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ABSTRACT

The issue of imperfect competition in economic theory has been repeatedly discussed given its importance in the distribution of economic resources. In this study, market power measured by price over marginal cost markup has been assessed using the data of census of manufacturing industries (CMI) over the period 1971-2006. All the large scale manufacturing industries have been observed as charging prices over their marginal costs. Estimated markups are in the range of ten percent to seventy percent with the exception of tobacco industry wherein more than two hundred percent of markup has been charged over its marginal cost. Behaviour of markup over business cycle has been found acyclical. In the first approximation of cyclical behaviour of markups, both pro-cyclical and counter-cyclical along with acyclical markups have been estimated. But this behaviour of markups is not confirmed by our second approximation of variable markup that shows that there is no significant relationship between markups and business cycle. In addition, import penetration has been observed as disciplining factor for domestic manufacturing industries. Movement of imports over mean import penetration ratio has significant impact in reducing the markup of price over marginal cost charged by manufacturing industries.

Keywords: Price Cost Markup, Business Cycle, Import Penetration, Manufacturing Industries

1. INTRODUCTION

The issue of imperfect competition in microeconomics as well as in macroeconomics has been repeatedly discussed given its importance in the distribution of economic resources. In the macroeconomic literature imperfect competition has been identified by estimating the markup of price over marginal cost in product markets. Markups are the sign of lack of competition as high markups are expected to be the results of greater market power. The level of total factor productivity (Solow residual) has been considered as the result of positive markups of price over marginal cost and its variation over business cycle [Hall, *et al.* (1986), Haskel, *et al.* (1995), Roeger (1995), Oliveira and Scarpetta (1999), Feddreke, *et al.* (2007), Beccarello (1996), Aghion, *et al.* (2008), Klein (2011)]. This idea of assessing markup from observed productivity residual has been developed by the seminal work of Hall, *et al.* (1986), who ascribes positive price over marginal cost markup to the pro-cyclical behaviour of Solow residual. Inspection of empirical findings reveals that price-cost ratios are normally above unity, and that it varies substantially across industries. There are evidences of imperfect competition in the developed countries' industries as well as developing countries [Hall (1988), Oliveira, *et al.* (1996), Beccarello (1996), Aghion, *et al.* (2008)]. Micro as well as macro level studies [Roeger (1995); Aghion, *et al.* (2008), Klein (2011)] suggest markups charging across industries and on aggregate level.

In addition to the magnitude of markup, the knowledge of its cyclical behaviour over business cycle is also important for its impact of macroeconomic policies on output and prices [Aziz and Leruth (1997)] and to design these policies optimally [Oliveira and Scarpetta (1999)]. Several empirical studies have shown that markups of price over marginal cost do not remain same during different economic conditions [Bils (1987), Domovitz, *et al.* (1988)]. But theoretical literature does not propose any conclusive single relationship between business cycles and markups that either it is pro or counter-cyclical.The factors behind the markups varying behaviour are aggregate demand variations to the labour market, prices of intermediate inputs and materials along with firms' strategic decisions during different economic scenarios. Different models of cyclical behaviour of markups attribute its varying behaviour to different factors. In the first model of markups variation, variation in the markups is caused by the varying elasticity of demand. Aggregate demand elasticity declines during period of economic slumps that result in the more market power and hence counter-cyclical markups behaviour as suggested by Okun (1981), Stiglitz (1984), Bils (1989) and Klemperer (1995). Another, "customer market" model of Phelps and Winter (1970) proposes that after anticipating higher future sales, firms reduce their prices today to benefit from their large customer base in the future. This behaviour will cause the firms to charge the markups pro-cyclically. Alternatively, in the model of "Implicit Collusion" presented by Rotemberg and Woodford (1999), markups are proposed to behave counter-cyclically as in the economic upswings firms are less able to collude due to higher incentive of increase in market share by reducing prices. Higher expected future profits at the prevailing markup relative to the current output ensure the prevalence of collusive agreement because benefits from future collusion are higher than gains to undercutting of markup. These circumstances leads toward rising of implicitly agreed markup. Alternatively, if current output is higher than expected future profit, implicit cartel must reduce its markups given the high probability of deviation in order to sustain collusion [Rotemberg and Woodford (1992)].

Empirical findings of different studies are non-robust i.e. depending on the empirical techniques and assumption used to assess the markups. Different aggregate and sectoral cyclical variables have used to assess its cyclical behaviour in these studies. Studies showing the counter-cyclical behaviour of markups [Rotemberg (1991), Oliveira and Scarpetta (1999), Feddreke, *et al.* (2007), Bils (1987), Linnemann (1999), Klein (2011)] and those giving the evidence of pro-cyclical markups [Haskel, *et al.* (1995), Macallan, *et al.* (2008), Machin and Reenan (1993), Morrison (1994), Beccarello (1997), Domovitz, *et al.* (1988), Small (1997), Olive (2004)] have assessed the markups behaviour for different economies and sectors.

International competition is believed to be a remedy for the inefficiency in production both for domestic as well as foreign industries [Helpman and Krugman (1989)]. Trade liberalisation forces the domestic industries to charge the feasible markup, failure of which will hamper these industries to compete in the open economy. Hakura (1998) incorporates the external competition for domestic industries into the estimation of their markup over marginal cost and checks how the external competition forces the industries to price for their products. He suggests that tariff and other trade restrictions protect the domestic industries to be exposed by international competition and hence reduction in these types of barriers could result in the decrease of market power through increased import penetration.

To access the price-cost markup at aggregate and disaggregate level, two types of methodological techniques have been used in empirical literature. One of them known as Structure-Conduct-Performance Paradigm (SCPP), is based on traditional method of estimating profits that utilises accounting data to measure price-cost margin that are defined as the ratio of revenue minus variable cost to revenue, i.e. (P-AVC/P). This method of obtaining profit just gives the measure of markup as price over average cost instead of price over marginal cost. Which shows the weakness of this approach as marginal cost differs from average cost in the presence of fixed cost. Moreover, this approach has been criticised on the grounds that price-cost margin cannot be directly observed and can only be estimated by structural econometric models [Hakura (1998)]. The second empirical method of measuring the price-cost margin is based on the technique of Hall, *et al.* (1986) that measures the markup of price over marginal cost. Given some limitations of traditional approach of measuring markup over new empirical technique, we are motivated to utilise the relatively better technique to assess the competition conditions of manufacturing industries of Pakistan.

So for the studies on manufacturing sector in case of Pakistan have focused on its competitive conditions by using the traditional method (SCPP) of estimating its markup of gross price-average cost measures. The present study estimates the markups to price over marginal cost with new empirical technique. As no study has been done with Hall's new technique of measuring the markup for overall manufacturing sectors to best of our knowledge, this study can present a good spectrum of the manufacturing industries. It will be helpful to policy-makers to understand the overall structure and behaviour of these industries over business cycle that will lead them to devise the industry specific polices.

The rest of paper is organised as fallows: Section two will provide some literature review regarding the markup that is being charged in the industries of different economies, its behaviour over business cycles and the impact of external competition on it. In section three theoretical background of extended empirical technique of Hall, *et al.* (1986) has been developed and discussed. Section four gives some detail about data, specified the empirical equations and discuss and interpret the results. And finally section five concludes the study.

2. LITERATURE REVIEW

There have been struggles among the researchers to assess the market power using different methods to measure it for different economies and industries. They have been trying to improve the measurement methods and to investigate its cyclical behaviour so that they would be able to show the good picture of market structure to help in designing the optimal policies. Almost all of the researchers found evidence of market power with some differences of its magnitude across industries and countries along with its different cyclical behaviours and controlling determinants.

Bils (1987) finds that marginal cost is strongly pro-cyclical due to the quasi fixity of the employment. He observes that firms would pay adjustment cost to raise employment or they should have to pay for overtime for every hour per worker. Prices do not respond to cyclical movements in the marginal cost and hence markups are counter-cyclical in most of the 2-digit U.S industries (10 percent expansion causes 3.3 percent markups to decrease). He concludes imperfections in the goods market are the source of business cycles.

Hall (1988), by using the three different instrumental variables has checked the difference between output growth and the growth in labour input for U.S manufacturing sectors during the period 1953-84 via checking the covariance between Solow residual and the instrumental variables for major and two-digit industries level and finds that in most of the industries (major as well as two-digit level) actual change in the output is greater than the weighted change in factor inputs i.e. productivity response due to the instrumental variables that are unlikely to affect productivity or be affected by it resulting in against the hypothesis of competition. Hall concludes that in U.S manufacturing industries, there is evidence of pricing over marginal cost showing some degree of market power.

Domowitz, *et al.* (1988) estimate the markup using gross output and intermediate inputs by taking three instrumental variables (GNP, military spending and import price) for the period of 1958-81 for U.S major as well as 4-digit manufacturing industries. Almost all of the industries show the market power with different magnitude of markups that are less than those estimated by Hall, *et al.* (1986), which shows that upward bias of markups estimated by Hall is due to value added data as recognised by Hall (1988) himself. Variation in markups across industries is found to be market structure dependent as unionisation and four-firm concentration measures are able to explain the differences in markups across industries.

Morrison (1992) has developed the production theory based framework to assess firm's markup behaviour and finds that markups in the U.S and Japan's manufacturing industries are in the range of 11 percent to 48 percent using the period of 1960-82. Secular trend of markups are found to be increasing for both countries but cyclical trend of markups differ across these two countries i.e. pro-cyclical for U.S and countercyclical for Japan. Her findings suggest that while estimating the true markups, adjustments like capacity utilisation and returns to scale measures should be incorporated. As these two adjustment variables have significant roles in reducing the profitability gained by markups. The impact of increasing the import prices is positively related with markups for both countries.

Norrbin (1993) has checked the correlation of Solow residual with aggregate variables selected by Hall and finds to be uncorrelated with those variables. Further he has investigated the results of markups estimated by Hall and has realised that markups of U.S manufacturing industries reported by Hall are lower and insignificant if one incorporate the intermediate inputs in the estimation of Solow residual. He further finds that results of Hall are sensitive to the choice of estimation techniques i.e. not robust.

