \tag{19}$$

where 'i' is the nominal interest rate, π_e is the expected rate of inflation, δ is the depreciation rate and the p_k is the economy wide deflator. For 'i' I use the average nominal interest rates on deposits provided by the Central Bank of Turkey. The depreciation rate is assumed to be 10%. For the expected rate of inflation rate I use an adaptive expectation model, which can be expressed as,

$$\pi_{e(t)} = 0.7 \times \pi^a_{(t)} + 0.3 \pi_{e(t-1)}, \tag{20}$$

where, $\pi^a_{(t)}$ is the actual rate of inflation. When multiplied with its rental price, the capital costs will be in TL nominal value for each year.

Value Added: It is obtained from the difference of the gross output and the intermediate inputs. It is also in nominal value (TL).

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[8] The capital/output ratio of 2.8 used in the data generation process was suggested by my research director in a personal discussion.

6.2. Tax Adjustment

As mentioned above, a tax adjustment should be done on the values of the gross output and the value added in order to avoid a possible bias. It is unclear if the data that were supplied to us include or not those taxes. I shall assume that gross output and value added are adjusted with the tax amounts but one has to keep in mind that this assumption, if incorrect could bias the results.

6.3. Empirical Procedure

I proceed first by estimating the relative shares of the labor, intermediate inputs and the capital in the value added, α, β and $(1-\alpha-\beta)$ respectively. These coefficients will be multiplied with their corresponding variables namely labor costs, cost of intermediate inputs and cost of capital. The sum of these three results will be subtracted from the value of gross output. The resultant will be regressed on the nominal output/capital ratio in order to estimate the coefficient B. Finally, B will be used to estimate the mark-ups.

Here are the equations to be estimated in order to find the relatives shares of the labor and intermediate inputs in the gross output.

$$\Delta(P_t Q_t) = (1/\alpha)\ \Delta(W_t L_t) + \varepsilon_t \tag{21}$$

$$\Delta(P_t Q_t) = (1/\beta)\ \Delta(P_{mt} M_t) + \omega_t \tag{22}$$

where, $P_t Q_t$ is the nominal value added, $W_t L_t$ and $P_{mt} M_t$ are the labor costs and intermediate input costs respectively. Table 2 presents the estimated coefficients. All are significantly different from zero at the 5% significance level. Relative shares of labor

and intermediate inputs are found by taking inverses of these coefficients. Then the share of capital input is calculated from the two other shares. Table 3 reports the relative shares of inputs.

Table 2: Estimated inverse coefficients for the input shares.

Industry codes	1/α: inverse of the share of labor input	1/β: inverse of the share of intermediary inputs
31	17.19 (0.73)* *(23.34)***	1.43 (0.02) *(66.64)*
32	11.93 (0.91) *(13.11)*	1.58 (0.03) *(43.92)*
33	21.45 (0.90) *(23.72)*	2.17 (0.08) *(24.76)*
34	5.14 (0.88) *(5.82)*	1.52 (0.06) *(24.79)*
35	25.09 (0.59) *(41.96)*	1.80 (0.01) *(116.88)*
36	9.80 (0.42) *(23.15)*	1.98 (0.03) *(51.85)*
37	12.01 (1.93) *(6.20)*	1.22 (0.04) *(28.22)*
38	12.44 (0.47) *(26.07)*	1.59 (0.02) *(84.31)*
39	10.54 (0.34) *(30.37)*	1.95 (0.03) *(56.68)*

Source: My estimation. Results are presented in annex 2.

Note: *Values in parentheses, in the second row of each cell, are standard errors.

**T-statistics are in *italics* and appear in the third row for each cell.

Industries in the table 2:

31 - Food manufacturing

32 - Textile, wearing apparel and leather industries

33 - Manufacture of wood and wood products including furniture

34 - Manufacture of paper, paper products, printing and publishing

35 - Manufacture of chemicals and of chemical petroleum, coal, rubber and plastic products

36 - Manufacture of non-metallic mineral products except products of petroleum and coal

37 - Basic metal industries

38 - Manufacture of fabricated metal products, machinery and equipment, transport equipment, professional and scientific and measuring and controlling equipment

39 - Other manufacturing industries

Table 3 : Relative shares of labor, intermediate and capital inputs in gross output for two-digit industries.