Levinsohn (1993) with the aim of testing the imports-as-market-discipline hypothesis used the firm level panel data and estimated the markups of different 3-digit Turkish industries before and after trade liberalisation over the 1983-86 period. By developing the static model of oligopoly he has found the estimated markups to be lower than expected arguing on that these markups of Turkish industries are lower because of understating of profits by firms to census bureau and non-reporting of entering and leaving firms during the period used by him. Six industries are found to pricing equal to their marginal cost, three above their marginal cost and two are found to be charging prices below their marginal cost before the liberalisation period. He has then checked the effect of policy change on non-competitive industries and found the result supporting the imports-as-market-discipline hypothesis as the industries in which trade was liberalised experienced a decline in their markups and the protected industries experienced an increase in their markups.

Katics and Petersen (1994) arguing about the weakness of cross sectional approach to measure the market structure-performance postulated the way toward measuring the impact of important variable i.e. import share on price-cost margin, by panel estimation of 2-digit U.S manufacturing industries for the period of 1964–86. Using the share of imports alone and interacted with concentration ratio, they have concluded that industries with more concentration ratios experienced large reduction in their price-cost margin during the period of high import shares, i.e. 1976–86.

Morrison (1994) using the production theory framework, has analysed the various manufacturing industries of Canada over the 1960-81 period and finds that these industries are charging prices 7 to 28 percent over their marginal costs on average having the secular behaviour of increasing markups over time. She has explored the cyclical behaviour of markups using the elasticity of different exogenous supply and demand determinants and finds to be pro-cyclical overall. The relaxation of constant returns to scale assumption, i.e. to allow for non-constant returns to scale has the significant impact in decreasing the markups and having the constant profit over time even in the presence of markups in most of the industries.

Basu, *et al.* (1994), using the 2-digit SIC level of U.S manufacturing industries have found returns to scale to be equal and close to constant across industries on the basis of gross output and quality-adjusted intermediate inputs in contrast to increasing return to scale proposed by Hall on the basis of value added data. They assert that given the low level of profits, markups should also be small. Moreover, they attached the external productivity spillover proposed by some researcher with specification error.

There are more evidence of positive markup pricing in different U.S industries provided by others like Roeger (1995), who by using the price based productivity residual to get rid of instrumental variables proposed the extended way for measurement of markup. With his extended method to estimate the markup, Roeger has used the same data of manufacturing sector (two-digit) for the same time period as used by Hall (1988) and shows that prices exceed the marginal cost in U.S industries supporting the Hall's claim. Although, markups estimated by the Roeger are less than that of Hall and Roeger justifying it by giving the argument that Hall's higher estimates are may be due to inappropriate instrumental variables.

To check the market power across countries and industries, Oliveira, *et al.* (1996), estimated the price markups over marginal cost of 36 manufacturing industries for the 14 OECD countries. Their findings show the existence of positive and significant markups in most of the industries of OECD countries reflecting the departure of these industries from perfect competition. They also concluded that markups are dependent on the market structure and the specific polices across industries and countries, e.g. in the case of communication, computer and pharmaceutical industries, the estimated markups are large as compare to other industries suggesting the some share of innovation rent in markups of that industries.

In the panel study of seven major OECD countries Beccarello (1996), for the period of 1971-89, has checked the market power in the one-digit manufacturing sectors. His findings show that there are signs of substantial market power in all examined countries as in the 93 percent of the manufacturing industries markups are found to be significant with some level of magnitude differences across countries and industries. All the countries reveal the pro-cyclical movement in their markups except U.S whose pro-cyclical movement of markup is found to be statistical insignificant. External competition finds to be affecting the markups negatively in his study.

Small (1997) by making the panel of different industries in manufacturing as well as services sectors of UK, has estimated the price over marginal cost markups for the period of 1968-91. His study gives the evidence of imperfect competition in most of the manufacturing and services sectors' industries with some degree of markups differences across these industries of both sectors. Markups are found to be higher in the services sector than in manufacturing. Using different cyclical variables and their lags he concluded that markups are pro-cyclical as confirmed by the pro-cyclicality of profit margins estimated by him.

Barizo, *et al.* (1998) has studied the markup with basic focus of its behaviour to see which U.S manufacturing industries data are consistent with the theoretical models of behaviour of markup. They have found that markups are inversely related to the current state of demand. Markups increase with future expectations of favourable demand changes supporting the views that markups not only depend on the current state of business cycle but also on future as well. Moreover, the current state of demand and of future has opposite impacts on the today's markups. Their study helps to explain the markups variations and clear the determinants of such variations.

Oliveira and Scarpetta (1999) have estimated the markups for U.S 3-digit manufacturing industries over the 1970-92 period and have found that steady state markups are in the range of 10-15 percent, for lower as compare to Hall's estimated markups. Most of the statistical significant markups are found to be counter-cyclical and the greater degree of downward rigidity and lower degree of substitution between capital and labour cause reinforcing of the counter-cyclicality of the markup. Moreover, markups of G-5 countries' manufacturing industries are found to be higher than U.S in the average range of 10-30 percent. Cross country comparison of the sectoral markups suggests that the persistent profit margins in the manufacturing sectors are due to the entry barriers that are not finished by the competitive forces even in the long run.

Linnemann (1999), by using 29 two-digit manufacturing industries of Germany has estimated the markups over the period 1970-90 with ordinary least and two stage least squares methods. He has found the average markup of around 1.2 in these industries that is further strengthened by results for aggregate manufacturing. Adjusted markups estimated by the aggregate private national product data over the 1960-93 periods are found to be 1.64 showing the markups of manufacturing sector as the representation for whole private economy. His study further explores the cyclical behaviour of markups using both aggregate (value added) as well as manufacturing sector (gross output) data. In both cases markups are found to be counter-cyclical ultimately depending on the elasticity of substitution among the input factors.

Silva (1999) making the panel of three-digit eighteen Australian manufacturing industries for the 1968-84 period, has estimated the markups to assess the competitiveness of these industries. His findings show that in most of the manufacturing industries price exceeds their marginal cost. He used both gross output and value added data of these industries to estimate the markups and finds that gross output based markups are twice as small as markups estimated by value added data. His choice of instrumental variables has some role for some industries to become non-competitive from competitive which shows that instrumental variable technique is not robust.

Weiss (2000) by making the panel of 299 four-digit US manufacturing industries and using random effects model has estimated the markups for the 1961-89 period. He has found the average price-marginal cost ratio to be 1.96 that are significantly related to characteristics of industries such as concentration, capital-output ratio and advertising to sales ratio which all have positive and significant impact in raising the estimated markups. Noteworthy, markups are found to be a cyclical as cyclical fluctuations in the markups are rejected in both concentrated and competitive industries.

Lopez and Lopez (2001) have postulated the way to solve the confusion about the mixed results of imports on the price cost margins by decomposing the effects of imports in price and cost effects. Using the data set of 4-digit 24 US food processing industries, they have proposed that net results of imports come through two impacts, i.e. direct impact of imports on price and domestic quantity adjustment to imports that are further depends on the elasticity of domestic price and degree of concentration. Their findings show that 7 out of 24 industries are having positive impacts on price cost margin that they attributed to weak economies of scale and low elasticity of demand in those industries. In the remaining industries impact of imports are found to be positive on price cost margins as direct impact of imports are dominating over other decomposed effects.

Olive (2004) has used the data set consisting of two- digit eight manufacturing industries of Australia for the period 1971-72 to 1984-85 to check the hypothesis regarding market power, returns to scale, cyclical behaviour of markups and the impact of openness on the markups. He applies cross-section and fixed time effects pooled estimations techniques and shows that six out of his eight selected manufacturing industries are charging the prices above their marginal costs with the average markup of 1.24 and are experiencing constant returns to scales. Markups are found to be pro-cyclical and openness have significant role in reducing the markups. But pro-cyclicality of markups is more in those industries which are less exposed to international competition as his study concludes.

Marchetti (2002) have incorporated some new concepts in the framework originally developed by Hall to assess the market power practiced by Italian Manufacturing using the data set of 2-digit thirteen manufacturing industries over the period of 1977-95. Prices are found to be in excess of marginal cost in most of the industries both in the seemingly unrelated model (SUR) and 3SLS estimates with some degree of average markups variation. The hypothesis of constant returns to scale are not rejected but for very few industries which are found to be capital intensive and highly-concentrated in which technology has some role for economies of scale. Using different three measures of sectoral cycles of demand and economic activity to check the robustness of cyclical behaviour of markups finds different behaviour of markups across industries that he proposes that depend ultimately on the characteristics of product and production process. Furthermore his study checks the impacts of both internal and external competition on markups and is found to be consistent with standard economic theory as import has the role in reducing the markups and concentration with having the role of increasing the markups.

Farinas, *et al.* (2003) using the panel data of 291 manufacturing industries of Spain for the period of 1990-98, has estimated the cyclical behaviour of markups calculated by optimal conditions that are derived from firm’s dynamic optimisation problem. Their findings shows that markups are pro-cyclical and adjustments costs of permanent labour are significantly contributing the average profit margins to differ from price-marginal cost margins. Adjustments costs for permanent labour are found be double than the variation in the profit margins with respect to Learner indices. Their study reveals that markups are heterogeneous across the industries which depend on the level of concentration of industry, as more concentrated industries charge higher markups than fragmented.

Aghion, *et al.* (2008), to see the impact of product market competition on the productivity growth of South African manufacturing firms and sectors has used three different data sets and compute the markups of price over cost by estimating through two proxies of Lerner index. Using the industry-level panel data since the mid-60s from UNIDO, they have estimated the first proxy for Learner index i.e. differential between value added and total wage bill as the percentage of gross output and found the price cost margin to be 22 percent that is time invariant across the studied periods. In the second method (Hall based) estimation of price cost margins they have used the industry-level data from TIPS over the periods of 1970–2004. In their pooled mean group dynamic (PMGE) heterogeneous panel estimation they have found the aggregate markup for manufacturing sector over the selected period of 54 percent. Three-digit manufacturing industries analysis suggests that markups are not decreasing over the time rather increased toward the end of sample period opposing the results of earlier studies as evidence of stable and non-declining pricing power given by them using firm-level data.

Klein (2011), using the data of South Africa's aggregate private sector has estimated the markup over the 1980–2009 periods and finds that average markup is around 1.5, which shows that significant market power is being practiced by the firms in South African private industries. Markups are found to be counter-cyclical contributing the weak co-movement of output and inflation.

In the present study efforts have been made to find out the impacts of different domestic and external competition measures on market power of local industries and firms. One of which is the import-as-market-discipline hypothesis which says that greater import penetration enforce the firms to charge the prices lower than that could have been charged in the absence of trade liberalisation, disciplines the markets toward perfect competition.

3. THEORETICAL BACKGROUND

This section presents the theoretical background of measuring the markup and its relationship with business cycle. The Hall's approach to measure markup is discussed in Section 2.1, its extended version in Section 2.2

3.1. Hall's Method of Measuring Markup

Solow (1957) in his seminal paper proposed a way to calculate the productivity growth by using the output growth, product price, capital and labour inputs and the wage rate under the assumptions of constant returns to scale and perfect competition as shown by following equation:

$$\Delta q_t - \alpha \Delta n_t - (1-\alpha)\Delta k_t = \theta_t \quad \dots \quad \dots \quad \dots \quad \dots \quad (3.1)$$

Where Δq is the rate of growth of output, α is the share earned by labour in total revenue (ratio of compensation to total revenue), Δn and Δk are the rate of growth of labour and capital respectively. And θ is the rate of Hicks-neutral technical progress.[1] This measure has come to be known as total factor productivity because it not only includes output with labour input but also accounts for capital and other all kinds of inputs as well. However, Hall, *et al.* (1986) has demonstrated that the difference between output growth and weighted average of inputs growth cannot be solely attributed to the technological change as there can be other reasons for that change. Amongst them the most likely is the absence of Solow's assumption, who has assumed the equality of price and marginal cost while calculating the total factor productivity (TFP).

Hall, *et al.* (1986) has started with a firm that is enjoying the technical progress in the use of labour and capital inputs and approximating its marginal cost by the following expression:

$$MC = \frac{W.\Delta N + R.\Delta K}{\Delta Q - (\theta + u)Q} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3.2)$$

Where *Q* is the real added value, *W* and *R* are the prices of labour and capital inputs respectively. In the denominator, change in output is adjusted for the amount by which output would have risen if there is no change in the labour and capital inputs by assuming θ as constant and *u* as random Hicks-neutral technical progress. The above equation for the marginal cost can be written in the form of rate of growth of output and capital as following:

$$\frac{\Delta Q}{Q} = \frac{WN}{xQ}\frac{\Delta N}{N} + \frac{RK}{xQ}\frac{\Delta K}{K} + \theta + u_t \quad \dots \quad \dots \quad \dots \quad \dots \quad (3.3)$$

Where *x* denotes marginal cost and in the case of constant returns to scales, the factor shares of both capital and labour sum to one, so we can rewrite the above equation as follows:

$$\Delta q = \mu\alpha\Delta n + (1 - \alpha\mu)\Delta k + \theta + u_t$$
$$\Delta q_t - \alpha\Delta n_t - (1-\alpha)\Delta k_t = (\mu - 1)(\Delta n - \Delta k)_t + \theta + u_t \quad \dots \quad (3.4)$$

[1] The change that does not causes the balance of labour and capital in the products' production function to change called Hicks-neutral technical change.

Where α=*W.N/P.Q*, the labour share in the total revenue and μ=P/MC.

In the competition case when μ=1, the rate of change of output is equal to the rate of change of labour and capital inputs weighted by their respected shares in revenue plus the constant and random technical growth elements. Whereas, if the price and marginal cost are not equal, μ will not be equal to one and hence the difference between output growth and weighted average of inputs growth is not equal to technical change only.

The assumption about the random disturbance u_t is that, it is uncorrelated with business cycle. Boom and recession periods do not cause the change in the technology and fluctuations in this random disturbance do not result in the business cycle. But this property of Solow residual often fails to be observed i.e. residual tends to be higher in years of expansion than years of recession. The most likely reason of this observation is the rejection of perfect competition and results in biased estimation of productivity residual as proposed by Hall, *et al.* (1986).

Hall, *et al.* (1986) has justified the pro-cyclical bias of Solow residual by the non-competitive behaviour via giving the explanation of labour hoarding and overhead labour. Productivity declines in temporary slumps because idle workers are not laid off by the firm for the beneficial future employment. In the competitive environment one of two results would be seen, either price will decline to the marginal cost that is at the minimum level because extra hours of labour are freely available now or it will fall enough to stimulate the demand that will not let the hoarded workers to lay off. In the later case output and employment would not fall, so, no change in the productivity at all. Whereas in the former case, decline in the price would result in dramatic rise in the revenue share of labour and despite the small variation in the labour input due to hoarded workers will offset the decline in output hence no change in the productivity. So, pro-cyclicality of Solow residual negates the competition and can be observed only in the non-competitive environment.

Estimation of Equation (2.4) would result in bias and inconsistent estimates of coefficients because there are likely chances that disturbance term u and the change in labour and capital are correlated to each other. So, there is a need of instrumental variables that are correlated with output but are neither cause of nor caused by the technological change. The instrumental variables used by Hall are the rate of growth of military spending, the rate of the increase in the world price of crude petroleum and the dummy for political party of president.

3.2. Roeger's Extension to Measuring Markup

Regardless of using instrumental variables, Hall himself feels difficulty to prove the exogeneity of these variables under all views of macroeconomic fluctuations. Because military spending are not totally determined by the political objectives and the price of crude petroleum are not exogenous, especially when energy is to be considered as additional factor of production [see Bruno (1981)].[2] In the absence of the reliable instruments, Roeger (1995) suggested to compute the dual Solow residual (price-based)[3] by starting with the cost function under the assumptions of constant returns to scale and imperfect competition as follows:

$$C(W,R,Y,\Theta) = \frac{G(W,R)Y}{\Theta} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.5)$$

Where *W* and *R* are two arguments of cost function *C*(.) and price of labour and capital respectively. Θ is a shift variable representing the change in the productivity. Differentiating the above expression with respect to output to obtain the marginal cost:

$$MC = \frac{\partial C}{\partial Y} = \frac{G(W,R)}{\Theta} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.6)$$

Logarithmic differentiation of the above equation is as under:

$$\Delta mc = \left[\frac{G_w W}{G(.)}\right]\Delta w + \left[\frac{G_r R}{G(.)}\right]\Delta r - \Delta\theta \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.7)$$

Where $G_w = \frac{\partial G}{\partial W}$ and $G_R = \frac{\partial G}{\partial R}$

Simplifying further by using Shepherd's lemma and writing it into the expression as follows:

$$\Delta mc = \left[\frac{\Theta NW}{YG(.)}\right]\Delta w + \left[\frac{\Theta RK}{YG(.)}\right]\Delta r - \Delta\theta \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.8)$$

As $G_w = \frac{\Theta N}{Y}$ $\quad and \quad$ $G_R = \frac{\Theta K}{Y}$

Now using the cost function, we get following equation:

$$\Delta mc = \left[\frac{NW}{C(.)}\right]\Delta w + \left[\frac{RK}{C(.)}\right]\Delta r - \Delta\theta \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.9)$$

This states that the change in the marginal cost is the difference between a weighted average of changes in input prices with respect to their relative shares in total cost and the change in the productivity. Under constant returns to scale equation () can be written in the form as follows:

$$\Delta mc = \left[\frac{NW}{C(.)}\right]\Delta w + \left[1 - \frac{NW}{C(.)}\right]\Delta r - \Delta\theta \quad \ldots \quad \ldots \quad \ldots (3.10)$$

The relation between price and marginal cost as given by

$$(1 - B)P = MC$$

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[2]Hall (1991) has used instrumental variables of military spending, price of crude petroleum and growth rate of GNP.

[3]The primal approach of growth accounting measures inputs such as capital or labour while dual approach of growth accounting relies on the prices of output and factors like labour and capital.

Where *B* is the Lerner index ranges from a high of 1 to a low of 0. If *B*=0, then the price will be equal to marginal cost and different in the case of non-zero value of *B.*

And the dual (price based) Solow residual can be shown by the following expression:

$$\alpha\Delta w-(1-\alpha)\Delta r-\Delta p=-B(\Delta p-\Delta r)+(1-B)\Delta\theta \qquad \ldots (3.11)$$

The Equation (3.4) in previous section can be written in the form if we incorporate the condition that μ=1/1-*B*.

$$\Delta q-\alpha\Delta n-(1-\alpha)\Delta k=B(\Delta q-\Delta k)+(1-B)\Delta\theta \ \ldots \qquad \ldots (3.12)$$

By subtracting (2.12) from (2.11), we get suitable expression for the estimation of markup as follows:

$$\begin{aligned} NSR &= (\Delta q+\Delta p)-\alpha(\Delta n+\Delta w)-(1-\alpha)(\Delta k+\Delta r) \\ &= B[(\Delta q+\Delta p)-(\Delta k+\Delta r)] \ \ldots \qquad \ldots \qquad \ldots \qquad \ldots (3.13) \end{aligned}$$

The term NSR stands for nominal Solow residual, as it includes not only real variables but also prices of those variables. Roeger's approach of measuring the markup has the advantage of leaving the nominal variables without unobservable productivity term.

The importance of intermediate inputs has been discussed by different researchers including Hall (although he did not use intermediate inputs) in the estimation of markups to price over marginal cost [Domowitz, *et al.* (1988), Basu, *et al.* (1994)]. Most of the researchers used gross output data with intermediates inputs for the estimation of industries as well as firms' measures of markups after Hall. They find that markups estimated by Hall on the basis of value added data are biased due to the share of intermediate inputs in the production [Domowitz, *et al.* (1988), Norrbin (1993), Oliveira and Scarpetta (1999)].

Given the importance of these intermediate inputs, share of it must be added in the production of gross output so that reasonable markups are to be estimated. Oliveira and Scarpetta (1999) use the equation for estimating markup by incorporating the intermediate inputs with gross output.

$$\begin{aligned} NSR^G &= \Delta(q^G+p^G)-\alpha^G\Delta(n+w)-\beta^G\Delta(m+p_m) \\ &\quad -(1-\alpha^G-\beta^G)\Delta(k+r) \\ &= (\mu-1)[\alpha^G\Delta(n+w)+\beta^G\Delta(m+p_m)-(\alpha^G+\beta^G)\Delta(k+r)] \qquad (3.14) \end{aligned}$$

(μ-1) is the measure of markup which can be computed mathematically or by estimating this equation adding the error term.