Industry codes	α: share of labor input	β: share of intermediary inputs	(1-α-β): share of capital input
31	0.058	0.695	0.252
32	0.083	0.631	0.284
33	0.046	0.460	0.493
34	0.194	0.653	0.151
35	0.039	0.553	0.406
36	0.102	0.503	0.394
37	0.083	0.814	0.102
38	0.080	0.628	0.29
39	0.094	0.511	0.393

Source: My estimation with the data provided by state institute of Statistics of Turkey Regression results are presented in annex 2.

Industries in the table 3:

31 - Food manufacturing

32 - Textile, wearing apparel and leather industries

33 - Manufacture of wood and wood products including furniture

34 - Manufacture of paper, paper products, printing and publishing

35 - Manufacture of chemicals and of chemical petroleum, coal, rubber and plastic products

36 - Manufacture of non-metallic mineral products except products of petroleum and coal

37 - Basic metal industries

38 - Manufacture of fabricated metal products, machinery and equipment, transport equipment, professional and scientific and measuring and controlling equipment

39 - Other manufacturing industries

Using the estimated input shares, I generate the variables ΔY and ΔX given in equations (15) and (16) for each industry separately. For ΔY, I multiply the estimated labor share with the log-differences of the payroll, the estimated intermediate input share with the log-difference of cost of intermediate inputs and the estimated capital share with the log-difference of capital costs. I subtract all of these from the log-difference of the gross output. I do a similar operation for ΔX, I subtract the log-difference of the capital cost from the log-difference of the gross output. Regressing ΔY on ΔX for each industry gives us the estimated Lerner index coefficient B. I transform this to the mark-up ratio using the simple formula: $\mu = 1/(1-B)$. Table 4 presents the estimated Lerner index coefficients and the mark-up ratios. Regression results are given in appendix 3.

Table 4: Estimated Lerner indices and the mark-up ratios for Turkish manufacturing industries (two-digit level) for the period 1984-1996.

Industry codes	Lerner Index (B)	Mark-up Ratio (μ)
31	0.25 (0.002)* *96.41***	1.34
32	0.28 (0.001) *186.48*	1.39
33	0.53 (0.029) *17.86*	2.12
34	0.15 (0.006) *24.82*	1.18
35	0.41 (0.007) *53.23*	1.69
36	0.39 (0.004) *84.44*	1.64
37	0.09 (0.005) *18.23*	1.11
38	0.28 (0.002) *133.26*	1.40
39	0.39 (0.006) *59.55*	1.64

Source: Estimation results are presented in annex 3.
Note: *Values in parentheses, in the second row of each cell, are standard errors.
**T-statistics are in *italics* and appear in the third row for each cell.

Industries in the table 4:
31 - Food manufacturing
32 - Textile, wearing apparel and leather industries
33 - Manufacture of wood and wood products including furnish
34 - Manufacture of paper, paper products, printing and publishing
35 - Manufacture of chemicals and of chemical petroleum, coal, rubber and plastic products
36 - Manufacture of non-metallic mineral products except products of petroleum and coal
37 - Basic metal industries
38 - Manufacture of fabricated metal products, machinery and equipment, transport equipment, professional and scientific and measuring and controlling equipment
39 - Other manufacturing industries

7. INTERPRETATION OF THE RESULTS

As can be seen in table 4, the estimated Lerner indices coefficients (B) are significantly different from zero at 5% significance level for all industries.

In this part, while interpreting my results, I try to compare them with those of Hall's and Roeger's. However, it should be noted that their estimates are for the U.S. industries. Their estimation period and method are different from mine. In addition there are differences in the sub-industry classification. Therefore the comparison does not aim at explaining the difference of the market structures between U.S and Turkey.