Despite the fact of removal of endogeniety and instrumentation problems of above equation, the assumption of constant returns to scale is in question as non-existence of constant returns to scale can over or understate the estimated markup. Oliveira and Scarpetta (1999) demonstrate that in the presence of increasing returns to scale the above equation would be in as follows:

$$NSR^G = \left(\frac{\mu}{\lambda} - 1\right)[\alpha^G \Delta(n + w) + \beta^G \Delta(m + p_m) - (\alpha^G + \beta^G)\Delta(k + r)] \quad \ldots \quad \ldots \quad \ldots \quad \ldots (3.15)$$

Where λ>1 shows the presence of increasing returns to scale and markup estimated through Solow residual should be accounted as lower-bound value if increasing returns to scale exist.

4. DATA, EMPIRICAL SPECIFICATION AND EMPIRICAL RESULTS

4.1. Sample and Data

For this study the data of 2-digit as well as some of 3-digit international standard industrial classification (ISIC) level industries according to PSIC-2007 has been used from census of manufacturing industries (CMI). Time period for the study covers the 1970-71 to 2005-06 censuses, as we are bound to exploit it only due to the non-availability of published census after that. The definition of different variables used in the analysis and their data sources is given in appendix Table B1.

4.2. Markup of Manufacturing Industries

4.2.1. *Empirical Specification*

By adding the error term to right hand side of Equation (3.14) as follows:

$$NSR^{\alpha}_{t\,\alpha} = \gamma \Delta x_t + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.1)$$

Where subscript t shows time period and

$$NSR_t^{\alpha} = \Delta(q^G + p^G) - \alpha^G \Delta(n + w) - \beta^G \Delta(m + p_m) - (1 - \alpha^G - \beta^G)\Delta(k + r)$$

and

$$\Delta x_t = [\alpha^G \Delta(n + w) + \beta^G \Delta(m + p_m) - (\alpha^G + \beta^G)\Delta(k + r)]$$

Where q^G and p^G are natural logarithms of gross output and its price, *n* and m are natural logarithms of labour and intermediate input with their prices *w* and $p_{m.}$ α^G and β^G are the share of labour and intermediate inputs in the gross production respectively. *r* and *k* are natural logarithms of capital and its rental price,Δ is first difference operator and ε is the error term.

This extension of Hall's approach by Roeger illustrates an important advantage as there is no need of price deflators for either gross output or intermediate inputs as industry wise price indices of gross output and their intermediate inputs are not easily available. Given the advantage provided by this equation, this study has used value of gross output[4] and intermediate inputs without deflating them. Moreover, there is no need of number of employees and the wage rate separately as this variable is also in nominal units, and for this employment cost that covers the wage and number of employees both is used in this study. However, for the cost of capital there is still need of separate calculation of rental price of capital. CMI does not report the data of rental price of capital but it has been defined in the different studies following Hall (1991) as follows:

$$R = [(i - \pi^{e}) + \delta]. P_k$$

Where i is the long-run nominal interest rate[5] that has been proxied by yield on government bonds. π^e is the rate of expected inflation that has been derived by smoothing the annual percentage change of GDP deflator using the Hodrick-Prescott filter. $\delta$is the depreciation rate of capital assumed as 5 percent showing the average service life of 20 years and P_k is the economy-wide deflator for gross fixed capital formation.

Equation (3.1) has been estimated by the standard OLS method for a set of manufacturing industries to assess the market power in all the industries separately. The coefficient γ=μ-1tells about how much percentage over one markup are charged by manufacturing industries. The more the value γ has, the more an industry is charging markup over its marginal cost. Results are provided in Table 4.1.

4.2.2. *Empirical Results and Discussion*

The estimated markups of all manufacturing industries are significantly greater than one, giving the evidence of non-competitive behaviour of these industries in the economy. These results of estimated markups seem greater than markups reported by other studies conducted on firm level data e.g. Akbar (2013) has found the average price-cost markup to be 14 percent for the panel of nine manufacturing sectors over the 1998–2009 period of Pakistan's manufacturing industries. These markups of different sectors are obtained by traditional method of gross profit-sale ratio that varies according to the industries' structure in the market.

The pioneering work of Hall, *et al.* (1986) to estimate the markups for the U.S manufacturing industries from Solow residual reported the markups to be varying from two times to twenty times of marginal cost that are for greater than

[4]Value of gross output is based on producer price.

[5]Yield on government bonds has been used as proxy for interest rate that is taken from International Financial Statistics (IFS).

Table 4.1

Price Over Marginal Cost Markup of Manufacturing Industries

ISIC Industries	γ=μ-1	ISIC Industries	γ=μ-1
Food	0.22*	Rubber Products	0.29*
	(0.015)		(0.028)
Beverages	0.69*	Plastic Products	0.22*
	(0.030)		(0.022)
Tobacco	2.34*	Pottery, China and	0.38*
	(0.222)	Earthenware	(0.021)
Textiles	0.21*	Glass and Glass Products	0.24*
	(0.019)		(0.043)
Wearing Apparel	0.12**	Other Non-metallic	0.56*
	(0.044)	Mineral Products	(0.076)
Leather	0.13*	Iron and Steel Basic	0.28*
	(0.035)		(0.058)
Foot Wear	0.26*	Non-Ferrous Metal Basic	0.16*
	(0.043)		(0.040)
Wood and Wood Products	0.30*	Fabricated Metal	0.30*
	(0.026)		(0.033)
Publishing, Printing and	0.28*	Machinery Except	0.14*
Reproduction	(0.059)	Electrical	(0.025)
Paper and Paper Products	0.33*	Electrical Machinery	0.38*
	(0.033)		(0.044)
Drugs and Pharmaceutical	0.39*	Transport	0.13*
	(0.027)		(0.044)
Furniture	0.25*	Surgical Instruments	0.19*
	(0.020)		(0.024)
Industrial Chemicals	0.47*	Sports and Athletic	1.27*
	(0.032)		(0.048)
Other Chemicals	**0.30***		
	(0.038)		

*Significant at 1 percent; **Significant at 5 percent; ***Significant at 10 percent.
Standard errors are reported in parenthesis.

the markups estimated by different researchers later on. Norrbin (1993) and Basu and Fernald (1995) have explained that markups estimated by Hall were the results of using value added data rather than using gross output data with materials input. They argue that clear upward bias could be corrected by using share of intermediate inputs in the gross output while estimating the markups.

The results reported in Table 4.1 of higher markups than markups estimated from firm level data are completely in line with other studies conducted on aggregate manufacturing sectors for different countries. Roeger (1995) has estimated the markups for US manufacturing industries to be fifty percent of marginal cost in most of the industries with three industries of hundred percent of their marginal cost. Moreover, Oliveira and Scarpetta (1999) find the markups for U.S manufacturing industries with lowest of five percent to highest of fifty six percent of marginal cost. They also estimate the markups of manufacturing sectors of different other countries (Germany, France, United Kingdom and Japan) and find the estimated markups of greater than that of U.S. Other evidence of high markups in the advanced countries are given by the Beccarello (1996), who estimate the markups for manufacturing industries of G-7 countries in which he has estimated the average markup of Italy to be 74 and of Japan to be 89 percent of their marginal cost. Fedderke, *et al.* (2007) have estimated the average markups over price to be eighty percent with the lowest of fifteen percent to highest of three hundred and fifty percent for the South African manufacturing industries.

The estimated average markups in this analysis of all industries of thirty six percent over marginal cost on the basis of gross output are reasonable except for the tobacco in which more than two hundred percent of price is being charged over its marginal cost. Heavy prices charged by this sector is not the phenomenon with Pakistan only as in most of the countries, this sector is seems to be highest price charging sector. Above mentioned studies have estimated the markups for this sector and found it to be greater than of average markup of all industries, e.g. Roeger (1995) and Oliveira and Scarpetta (1999) have estimated the markup about two hundred percent of marginal cost in the case of U.S and France respectively. Moreover, Fedderke, *et al.* (2007) find the markup of tobacco sector more than four hundred percent for South Africa. Tobacco is highly concentrated sector in Pakistan as very few firms are operating in this sector giving it market power in the economy.

Wearing Apparel, Leather and transport equipment industries are the minimum price charging sectors as shown by their price markup over marginal cost in the previous table. Keeping in mind the nature of these sectors as non-concentrated one, one should expect low market power practiced by these sectors and hence of low markup over their marginal cost. The highest estimated markups after tobacco are of industrial chemicals, beverages, drugs and pharmaceuticals, electrical machineries, paper and paper products, pottery, china and earthenware and other non-metallic mineral products that are charging thirty five to seventy percent of markups. Paper and paper Products and Industrial chemicals are the sectors with high concentration ratios as measured by four-firm concentration ratio calculated by the study of Akbar, *et al.* (2013), giving the rationale of high markup charged by these sectors.

Remaining sectors are charging up to thirty percent markups over their marginal cost depending upon their structure and exposure to international competition in the market. These sectors do not belong to any particular class mean both type of i.e. agriculture and non-agriculture based sectors are included in it. The magnitude of their markups is also acceptable if we observe the findings of above mentioned studies regarding these sectors.

The evidences of imperfect competition in all the industries are likely to occur as the conditions of ideal situation of perfect competition do not exist in the real word. Developed countries are believed to be more competitive as compared to developing countries. If one finds the industries of developed countries to be non-competitive, then industries of developing countries must be considered more imperfect than their counterparts.

4.3. Behaviour of Markup over Business Cycle (First Approximation)

4.3.1. *Empirical Specification*

To assess the variability of markup over the business cycle there is need to posit the linear relationship between markup and a variable which accounts for the cyclical fluctuations of demand [see e.g. Domovitz, *et al.* (1986), Bils (1987) and Beccarello (1996)]. So by assuming the variable markup as follows:

$$\mu_t = \bar{\mu} + \vartheta C_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.2)$$

Where, C_t is the variable that measures the fluctuations in demand. The first approximation of above equation gives the non-linear estimating equation in parameters as we have combined the primal and Solow residual. To get rid of this problem, it has been suggested by Oliveira and Scarpetta (1999) to define the relationship between price margin and cycle using the *Lerner index* as B=(P-MC)/P, by which markup can easily be traced by the relationship of B=1-1/μ. By following the Oliveira and Scarpetta (1999) regarding defining the relationship between the learner index and business cycle as follows:[6]

$$B_t = \bar{B} + \varphi C_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.3)$$

"*Variable Lerner Index has different implications for the primal and the dual Solow residuals*" as proposed by Scarpetta, *et al.* (1999), so by starting with the equation and deriving the final estimating equation with a cyclical variable, derivation of which has been provided in Appendix A.

$$NSR^G = \bar{B}.\Delta y_t + \varphi[\Delta y_t . C_t - \Delta C_t] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.4)$$

Where

$$\Delta y_t = [\Delta(p^G + q^G) - \Delta(k + r)]$$

All variables are as previously defined. Different aggregate and sectoral variables have been used for the proxies of variable C_t in the empirical literature. Aggregate unemployment has been used by Haskel, *et al.* (1995) and Domovitz, *et al.* (1986), real GDP used by Beccarello (1996) while variables of sectoral employment and sectoral output were used by Bils (1987) and Domovitz, *et al.* (1986) respectively. We have followed to Oliveira and Scarpetta (1999) regarding the selection of variable C_t that represents the fluctuations in demand, and choose the deviations of industry output from its long-term trend[7] on the basis of rationale provided by them as nominal Solow residual are highly correlated with it. Equation (4.4) has been estimated by standard OLS method

[6] Detailed Derivation has been provided in Appendix A.

[7] Deviation of industry output has been derived by subtraction of cyclical output from long-term trend, which was derived by the Hodrick-Prescott filter. The value of weighting factor (λ) has been settled equal to 100 following the tradition for annual data.

for each industry separately and results are given in the Table (4.2). The sign of φ shows whether markup behaves counter-cyclically in case of negative or otherwise if the sign is positive.

Table 4.2

Cyclical Behaviour of Markup

ISIC Industries	$\bar{B}$	$\bar{\mu}$= (1/1-$\bar{B}$)	φ	ISIC Industries	$\bar{B}$	$\bar{\mu}$= (1/1-$\bar{B}$)	φ
Food	0.185* (0.010)	1.23	0.23 (0.042)	Rubber Products	0.24* (0.016)	1.31	–0.01 (0.051)
Beverages	0.415* (0.011)	1.71	0.24 (0.043)	Plastic Products	0.19* (0.014)	1.23	0.06** (0.024)
Tobacco	0.74* (0.018)	3.84	–0.002 (0.073)	Pottery, China & Earthenware	0.27* (0.011)	1.37	0.12** (0.042)
Textiles	0.18* (0.013)	1.22	0.03 (0.064)	Glass & Glass Products	0.22* (0.027)	1.28	–0.04 (0.052)
Wearing Apparel	0.15* (0.034)	1.18	0.05 (0.071)	Other Non-metallic Mineral Products	0.41* (0.024)	1.64	–0.31* (0.082)
Leather	0.14* (0.030)	1.16	–0.01 (0.077)	Iron & Steel Basic	0.26* (0.033)	1.35	–0.16*** (0.097)
Foot Wear	0.25* (0.027)	1.33	0.04 (0.026)	Non-Ferrous Metal Basic	0.19* (0.029)	1.23	0.05*** (0.029)
Wood and Wood Products	0.24* (0.016)	1.31	–0.01 (0.036)	Fabricated Metal	0.24* (0.019)	1.31	–0.10** (0.070)
Publishing, Printing and Reproduction	0.27* (0.033)	1.37	–0.11*** (0.083)	Machinery Except Electrical	0.14* (0.019)	1.16	0.07 (0.047)
Paper and Paper Products	0.26* (0.019)	1.35	–0.01 (0.057)	Electrical Machinery	0.29* (0.023)	1.41	–0.06 (0.092)
Drugs and Pharmaceutical	0.29* (0.013)	1.41	–0.12*** (0.058)	Transport	0.14* (0.029)	1.16	–0.27** (0.081)
Furniture	0.21* (0.013)	1.26	–0.002 (0.025)	Surgical Instruments	0.18* (0.015)	1.22	–0.22** (0.067)
Industrial Chemicals	0.32* (0.013)	1.47	–0.18** (0.066)	Sports and Athletic	0.26* (0.027)	1.35	0.16** (0.066)
Other Chemicals	0.24* (0.021)	1.31	0.12** (0.059)				

*Significant at 1 percent; **Significant at 5 percent;***Significant at 10 percent.
Standard errors are reported in parenthesis.

4.3.2. *Empirical Results and Discussion*

The results regarding cyclical behaviour of markup charged by manufacturing industries are mixed across industries i.e. in some industries markups appear to be positively correlated with economic fluctuations (pro-cyclical) while in some other industries it behaves negatively (counter-cyclical). Moreover, most of the industries have reported the insignificant impact of cyclical variable on markup which shows that in those industries there is no specific relationship between markup and business cycle hence the behaviour of markup charged by these industries is acyclical. The industries which have shown counter-cyclical behaviour of markup over business cycle are publishing and printing, drugs and pharmaceuticals, industrial chemicals, other non-metallic mineral products, iron and steel basic, fabricated metals, transport and surgical instruments as the coefficient sign φ of cyclical variable are negative in these industries. The industries with pro-cyclical behaviour of markup are other chemical, plastic products, pottery, china and earthen ware and sports and athletic goods industries with different level of significance.

In all other remaining industries i.e. food, beverages, tobacco, wearing apparel, leather, foot wear, rubber products, glass and glass products, non-electrical machinery and electrical machineries, no significant relation between business cycle and markup has been observed suggesting the acyclical behaviour of markup. These results regarding cyclical behaviour of markup varying over different manufacturing industries are supported by other studies like [Marchetti (2002)], who by using aggregate data also finds pro-cyclical, counter-cyclical and acyclical behaviour of markups supporting the view that markup and its behaviour depends ultimately on the industry's product and production process on the basis of which it has to take decision.

Noteworthy, the inclusion of cyclical variable C_t in estimating Equation (4.4) does not affect the values as well as statistical significance of average markup $\bar{\mu} = 1 - 1/\bar{B}$ reported in Table 4.2.

4.4. Behaviour of Variable Markup over Business Cycle (Second Approximation)

4.4.1. *Empirical Specification*

Most of the studies have assessed the behaviour of markup over business cycle only through first-order effect that gives the steady state level of markup. There is need of second-order approximation of time varying markup equation to assess the cyclicality of markup [see e.g. Rotemberg and Woodford (1991) and Morrison (1992)]. However, the accurate specification of this concept results in identification problems, for which there is need of some simplifying assumptions for production function that have the weaknesses regarding their practical implementations.

Oliveira and Scarpetta (1999) has started with the specification of production function for the derivation of second-order approximation. They assume a two-level production function with three arguments labour, capital and intermediate inputs without imposing the strong separability condition across its all production inputs. Value added function is taken as function of labour and capital and then combined with intermediate inputs by Leontief specification for the simplicity of derived equation. The two-level production function with Hicks-neutral technical progress is then defined as follows:

$$Q = \Theta . F\left[V\left(K, N - \overline{N}\right), M\right] \qquad \dots \qquad \dots \qquad \dots \qquad \dots \quad (4.5)$$

Where, variables *K*, *N* and *M* are real capital stock, labour supply and real intermediate inputs. Θ is the state of technology at particular time with the specification of Δ logΘ=θ. *V* (.) is the value added function with its two arguments of capital and labour that are further assumed to be downward rigid in its adjustment captured by the $\overline{N}$, the amount of labour considered to be as fixed. The expression for the markup of price over marginal cost for the profit-maximising non-competitive firm can then be written as follows:

$$\mu = \frac{\Theta . F_N[V(K, N-\overline{N}), M]}{\frac{W}{P}} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (4.6)$$

F_N is the partial derivative of function with respect to *N* that is called marginal product of labour. After log-linear approximation of Equation 4 around a steady state growth path and doing some substitution and algebraic transformation we get the following derived expression for the estimation as follows.[8]

$$\Delta log\mu = \Delta(q^G + p^G)_t - \Delta w_t - [\Delta(v + p_v)_t - \Delta(m + p_m)_t].\overline{\mu}.s_m + \left[\frac{1}{\sigma_{K,N}}.\frac{s_k}{s_k+s_m} - \overline{\mu}.s_k\right]\Delta k_t + \left[\frac{1}{\sigma_{K,N}}.\frac{s_k}{s_k+s_m}.\frac{N}{N-\overline{N}} + \overline{\mu}.s_n\right] \Delta n_t - \overline{\mu}.s_m.\Delta m_t + \varepsilon_t \quad \dots \quad \dots \quad \dots \quad \dots \quad (4.7)$$

Where all variable are as previously defined with some new e.g. v and p_v are natural logarithm of real value added and its price respectively, $\sigma_{K,L}$ is the elasticity of substitution between labour and capital of value added function, $\overline{\mu}$ is the steady-state rate of markup and S_m, S_k, and S_n are the share of intermediate inputs, capital and labour respectively in the gross output. *W* is the wage in nominal terms.[9] Growth rate of value added at constant price has been used in place of growth rate of volume of intermediate inputs due to the unavailability of price indices for intermediate inputs as used by Oliveira and Scarpetta (1999). Real variables have been derived by deflating the nominal variables with their price indices.[10] *W* is the wage rate. The expression $\frac{N}{N-\overline{N}}$ is the indicator that shows that how much percentage of labour is downward rigid in its adjustment. If zero percent labour is rigid, the value of ratio $\frac{N}{N-\overline{N}}$ will be equal to unity and infinite, in case of hundred percent downward rigidity. This equation also has the advantage in term of data constraints as there is no need of price indices for getting the volumes of variables. Under the Leontief specification, the growth rate of volume of intermediate inputs can be proxied by the growth rate of volume of value added. As shares of labour and intermediate inputs are directly observable in gross output, so share of capital can easily be derived by Euler's equation as follows:

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[8]See Appendix A for detailed derivation of Equation (3.33)

[9]Nominal wage has been derived by dividing the employment cost with average daily employment for each industry.