According to the mark-up ratios obtained from the empirical work, I can classify nine industries into four groups:

1-Industries with very high market power: This group includes "manufacture of wood and wood products and furniture". It has a mark-up ratio of 2.12 that is higher than the values estimated by previous studies. For wood products Hall and Roeger estimated 1.801 and 1.75, respectively. Their estimates for the "furniture" are 1.97 and 1.28, respectively. I estimated the share of the capital input as 49% for this industry.

2-Industries with high market power: According to my results, three industries can be considered as having high market power. The first is the "manufacture of chemicals and of chemical petroleum, coal, rubber and plastic products". This industry has a mark-up ratio of 1.69. Hall and Roeger, respectively, found a value of 20.11 and 2.11 for the chemicals. My estimates are therefore lower than theirs. For "rubber and plastic

products" their estimated mark-up ratios are smaller than mine. The relative share of capital in gross output was estimated as 40%.

The second industry to have high market power is "the manufacture of non-metallic mineral products except products of petroleum and coal". This industry has a mark-up ratio of 1.64. This is lower that Hall's estimate (2.53) but larger than that of Roeger (1.59). The estimated relative share of capital in gross output is 39%.

The third class in this group of "high market power" is the "other manufacturing industries" which includes industries such as, jewelry, musical instruments, sporting and athletic goods, and manufacturing not elsewhere classified. The estimated mark-up for this group is 1.64.

3- *Industries with some market power:* There are three industry classes belonging to this group. First one is "food manufacturing" with the mark-up of 1.34, which is lower than the results of Hall and of Roeger, respectively 5.29 and 1.50. The share of capital input is estimated to be 25%.

The second class includes "textiles, wearing apparels and leather industries", with a mark-up ratio of 1.39. I estimated 28% for the relative share of capital. Hall's estimates are 2.58 for textile, 2.76 for apparel and 2.1 for leather. Roeger's result's are 1.34, 1.15 and 1.19 respectively.

The third class consists of the "fabricated metal products, machinery and equipment, transport equipment professional and scientific and measuring and controlling equipment". The corresponding mark-up and share of capital input are 1.40

and 29%, respectively. The difference in the sub-industry classification does not allow comparing the results.

4- *Industries with little market power*: I consider two industries for this group. The first one is "paper manufacturing, paper products, printing and publishing" with a mark-up ratio of 1.18. I estimate the relative share of capital input as 15% for this class. My estimates are smaller than those of Hall and Roeger. Hall estimates 3.71 and 14.263 for paper products and publishing, respectively. Roeger finds 1.57 for paper and 1.40 for publishing.

The second class of industry for this group is basic metal industries. My estimate of mark-up is 1.10. Hall's and Roeger's results are 2.172 and 1.58 for this industry, respectively. I estimated the relative share of capital input as 15%.

In general, the mark-up estimates obtained for Turkish manufacturing, using a different approach are smaller than the results of previous studies about U.S industries. However, as mentioned, comparing these results has no conclusive meaning.

It can be said that industries of basic metals and paper-publishing are relatively more competitive than other manufacturing industries in Turkey. It would be appropriate to model other industries as imperfectly competitive.

If we relate the share of capital to the estimated mark-ratios, we see that industries with higher capital shares have higher mark-up ratios.

8. CONCLUDING REMARKS

In this paper, the mark-up ratio is defined as a tool to distinguish the intensity of competition among industries. In a competitive industry, the ratio of price over

marginal cost is expected to be equal to one. To the extent that this ratio is larger than one, an industry can be said to be non-competitive. The mark-up ratio can also be related to other economic variables in order to evaluate the various effects on the market structure of a particular economy. Therefore we need unbiased mark-up estimates for different industry groups.