[10]Real capital has been derived by deflating the nominal capital with economy-wide gross fixed capital formation (GFCF) deflator while real value added has been derived by deflating the nominal value added by whole sale price index (WPI).

$$\bar{\mu}.s_n\frac{N}{N-\bar{N}}+\bar{\mu}.s_k+\bar{\mu}.s_m=1 \qquad \dots \qquad \dots \qquad \dots \qquad \dots \quad (4.8)$$

Equation (4.33) has been estimated for the set of manufacturing industries separately by standard OLS method. Estimation has been done by taking different values of elasticity of substitution between labour and capital with different percentage of fixed labour. The negative estimated coefficient shows counter-cyclical behaviour of markup and vice versa.

4.4.2. *Empirical Results and Discussion*

Estimated results have provided the evidence that there is no relationship between markup and business cycle of positive or negative either. As second approximation of time varying markup equation has reported the insignificant results thus supporting the results of first approximation whereby most of the industries have also shown acyclical behaviour of markup. Models of cyclical behaviour of markups have attributed the change in markups to different aggregate and sectoral disaggregate variables but this study's finding of acyclical behaviour of markup suggest that these markups charged by manufacturing industries are not determined by the business cycle. Only three industries with significant results (low significance level) are furniture, glass and glass products and iron and steel basic in which two of them are charging markup pro-cyclically.

These results are robust in the sense that different values of elasticity of substitution between labour and capital with different percentage of fixed labour have not changed the results of industries markup behaviour. Results are provided in Tables 4.3(a) and 4.3(b).

Table 4.3(a)

Cyclical Behaviour of Markup (Second Approximation)

	σ=1			σ=2			σ=0.5		
	Percentage of Fixed Labour			Percentage of Fixed Labour			Percentage of Fixed Labour		
ISIC Industries	$\bar{N}$=0	$\bar{N}$=0.2	$\bar{N}$=0.4	$\bar{N}$=0	$\bar{N}$=0.2	$\bar{N}$=0.4	$\bar{N}$=0	$\bar{N}$=0.2	$\bar{N}$=0.4
Food	–0.24	–0.24	–0.25	–0.27	–0.27	–0.28	–0.16	–0.17	–0.17
Beverages	0.35	0.36	0.38	0.43	0.49	0.44	0.21	0.23	0.25
Tobacco	1.02	1.01	0.99	1.33	1.32	1.30	0.46	0.46	0.45
Textiles	–1.29	–1.24	–1.15	–1.48	–1.46	–1.42	–0.71	–0.64	–0.53
Wearing Apparel	–0.18	–0.18	–0.17	–0.08	–0.09	–0.09	–0.25	–0.23	–0.20
Leather	–0.17	–0.16	–0.14	–0.21	–0.20	–0.19	–0.10	–0.08	–0.06
Foot Wear	–0.20	–0.18	–0.16	–0.27	–0.26	–0.25	–0.11	–0.09	–0.08
Wood & Wood Products	–0.004	–0.005	–0.005	–0.008	–0.007	–0.007	–0.002	–0.003	–0.003
Paper & Paper Products	0.27	0.26	0.23	0.39	0.38	0.37	0.10	0.09	0.07
Furniture	0.65***	0.63***	0.59***	0.77	0.79	0.81	0.33***	0.32***	0.29***
Publishing, Printing and Reproduction	–0.43	–0.43	–0.44	–0.20	–0.21	–0.23	–0.56	–0.54	–0.54
Drugs and Pharmaceuticals	0.16	0.13	0.10	0.38	0.35	0.31	0.04	–0.10	–0.13
Industrial Chemicals	0.66	–0.66	–0.67	–0.72	–0.72	–0.73	–0.45	–0.45	–0.44
Other Chemicals	–0.37	–0.32	–0.25	–0.46	–0.42	–0.36	–0.25	–0.20	–0.14
Rubber Products	–0.22	–0.22	–0.21	–0.49	–0.50	–0.50	0.04	0.03	0.02
Plastic Products	–0.02	–0.02	–0.01	–0.07	–0.06	–0.05	0.007	0.008	0.009

*Significant at 1 percent; **Significant at 5 percent, ***Significant at 10 percent.

Table 4.3(b)

Cyclical Behaviour of Markup (Second Approximation)

ISIC Industries	σ=1 Percentage of Fixed Labour $\overline{N}$=0	$\overline{N}$=0.2	$\overline{N}$=0.4	σ=2 Percentage of Fixed Labour $\overline{N}$=0	$\overline{N}$=0.2	$\overline{N}$=0.4	σ=0.5 Percentage of Fixed Labour $\overline{N}$=0	$\overline{N}$=0.2	$\overline{N}$=0.4
Pottery, China and Earthenware	–0.02	–0.02	–0.04	–0.08	–0.04	–0.003	0.00	0.02	0.04
Glass and Glass Products	0.64***	0.62***	0.58***	0.68***	0.68***	0.67***	0.37	0.35	0.31
Other Non–metallic Mineral Products	–0.94	–0.84	–0.73	–1.38	–1.34	–1.26	–0.35	–0.30	–0.23
Iron and Steel Basic	–0.60**	–0.59**	–0.58**	–0.68**	–0.68**	–0.68**	–0.36**	–0.34**	–0.32**
Non–Ferrous Metal Basic	–0.20	–0.19	–0.17	–0.28	–0.27	–0.26	–0.11	–0.09	–0.08
Fabricated Metal	0.46	0.45	0.43	0.62	0.61	0.60	0.25	0.24	0.23
Machinery Except Electrical	–0.19	–0.20	–0.21	–0.23	–0.23	–0.24	–0.12	–0.13	–0.14
Electrical Machinery	–0.52	–0.54	–0.56	–0.58	–0.59	–0.61	–0.39	–0.40	–0.43
Transport	–0.60	–0.60	–0.61	–0.57	–0.58	–0.58	–0.60	–0.59	–0.57
Surgical Instruments	–0.45	–0.48	–0.53	–0.28	–0.31	–0.35	–0.51	–0.52	–0.53
Sports and Athletic	0.30	0.29	0.26	0.32	0.32	0.31	0.23	0.20	0.16

*Significant at 1 percent; **Significant at 5 percent;***Significant at 10 percent.

4.5. Import Penetration and Markup

4.5.1. *Empirical Specification*

Too see the impact of external competition on the pricing ability of firms over their marginal cost Hakura (1998) proposed the equation to test whether import penetration has any impact on markup pricing as follows:

$$dq_t = B_o + B_1 \Delta z_t + B_2[IPR_t - \overline{\mathrm{IPR}}_t].\Delta z_t + \varepsilon_t \qquad \ldots \qquad \ldots \quad (4.9)$$

Where $dq_t = dv + \frac{s_{ym}}{1-s_{ym}}dm$ and $\Delta z_t = s_{vn} + s_{vk} + \frac{s_{ym}}{1-s_{ym}}dm$

Where dv is the log change in value added, s_{vk} and s_{vn} are the share of capital and labour inputs in value added while s_{ym} is the share of intermediate inputs in gross output.

The problem with Hakura's specified equation is that it is subject to endogeniety problem as proposed by Fedderke, *et al.* (2005). For this reason following equation has been estimated by them to test the impact of import penetration on the markup.

$$NSR_t = \delta_1 + \delta_2[IPR_t - \overline{\mathrm{IPR}}\ ].\Delta x_t + \epsilon_t \qquad \ldots \qquad \ldots \qquad \ldots (4.10)$$

Where $\Delta x_t = [\alpha^G \Delta(n+w) + \beta^G \Delta(m+p_m) - (\alpha^G + \beta^G)\Delta(k+r)]$

IPR[11] and $\overline{IPR}$ are the import penetration ratio and mean of it, coefficient δ with interaction term Δx_t will determine whether the changes in import penetration

[11]IPR was derived as ratio of total imports to total consumption (Production + Imports – Exports). Mean import penetration ratio is the average of import penetration over the period of time.

have any role in lowering the markup through increase in competition or not. Negative sign of δ_2 shows that, deviation of import penetration rate from mean import penetration rate has negative impact on markup. Equation (4.10) has been estimated for each industry separately by standard OLS method.[12]

4.5.2. *Empirical Results and Discussion*

Estimated values of δ_2 for most of the manufacturing industries are according to the standard economic theory which says that import penetration has the impact in disciplining the market i.e. force the firm to decrease its markup. These results are supported by empirical findings of different studies [Hakura (1998), Katics and Petersen (1994), Fedderke, *et al.* (2007)] wherein increase in import penetration has significant impact in reducing the market power measured by price-cost margin. Beverages, tobacco, leather, wood and wood products and rubber industries are seemed to decrease their markup due to increase in import penetration over their mean import penetration rate shown by their negative sign of coefficient δ_2. In case of food, paper and paper products and drugs and pharmaceuticals industries, the sign of δ_2 is also negative but there is no significant impact of increase in import penetration in reducing the markup of these industries. The only industry with positive sign of coefficient δ_2 although not significant is glass and glass products in which increase in import penetration has positive impact on markup.

Table 4.4

Import Penetration and Markup

Industries	δ_2
Food	–0.004
	(0.004)
Beverages	–0.31***
	(0.244)
Tobacco	–3.70**
	(1.89)
Leather	–0.001**
	(0.000)
Wood and Wood Products	–1.06*
	(0.260)
Drugs and Pharmaceuticals	–0.02
	(0.02)
Paper and Paper Products	–0.005
	(0.004)
Rubber Products	–0.007***
	(0.003)
Glass and Glass Products	0.004
	(0.007)

*Significant at 1 percent; **Significant at 5 percent;***Significant at 10 percent.
Standard errors are reported in parenthesis.

[12]These industries are those industries for which data of their imports were available and has been taken from *Pakistan Statistical Yearbook*.

5. CONCLUSION

In this study of Pakistan's overall manufacturing industries, we have analysed the competitive condition of industries measured by price over marginal cost and then checked the behaviour of these industries regarding markup charging in connection with business cycle over the time period of 1971–2006. In addition, the impact of import penetration in local output consumption of these industries on their markups has also been assessed. All selected manufacturing industries are found to be non-competitive as in all the industries, price is being charged over their marginal cost varying from seventy percent (Beverages) to twelve percent (wearing Apparel) with the exception of tobacco industry wherein more than two hundred percent price over its marginal cost has been charged. The average markup charged by twenty seven manufacturing industries is found to be 36 percent over marginal cost. Although the results of higher markups charged by different industries seem to be higher when one compares it with the markup estimated by studies based on micro and firm level studies. The findings of this study regarding markups charged by different industries are consistent with other studies that have been conducted on aggregate manufacturing. Most of Pakistan's manufacturing industries' markups are supported by other studies for different countries as nature of same type of industries match up to some extent across the borders e.g. in case of tobacco industry, highest markup is supported by most of the studies for different economies.