The aim of this paper has been to present different methods for the estimation of mark-ups and to apply the most appropriate one to Turkish data. I use the method suggested by Martins, Scarpetta and Pilat (1996, 7) on Turkish manufacturing industries, over the period 1984 to 1996. My results allow grouping Turkish industries into four competitiveness categories according to their corresponding mark-up estimates. The manufacture of "wood and wood products" appears to have very high market power. The second group consists of industries of "manufacture of chemicals and of chemical petroleum, coal, rubber and plastic products" and of "manufacture of non-metallic mineral products except products of petroleum and coal"; this group has high market power. "Textile, wearing apparel and leather industries", "food manufacturing" and "other manufacturing industries" constitute the group of industries having "some market power". Finally, the mark-up estimates show very little market power for "basic metal industries" and "manufacture of paper, paper products, printing and publishing".

The quality of these estimates depends on the data available for two-digit level industries. An interesting extension of this work would consist to do the same exercise with more disaggregated data for example at a three or four digit level. This would permit to a more detailed analysis of market structure.

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APPENDIX 1 : INTERNATIONAL STANDARD INDUSTRIAL CLASSIFICATION

3 - MANUFACTURING INDUSTRY

31 - Manufacture of food, beverages and tobacco
311- Food manufacturing
3111 - Slaughtering, preparing and preserving meat
3112 - Manufacture of dairy products
3113 - Caning and preserving of fruits and vegetables
3114 - Caning, preserving and processing of fish crustacea and
     similar goods
3115 - Manufacture of vegetable and animal oil fats
3116 - Grain mill products
3117 - Manufacture of bakery products
3118 - Sugar factories and refineries
3119 - Manufacture of cocoa, chocolate and sugar confectionery
 312 - Manufacture of foot products not elsewhere classified
3121 - Manufacture of foot products not elsewhere classified
3122 - Manufacture of prepared animal feeds
 313 - Beverage industries
3131 - Distilling, rectifying and blending spirits
3132 - Wine industries
3133 - Malt liquors and malt
3134 - Non-alcoholic beverages, carbonated fruit juice,
     natural mineral waters and source origin water
 314 - Tobacco manufactures
3140 - Tobacco manufactures

32 - Textile, wearing apparel and leather industries
 321 - Manufacture of textiles
3211 - Spinning, weaning and finishing textiles

3212 - Manufacture of textile goods except wearing apparel
3213 - Knitting mills
3214 - Manufacture of carpets and rugs
3215 - Cordage rope and twine industries
3219 - Manufacture of textiles not elsewhere classified
 322 - Manufacture of wearing apparel, except footwear
3221 - Manufacture of fur and leather products
3222 - Manufacture of wearing apparel, except fur and leather

323 - Manufacture of leather and products of leather, leather
     substitutes and fur, except footwear and wearing apparel
3231 - Tanneries and leather finishing
3232 - Fur dressing and dyeing industries
3233 - Manufacture of products of leather and leather
     substitutes, except footwear and wearing apparel
 324 - Manufacture of footwear, except vulcanize or moulded
     rubber of plastic footwear
3240 - Manufacture of footwear, except vulcanize or moulded
     rubber of plastic footwear

33 - Manufacture of wood and wood, products including furnish
 331 - Manufacture of wood and wood cork products, except
     furniture
3311 - Sawmills, planing and other wood mills
3312 - Manufacture of wooden and cane containers and small
     cane ware
3319 - Manufacture of wood and cork products not
     elsewhere classified
 332 - Manufacture of furniture and fixtures, except

primarily of metal

3320 - Manufacture of furniture and fixtures, except
primarily of metal

34 - Manufacture of paper of paper products, printing and publishing

341 - Manufacture of paper and paper products
3411 - Manufacture of pulp, paper and paperboard
3412 - Manufacture of containers and boxes of paper and
342 - Printing, publishing and allied industries
3421 - Printing, publishing and allied industries

35 - Manufacture of chemicals and of chemical petroleum, coal, rubber and plastic products

351 - Manufacture of industrial chemicals
3511 - Manufacture of basic industrial chemicals, except
fertilizers
3512 - Manufacture of fertilizers and pesticides
3513 - Manufacture of synthetic resins, plastic materials and
man-made fibers except glass
352 - Manufacture of other chemical products
3521 - Manufacture of paints, varnishes and lacquers
3522 - Manufacture of drugs and medicines (Inculuding veterinary
medicine)
3523 - Manufacture of soap and cleaning preparations,
perfumes, cosmetics and other toilet preparations
3529 - Manufacture of chemical products not elsewhere
classified
353 - Petroleum refineries
3530 - Petroleum refineries
354 - Manufacture of miscellaneous products of petroleum and
coal
3541 - Manufacture of asphalt paving and roofing materials

3542 - Manufacture of coke coal and briquettes
3543 - Compounded and blended lubricating oils and greases
3544 - Liquid petroleum gas tubing
355 - Manufacture of rubber products
3551 - Tyre and tube industries
3559 - Manufacture of rubber products not elsewhere
classified
356 - Manufacture of plastic products not elsewhere
classified
3650 - Manufacture of plastic products not elsewhere
classified

36 - Manufacture of non-metallic mineral products except products of petroleum and cool

361 - Manufacture of pottery, china and earthenware
3610 - Manufacture of pottery, china and earthenware
362 - Manufacture of manufacture of glass and glass products
3620 - Manufacture of manufacture of glass and glass products
369 - Manufacture of other non-metallic mineral products
3691 - Manufacture of structural clay products
3692 - Manufacture of cement, lime and plaster
3699 - Manufacture of other non-metallic mineral products not
elsewhere classified

37 - Basic metal industries

371 - Iron and steel basic industries
3710 - Iron and steel basic industries

372 - Non-ferrous metal basic industries
3720 - Non-ferrous metal basic industries

38 - Manufacture of fabricated metal products, machinery and equipment, transport equipment, professional and scientific and measuring and controlling equipment

381 - Manufacture of fabricated metal products except machinery and equipment

3811 - Manufacture of cutlery, hand tools and general hardware

3812 - Manufacture of furniture and fixtures primarily of metal

3813 - Manufacture of structural metal products

3819 - Manufacture of fabricated metal products except machinery and equipment not elsewhere classified

382 - Manufacture of machinery (except electrical)

3821 - Manufacture of engines and turbines

3822 - Manufacture of agricultural machinery and equipment and repairing

3823 - Manufacture of metal and wood working machinery repairing

3824 - Manufacture of special industrial machinery and equipment except metal and wood working and repairing machinery

3825 - Manufacture of office, computing and accounting machinery and repairing

3829 - Manufacture of machinery and equipment, except electrical, not elsewhere classified

383 - Manufacture of electrical machinery, apparatus, repairing , appliances and supplies

3831 - Manufacture of electrical industrial machinery and apparatus

3832 - Manufacture of radio television and communication equipment and apparatus

3833 - Manufacture of electrical appliances and housewares

3839 - Manufacture of electrical apparatus and supplies not elsewhere classified

384 - Manufacture of transport equipment

3841- Ship building and repairing

3842 - Manufacture assembly of railroad equipment and repairing

3843 - Manufacture assembly of motor vehicles and repairing

3844 - Manufacture of motorcycle and bicycles and repairing

3845 - Manufacture of aircraft and repairing

3849 - Manufacture of transport equipment not elsewhere classified

385 - Manufacture of professional, scientific measuring and controlling equipment not elsewhere classified and photographic and optical goods

3851 - Manufacture of professional, scientific measuring and controlling equipment, not elsewhere classified

3852 - Manufacture of photographic and optical goods

3853 - Manufacture of watches and clocks

3854 - Other

39 - Other manufacturing industries
390 - Other manufacturing industries
3901 - Manufacture of jewelry and related articles
3902 - Manufacture of musical instruments
3903 - Manufacture of sporting and athletic goods

3909 - Manufacturing industries not elsewhere classified

APPENDIX 2: REGRESSION RESULTS FOR THE RELATIVE SHARES OF INPUTS IN THE GROSS OUTPUT: EQUATIONS (14) AND (15) IN THE TEXT.