Behaviour of markup charged by different industries has shown acyclical as sectoral cyclical variables have no role in determining the behaviour of markups. Model of cyclical behaviour of markups attribute the behaviour of markups to business cycles. The reason may be that macroeconomic literature has not discussed the nature of industries specific to their product and production process and hence of their charging markup separately. Empirical findings have given the evidence of both pro-cyclical and counter-cyclical behaviour of markup with some of acyclical behaviour. Most of the empirical studies have concluded on the basis of first order effect of cyclical markup according to which these results are consistent with models of cyclical behaviour of markup for some industries, but cyclical behaviour of markup is determined by the second order effect as first order approximation only tells about steady-state markup. The results of our study are not justified may be due to data limitations as proper time series data of manufacturing industries are not available. Another reason of insignificant results of cyclical behaviour may be due to the assumptions that has been adopted while estimating the markups behaviour with second order effect.

Exposure to external market has proved in disciplining the market of local industries with respect to their price charging over marginal cost. As more import penetration has negative impact on the pricing ability of local industries over their marginal cost and hence enforce them to remain competitive. The results are consistent with economic theory of international trade exposure and its impact on different indicators' regulation.

APPENDIX A

MATHEMATICAL DERIVATIONS OF EQUATIONS

A.1. First order derivation for the variable markup from Equation (4.3)

A variable markup does not change the expression for the primal Solow residual but the dual (price-based) Solow residual's expression. Starting with basic relationship between price and marginal cost to show this point as follows:

$$\mu = P/Mc \text{with} \mu = 1/(1-B) \quad \dots \quad \dots \quad \dots \quad \dots \quad (A1)$$

By assuming the variable markup as Equation (3.11) defined in the text.

$$\mu = \bar{\mu} + \vartheta C \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (A2)$$

Where *C* is the cyclical variable defined in the text. Taking the total differential of Equation (A2) and transforming it into growth rate expression and then putting the value of μ.

$$\Delta mc = \Delta p - \vartheta \frac{\Delta C}{\mu} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (A3)$$

If markup is constant over time then change in price will be equal to change in marginal cost. Under the constant return to scale marginal cost can be written in the form as fallows:

$$\Delta mc = \frac{W.N}{C(.)}.\Delta w + \left[1 - \frac{W.N}{C(.)}\right].\Delta r - \theta \quad \dots \quad \dots \quad \dots \quad (A4)$$

New expression for dual Solow residual can be written by merging Equations (A3) and (A4) as under:

$$DSR = \alpha.\Delta w - (1-\alpha).\Delta r - \Delta p = -(\mu - 1)\,\alpha(\Delta w - \Delta r) - \vartheta \frac{C}{\mu} + \theta \quad (A5)$$

The nominal Solow residual can then be defined as under.

$$NSR = \bar{\mu}.\ \alpha\ [\Delta(w+n) - \Delta(r+k) - \vartheta \left[\alpha.C\ \{\Delta(w+n) - \Delta(r+k)\} - \frac{\Delta c}{\mu}\right] \quad (A6)$$

The difficulty with Equation (A6) is that it cannot be estimated as it is non-linear in parameters.

So there is need of another functional form by defining the relationship between price margins and cyclical variable using Learner index as under:

$$B = \bar{B} + \vartheta\ C \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (A7)$$

Now Equation (A3) can be written as :

$$\Delta mc = \Delta p - \vartheta \frac{\Delta C}{(1-B)} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (A8)$$

Replacing the above equation, Equation (A5) becomes as:

$$DSR = \alpha.\Delta w - (1-\alpha).\Delta r - \Delta p = -B.\Delta(\,p - r) - \vartheta.\Delta C + (1-B)\theta \quad \text{(A9)}$$

That gives the expression for estimated equation given in the text as under:

$$NSR = \bar{B} + [\Delta(p+q) - \Delta(r+k) - \vartheta[C.\Delta(p+q) - \Delta(r+k) - \Delta] \quad \text{(A10)}$$

Equation (A10) has the benefit in term of linearity in its parameters and has been estimated in the text.

A2: Second order Approximation of Cyclical Markup Starting with production function and on the basis of that defining markup function as defined in the text is as under:

$$\mu = \frac{\Theta.F_N[V(K,N-\overline{N}),M]}{\frac{W}{P}} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \text{(A11)}$$

Assuming the same growth rate of θ and *w*, taking total differential and dividing by (μ.*W/P*) and simplifying it, one gets:

$$\Delta log\mu = \theta - \Delta(w-p) + \frac{1}{F_V}.(F_{VV}dV + F_{VM}dM)$$
$$+ \frac{1}{F_V}(G_{NN}dN + G_{NK}dk) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \text{(A12)}$$

Elasticity of substitution between labour and capital can be defined in the value added function.

$$\sigma_{N,K} = \frac{V_N V_K}{V_{NK} V}$$
$$\sigma = \frac{F_V F_M}{F \quad F_{VM}}$$

Using the property of separability and differentiating the Euler's equation of *F* and *v* with respect to *v* and *N*, respectively, we get:

$$F_{vv} = -\frac{F_{vM}}{v} \text{and} V_{NN} = -\frac{V_{KN}.K}{(L-\bar{L})}$$
$$\frac{F_M.M}{F} = \bar{\mu}.s_M \text{ and } \frac{V_K.K}{G} = \frac{s_K}{s_K + s_N}$$

The above expressions that are first-order conditions and can be transformed in the equation as:

$$\Delta log\mu = \theta - \Delta(w-p) \quad - \frac{1}{\sigma}\overline{\mu}.s_m.\Delta v + \quad \frac{1}{\sigma}\overline{\mu}.s_m \Delta m$$
$$- \frac{1}{\sigma_{K,N}}\frac{s_k}{s_k+s_m}.\frac{N}{N-\overline{N}}.\overline{\mu}.s_m \Delta n \quad + \left[\frac{1}{\sigma_{K,N}}.\frac{s_k}{s_k+s_m}\right]\Delta k_t \quad \ldots \text{(A13)}$$

The productivity term can be derived from totally differentiating the production function and recalling the expressions

$\frac{F_K K}{Q} = \frac{\overline{\mu}.s_K}{\theta}, \frac{F_L L}{Q} = \frac{\overline{\mu}.s_L}{\theta}$ and $\frac{F_M M}{Q} = \frac{\overline{\mu}.s_M}{\theta}$

By which we can get the equation given below as:

$$\Delta q = \theta + \overline{\mu}.s_k \Delta k + \overline{\mu}.s_N \Delta n + \overline{\mu}.s_M \Delta m \quad \ldots \quad \ldots \quad \ldots \text{(A14)}$$

Putting above equation in Equation (A13), one obtains:

$$\Delta log\mu = \Delta(q^G + p^G) \quad - \Delta w \quad - \frac{1}{\sigma}[\Delta(m+v) \quad].\overline{\mu}.s_m + \left[\frac{1}{\sigma_{K,N}}.\frac{s_k}{s_k+s_m} - \overline{\mu}.s_k\right]\Delta k \quad + \left[\frac{1}{\sigma_{K,N}}.\frac{s_k}{s_k+s_m}.\frac{N}{N-\overline{N}} + \overline{\mu}.s_n\right] \Delta n \quad - \overline{\mu}.s_m.\Delta m \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \text{(A15)}$$

In case of σ=0, the term $\frac{1}{\sigma}[\Delta(m+v) \quad].\overline{\mu}.s_m$ will be undetermined. However, two factor elasticity of substitution $\sigma = \frac{\Delta(v+m)}{\Delta(p_M - p_V)}$ by putting of which in previous expression under the Leontief's assumption $\Delta p_V - \Delta p_M = (\Delta p_V + \Delta v) - (\Delta p_M + \Delta m)$.

The indeterminacy of above equation can be identified, as follows:

$$\frac{1}{\sigma}\overline{\mu}.s_m(\Delta m - \Delta v) = [(\Delta p_V + \Delta v) - (\Delta p_M + \Delta m)]\overline{\mu}.s_m \quad \ldots \text{(A16)}$$

By putting of which in Equation (A15), one gets the equation as under:

$$\Delta log\mu = \Delta(q^G + p^G) \quad - \Delta w \quad - [\Delta(p_V + v) \quad].\overline{\mu}.s_m + \left[\frac{1}{\sigma_{K,N}}.\frac{s_k}{s_k+s_m} - \overline{\mu}.s_k\right]\Delta k \quad + \left[\frac{1}{\sigma_{K,N}}.\frac{s_k}{s_k+s_m}.\frac{N}{N-\overline{N}} + \overline{\mu}.s_n\right] \Delta n \quad - \overline{\mu}.s_m.\Delta m \quad \ldots \quad \ldots \quad \ldots \quad \ldots \text{(A17)}$$

APPENDIX B

Table B1

List of Variables

Variables	Description	Source
Gross Output	Value of Production Exclusive of Taxes	Census of Manufacturing Industries (CMI)
Labour Compensation	Employment Cost (labour employment and wages)	Census of Manufacturing Industries (CMI)
Intermediate Inputs	Industrial Cost	CMI
Capital Stock	Value of Fixed Capital Deflated by Gross fixed Capital Formation (GFCF)	Census of Manufacturing Industries (CMI) and International Financial Statistic (IFS)
Rental Price	Interest Rate minus Expected Inflation Multiplied by Price of Capital (Derived by GFCF)	International Financial Statistic (IFS)
Cyclical Variable	HP Filtered Series of Gross Output	Census of Manufacturing Industries (CMI) and International Financial Statistic (IFS)
Value Added	Value Added to Census at market Prices	Census of Manufacturing Industries (CMI)
Wages	Employment Cost divided by Daily Average Number of Employment	Census of Manufacturing Industries (CMI)
Import Penetration Ratio	Ratio of Import to Total Compensation (Production+Export-Import)	Pakistan Yearbook

REFERENCES

Abayasiri-Silva, K. (1999) *Market Power in Australian Manufacturing Industry: A Confirmation of Hall's Hypothesis* (No. g-132). Monash University, Centre of Policy Studies/IMPACT Centre.