INDUSTRY CODE :31

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 19:17
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DG	17.19265	0.736607	23.34034	0.0000

R-squared	0.970820	Mean dependent var	1.07E+08
Adjusted R-squared	0.970820	S.D. dependent var	1.87E+08
S.E. of regression	31995749	Akaike info criterion	34.63603
Sum squared resid	1.23E+16	Schwarz criterion	34.67949
Log likelihood	-242.5804	Durbin-Watson stat	2.049868

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 19:11
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DI	1.437861	0.021573	66.64970	0.0000

R-squared	0.996352	Mean dependent var	1.07E+08
Adjusted R-squared	0.996352	S.D. dependent var	1.87E+08
S.E. of regression	11312191	Akaike info criterion	32.55659
Sum squared resid	1.54E+15	Schwarz criterion	32.60004
Log likelihood	-229.0640	Durbin-Watson stat	2.441025

INDUSTRY CODE 32

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 19:51
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DG	11.93911	0.910177	13.11735	0.0000

R-squared	0.911605	Mean dependent var	1.16E+08
Adjusted R-squared	0.911605	S.D. dependent var	2.02E+08
S.E. of regression	60012084	Akaike info criterion	35.89392
Sum squared resid	4.32E+16	Schwarz criterion	35.93737
Log likelihood	-250.7567	Durbin-Watson stat	1.578073

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 19:52
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DI	1.582936	0.036039	43.92273	0.0000

R-squared	0.991618	Mean dependent var	1.16E+08
Adjusted R-squared	0.991618	S.D. dependent var	2.02E+08
S.E. of regression	18479424	Akaike info criterion	33.53814
Sum squared resid	4.10E+15	Schwarz criterion	33.58160
Log likelihood	-235.4441	Durbin-Watson stat	2.328961

INDUSTRY CODE 35

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:20
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DG	25.09140	0.597947	41.96258	0.0000

R-squared	0.990866	Mean dependent var	1.41E+08
Adjusted R-squared	0.990866	S.D. dependent var	2.48E+08
S.E. of regression	23734229	Akaike info criterion	34.03866
Sum squared resid	6.76E+15	Schwarz criterion	34.08212
Log likelihood	-238.6975	Durbin-Watson stat	1.544507

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:21
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DI	1.805666	0.015449	116.8825	0.0000

R-squared	0.998816	Mean dependent var	1.41E+08
Adjusted R-squared	0.998816	S.D. dependent var	2.48E+08
S.E. of regression	8546175.	Akaike info criterion	31.99579
Sum squared resid	8.76E+14	Schwarz criterion	32.03925
Log likelihood	-225.4188	Durbin-Watson stat	1.179722

■■■

INDUSTRY CODE 36

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:27
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DG	9.802445	0.423378	23.15295	0.0000

R-squared	0.969621	Mean dependent var	28746899
Adjusted R-squared	0.969621	S.D. dependent var	48067912
S.E. of regression	8378056.	Akaike info criterion	31.95606
Sum squared resid	8.42E+14	Schwarz criterion	31.99951
Log likelihood	-225.1606	Durbin-Watson stat	1.305593

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:27
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DI	1.986721	0.038310	51.85908	0.0000

R-squared	0.993837	Mean dependent var	28746899
Adjusted R-squared	0.993837	S.D. dependent var	48067912
S.E. of regression	3773684.	Akaike info criterion	30.36093
Sum squared resid	1.71E+14	Schwarz criterion	30.40439
Log likelihood	-214.7922	Durbin-Watson stat	1.216739

■■■

INDUSTRY CODE 37

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:33
Sample: 1984 1996
Included observations: 13

Variable CoefficientStd. Error t-Statistic Prob.

DG   12.01198 1.935816 6.205123 0.0000

R-squared 0.655959	Mean dependent var		47005337
Adjusted R-squared	0.655959	S.D. dependent var	73100178
S.E. of regression	42876897	Akaike info criterion	35.22149
Sum squared resid	2.21E+16	Schwarz criterion	35.26495
Log likelihood	-246.3859	Durbin-Watson stat	1.787101

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:35
Sample: 1984 1996
Included observations: 13

Variable CoefficientStd. Error t-Statistic Prob.

DI   1.228194 0.043522 28.22038 0.0000

R-squared 0.978506	Mean dependent var		47005337
Adjusted R-squared	0.978506	S.D. dependent var	73100178
S.E. of regression	10717016	Akaike info criterion	32.44849
Sum squared resid	1.38E+15	Schwarz criterion	32.49195
Log likelihood	-228.3614	Durbin-Watson stat	1.638539

■■■ ■ ।

INDUSTRY CODE 38

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:46
Sample: 1984 1996
Included observations: 13

Variable CoefficientStd. Error t-Statistic Prob.

DG   12.44499 0.477198 26.07929 0.0000

R-squared 0.976747	Mean dependent var		1.20E+08
Adjusted R-squared	0.976747	S.D. dependent var	2.14E+08
S.E. of regression	32601691	Akaike info criterion	34.67355
Sum squared resid	1.28E+16	Schwarz criterion	34.71701
Log likelihood	-242.8243	Durbin-Watson stat	2.280648

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:47
Sample: 1984 1996
Included observations: 13

Variable CoefficientStd. Error t-Statistic Prob.

DI   1.592155 0.018884 84.31205 0.0000

R-squared 0.997740	Mean dependent var		1.20E+08
Adjusted R-squared	0.997740	S.D. dependent var	2.14E+08
S.E. of regression	10164308	Akaike info criterion	32.34259
Sum squared resid	1.24E+15	Schwarz criterion	32.38605
Log likelihood	-227.6730	Durbin-Watson stat	2.515766

■■■ ■ ।

INDUSTRY CODE 39

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:56
Sample: 1984 1996
Included observations: 13

Variable   CoefficientStd. Error t-Statistic Prob.

DG   10.54428 0.347151 30.37378 0.0000

R-squared 0.983535	Mean dependent var		1553231.
Adjusted R-squared	0.983535	S.D. dependent var	3042872.
S.E. of regression	390444.3	Akaike info criterion	25.82388
Sum squared resid	1.83E+12	Schwarz criterion	25.86734
Log likelihood	-185.3015	Durbin-Watson stat	1.680681

LS // Dependent Variable is DJ
Date: 04/08/99 Time: 21:58
Sample: 1984 1996
Included observations: 13

Variable   CoefficientStd. Error t-Statistic Prob.

DI   1.955528 0.034500 56.68259 0.0000

R-squared 0.995229	Mean dependent var		1553231.
Adjusted R-squared	0.995229	S.D. dependent var	3042872.
S.E. of regression	210186.6	Akaike info criterion	24.58531
Sum squared resid	5.30E+11	Schwarz criterion	24.62876
Log likelihood	-177.2507	Durbin-Watson stat	3.068222

APPENDIX 3: REGRESSION RESULTS FOR THE EQUATION (14)

INDUSTRY CODE: 31

LS // Dependent Variable is DY
Date: 04/08/99 Time: 19:45
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DX	0.254290	0.002637	96.41806	0.0000

R-squared	0.998684	Mean dependent var	-0.090677
Adjusted R-squared	0.998684	S.D. dependent var	0.652765
S.E. of regression	0.023681	Akaike info criterion	-7.412354
Sum squared resid	0.006730	Schwarz criterion	-7.368896
Log likelihood	30.73410	Durbin-Watson stat	2.251472

INDUSTRY CODE: 32

LS // Dependent Variable is DY
Date: 04/08/99 Time: 19:59
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DX	0.280586	0.001505	186.4852	0.0000

R-squared	0.999648	Mean dependent var	-0.100696
Adjusted R-squared	0.999648	S.D. dependent var	0.715673
S.E. of regression	0.013434	Akaike info criterion	-8.546183
Sum squared resid	0.002166	Schwarz criterion	-8.502726
Log likelihood	38.10399	Durbin-Watson stat	2.608790

INDUSTRY CODE: 33

LS // Dependent Variable is DY
Date: 04/08/99 Time: 20:54
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DX	0.529481	0.029639	17.86419	0.0000