Aghion, P., M. Braun, and J. Fedderke (2008) Competition and Productivity Growth in South Africa. *Economics of Transition* 16:4, 741–768.

Akbar Ullah, A. U., E. Ghani, and A. Y. Javed (2013) Market Power and Industrial Performance in Pakistan. (Working Papers and Research Reports, 2013).

Ara, I. (2004) Is Pakistan's Manufacturing Sector Competitive? *The Pakistan Development Review* 685–706.

Aziz, J. and L. E. Leruth (1997) *Cyclical Effects of the Composition of Government Purchases*. International Monetary Fund.

Banerjee, A. and B. Russell (2004) A Reinvestigation of the Markup and the Business Cycle. *Economic Modelling* 21:2, 267–284.

Banerjee, A. and B. Russell (2005) Inflation and Measures of the Markup. *Journal of Macroeconomics* 27:2, 289–306.

Bartlesman, E. and W. B. Gray (1996) The NBER Manufacturing Productivity Database.

Basu, S. (1995) Intermediate Goods and Business Cycles: Implications for Productivity and Welfare. *The American Economic Review*, 512–531.

Basu, S. and J. G. Fernald (1994) Constant Returns and Small Mark-ups in US Manufacturing (No. 483). Board of Governors of the Federal Reserve System.

Basu, S. and J. G. Fernald (1995) Are Apparent Productive Spillovers a Figment of Specification Error? *Journal of Monetary Economics* 36: 1, 165–188.

Basu, S. and J. G. Fernald (1997) Returns to Scale in US Production: Estimates and Implications. *Journal of Political Economy* 105:2, 249–283.

Beccarello, M. (1997) Time Series Analysis of Market Power: Evidence from G-7 Manufacturing. *International Journal of Industrial Organisation* 15:1, 123–136.

Bils, M. (1987) The Cyclical Behaviour of Marginal Cost and Price. *The American Economic Review* 838–855.

Bloch, H. and M. Olive (2001) Pricing over the Cycle. *Review of Industrial Organization* 19;1, 99–108.

Ceritoğlu, E. (2002) *The Cyclicality of Mark-up Ratios: The Case of Turkish Industry*. Research and Monetary Policy Department, Central Bank of the Republic of Turkey.

Chevalier, J. A. and D. S. Scharfstein (1994) Capital Market Imperfections and Countercyclical Mark-ups: Theory and Evidence (No. w4614). National Bureau of Economic Research.

Domowitz, I., R. G. Hubbard, and B. C. Petersen (1988) Market Structure and Cyclical Fluctuations in US Manufacturing.

Fedderke, J., C. Kularatne, and M. Mariotti (2007) Mark-up Pricing in South African Industry. *Journal of African Economies* 16:1, 28–69.

Galeotti, M. and F. Schiantarelli (1998) The Cyclicality of Mark-ups in a Model with Adjustment Costs: Econometric Evidence for US Industry. *Oxford Bulletin of Economics and Statistics* 60:2, 121–142.

Goldstein, J. P. (1986) Mark-up Pricing over the Business Cycle: The Micro Foundations of the Variable Mark-up. *Southern Economic Journal* 233–246.

Hakura, D. (1998) *The Effects of European Economic Integration on the Profitability of Industries*. International Monetary Fund.

Hall, R. E. (1988) The Relation between Price and Marginal Cost in US Industry.

Hall, R. E. (1991) *Invariance Properties of Solow's Productivity Residual* (No. w3034). National Bureau of Economic Research.

Hall, R. E., O. J. Blanchard, and R. G. Hubbard (1986) Market Structure and Macroeconomic Fluctuations. *Brookings Papers on Economic Activity* 1986:2, 285–338.

Harrison, A. E. (1994) Productivity, Imperfect Competition and Trade Reform: Theory and Evidence. *Journal of International Economics* 36:1, 53–73.

Haskel, J., C. Martin and I. Small (1995) Price, Marginal Cost and the Business Cycle. *Oxford Bulletin of Economics and Statistics* 57:1, 25–39.

Helpman, E. and P. R. Krugman (1989) *Trade Policy and Market Structure*. MIT Press.

Hoekman, B., H. L. Kee, and M. Olarreaga (2001) Mark-ups, Entry Regulation and Trade: Does Country Size Matter?

Katics, M. M. and B. C. Petersen (1994) The Effect of Rising Import Competition on Market Power: A Panel Data Study of US Manufacturing. *The Journal of Industrial Economics* 277–286.

Khan, M. U. H. and A. A. Burki (1999) Technological Change and Substitution Possibilities in Pakistan's Large-scale Manufacturing: Some New Evidence. *Pakistan Economic and Social Review* 123–138.

Khan, S. U. K. (2005) Macro Determinants of Total Factor Productivity in Pakistan.

Klein, N. (2011) *South Africa: The Cyclical Behaviour of the Mark-ups and its Implications for Monetary Policy*. International Monetary Fund.

Klemperer, P. (1995) Competition when Consumers have Switching Costs: An Overview with Applications to Industrial Organisation, Macroeconomics, and International Trade. *The Review of Economic Studies* 62:4, 515–539.

Kurita, T. (2010) Empirical Modeling of Japan's Markup and Inflation, 1976–2000. *Journal of Asian Economics* 21:6, 552–563.

Lee, I. K. (2001) Asymmetry in the Response of Price-Cost Margins to the Level of Demand Across Booms and Slumps: The Case of US Industries. *International Economic Journal* 15:4, 47–58.

Levinsohn, J. (1993) Testing the Imports-as-Market-Discipline Hypothesis. *Journal of International Economics* 35:1, 1–22.

Linnemann, L. (1999) Sectoral and Aggregate Estimates of the Cyclical Behaviour of Markups: Evidence from Germany. *Weltwirtschaftliches Archiv* 135:3, 480–500.

Lopez, R. A. and E. Lopez (2003) The Impact of Imports on Price-Cost Margins: An Empirical Illustration. *Empirical Economics* 28:2, 403–416.

Macallan, C., S. Millard and M. Parker (2008) *The Cyclicality of Mark-ups and Profit Margins for the United Kingdom: Some New Evidence* (No. 351). Bank of England.

Machin, S. and J. Van Reenen (1993) Profit Margins and the Business Cycle: Evidence from UK Manufacturing Firms. *The Journal of Industrial Economics* 29–50.

Mahmood, Z. and N. M. Khilji (1989) Derived Demand for Factors in the Large-scale Manufacturing Sector of Pakistan [with Comments]. *The Pakistan Development Review* 28:4, 731–742.

Marchetti, D. J. (2002) Mark-ups and the Business Cycle: Evidence from Italian Manufacturing Branches. *Open Economies Review* 13:1, 87–103.

Morrison, C. J. (1992) Mark-ups in US and Japanese Manufacturing: A Short-Run Econometric Analysis. *Journal of Business & Economic Statistics* 10:1, 51–63.

Morrison, C. J. (1994) The Cyclical Nature of Mark-ups in Canadian Manufacturing: A Production Theory Approach. *Journal of Applied Econometrics* 9:3, 269–282.

Nadiri, M. I. (1970) Some Approaches to the Theory and Measurement of Total Factor Productivity: A Survey. *Journal of Economic Literature* 8:4, 1137–1177.

Nekarda, C. J. and V. A. Ramey (2013) *The Cyclical Behaviour of the Price-Cost Markup* (No. w19099). National Bureau of Economic Research.

Norrbin, S. C. (1993) The Relation between Price and Marginal Cost in US Industry: A Contradiction. *The Journal of Political Economy* 101:6, 1149–1164.

Okun, A. M. (1981) *Prices and Quantities: A Macroeconomic Analysis*. Brookings Institution Press.

Olive, M. (2004) Markup, Returns to Scale, the Business Cycle and Openness: Evidence from Australian Manufacturing. Economic Papers: *A Journal of Applied Economics and Policy* 23:1, 44–57.

Oliveira Martins, J. and S. Scarpetta (1999) The Levels and Cyclical Behaviour of Mark-ups Across Countries and Market Structures. Organisation for

Economic Co-operation and Development, Economics Department. (Working Paper 213).

Oliveira Martins, J., S. Scarpetta, and D. Pilat (1996) Mark-up Ratios in Manufacturing Industries: Estimates for 14 OECD Countries (No. 162). OECD Publishing.

Rezitis, A. and M. Kalantzi (2012) 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.

Roeger, W. (1995). Can Imperfect Competition Explain the Difference between Primal and Dual Productivity Measures? Estimates for US Manufacturing. *Journal of Political Economy*, 316–330.

Rotemberg, J. J. and G. Saloner (1986) A Supergame-Theoretic Model of Price Wars During Booms. *The American Economic Review* 76:3, 390–407.

Rotemberg, J. J. and M. Woodford (1991) Mark-ups and the Business Cycle. In *NBER Macroeconomics Annual 1991, Volume 6* (pp. 63–140). MIT Press.

Rotemberg, J. J. and M. Woodford (1992) Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity. *Journal of Political Economy* 1153–1207.

Rotemberg, J. J. and M. Woodford (1999) The Cyclical Behaviour of Prices and Costs. *Handbook of Macroeconomics* 1, 1051–1135.

Sargent, T. J. and N. Wallace (1974) The Elasticity of Substitution and Cyclical Behaviour of Productivity, Wages, and Labour's Share. *The American Economic Review* 64:2, 257–263.

Small, I. (1997) *The Cyclicality of Mark-ups and Profit Margins: Some Evidence for Manufacturing and Services*. Bank of England.

Stiglitz, J. E. (1984) Price Rigidities and Market Structure. *The American Economic Review* 350–355.

Waldmann, R. J. (1991) Implausible Results or Implausible Data? Anomalies in the Construction of Value-added Data and Implications for Estimates of Price-Cost Mark-ups. *The Journal of Political Economy* 99:6, 1315–1328.

Weiss, C. R. (2000) Mark-ups, Industry Structure and the Business Cycle. *Applied Economics Letters* 7:3, 189–191.

Wolman, A. (1999) Sticky Prices, Marginal Cost, and the Behaviour of Inflation. *FRB Richmond Economic Quarterly 85:*4, 29–48.