R-squared	0.951019	Mean dependent var	-0.717606
Adjusted R-squared	0.951019	S.D. dependent var	1.259676
S.E. of regression	0.278786	Akaike info criterion	-2.480820
Sum squared resid	0.932658	Schwarz criterion	-2.437362
Log likelihood	-1.320872	Durbin-Watson stat	0.472897

INDUSTRY CODE: 34

LS // Dependent Variable is DY
Date: 04/08/99 Time: 21:11
Sample: 1984 1996
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DX	0.151927	0.006120	24.82630	0.0000

R-squared	0.980511	Mean dependent var	-0.054274
Adjusted R-squared	0.980511	S.D. dependent var	0.394788
S.E. of regression	0.055113	Akaike info criterion	-5.722924
Sum squared resid	0.036450	Schwarz criterion	-5.679466
Log likelihood	19.75280	Durbin-Watson stat	1.668837

■■

INDUSTRY CODE: 35

LS // Dependent Variable is DY
Date: 04/08/99 Time: 21:23
Sample: 1984 1996
Included observations: 13

Variable   CoefficientStd. Error t-Statistic Prob.

DX   0.407698 0.007659 53.23126 0.0000

R-squared	0.995701	Mean dependent var	-0.140638
Adjusted R-squared	0.995701	S.D. dependent var	1.052267
S.E. of regression	0.068991	Akaike info criterion	-5.273748
Sum squared resid	0.057118	Schwarz criterion	-5.230290
Log likelihood	16.83316	Durbin-Watson stat	2.901529

■■

INDUSTRY CODE: 36

LS // Dependent Variable is DY
Date: 04/08/99 Time: 21:31
Sample: 1984 1996
Included observations: 13

Variable   CoefficientStd. Error t-Statistic Prob.

DX   0.392207 0.004645 84.44068 0.0000

R-squared	0.998282	Mean dependent var	-0.141711
Adjusted R-squared	0.998282	S.D. dependent var	0.983356
S.E. of regression	0.040758	Akaike info criterion	-6.326388
Sum squared resid	0.019935	Schwarz criterion	-6.282931
Log likelihood	23.67532	Durbin-Watson stat	1.441871

■■

INDUSTRY CODE: 37

LS // Dependent Variable is DY
Date: 04/08/99 Time: 21:38
Sample: 1984 1996
Included observations: 13

Variable   CoefficientStd. Error t-Statistic Prob.

DX   0.097905 0.005368 18.23790 0.0000

R-squared	0.964329	Mean dependent var	-0.040161
Adjusted R-squared	0.964329	S.D. dependent var	0.267479
S.E. of regression	0.050518	Akaike info criterion	-5.897034
Sum squared resid	0.030625	Schwarz criterion	-5.853576
Log likelihood	20.88452	Durbin-Watson stat	1.269377

■■

INDUSTRY CODE: 38

LS // Dependent Variable is DY
Date: 04/08/99 Time: 21:52
Sample: 1984 1996
Included observations: 13

Variable   CoefficientStd. Error t-Statistic Prob.

DX   0.287848 0.002160 133.2617 0.0000

R-squared	0.999312	Mean dependent var	-0.098395
Adjusted R-squared	0.999312	S.D. dependent var	0.732064
S.E. of regression	0.019209	Akaike info criterion	-7.830987
Sum squared resid	0.004428	Schwarz criterion	-7.787529
Log likelihood	33.45521	Durbin-Watson stat	1.816402

■ ■

INDUSTRY CODE: 39

LS // Dependent Variable is DY
Date: 04/08/99 Time: 22:00
Sample: 1984 1996
Included observations: 13

Variable   CoefficientStd. Error t-Statistic Prob.

DX   0.389637 0.006542 59.55581 0.0000

R-squared	0.996542	Mean dependent var	-0.157141
Adjusted R-squared	0.996542	S.D. dependent var	1.024187
S.E. of regression	0.060226	Akaike info criterion	-5.545515
Sum squared resid	0.043525	Schwarz criterion	-5.502057
Log likelihood	18.59964	Durbin-Watson stat	2.818382