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Markup and the Business Cycle: Evidence from Italian Manufacturing Branches

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SINTESI

Il contenuto di questo lavoro esprime solamente le opinioni dell'autore; pertanto non rappresenta la posizione ufficiale della Banca d'Italia.

L'articolo propone un'analisi del *markup* nelle branche dell'industria manifatturiera italiana. Il *markup* è definito come il rapporto tra prezzo e costo marginale; quest'ultimo include, oltre al costo del lavoro, il costo imputabile all'uso del capitale e quello relativo al consumo di materie prime e beni intermedi. Un primo obiettivo del lavoro è quello di valutare quanto la forma di mercato prevalente nei singoli settori dell'industria italiana sia distante dalla tradizionale assunzione di concorrenza perfetta, che implica un *markup* unitario. Un secondo obiettivo è di studiare la relazione esistente tra il *markup* e il ciclo economico. Il livello di disaggregazione di questo studio corrisponde, con qualche eccezione, a quello della classificazione NACE a 44 branche; il periodo considerato è 1975-1995. Il costo marginale è approssimato a partire dalle variazioni osservate nella quantità dei fattori produttivi utilizzati (lavoro, capitale e beni intermedi) e dalle rispettive remunerazioni, e viene messo a confronto con le variazioni della produzione valutata ai prezzi di mercato.

Per quel che riguarda la misurazione del grado di concorrenza, il lavoro mostra che nella media del periodo considerato, e a seconda della procedura di stima utilizzata, il prezzo risulta superiore al costo marginale in otto o dieci settori su tredici. L'ipotesi di concorrenza perfetta è dunque rifiutata nella grande maggioranza dei settori. In generale, il potere di mercato delle imprese industriali mostra dimensioni apprezzabili, in linea con i valori riscontrati in altri paesi industrializzati da studi analoghi, con un valore medio del *markup* nell'intero comparto manifatturiero intorno a 1,16. Infine, i rendimenti di scala risultano costanti nella grande maggioranza dei settori (nove o undici branche su tredici, a seconda della procedura di stima).

Per quel che riguarda la relazione tra *markup* e ciclo economico, il lavoro si concentra sull'influenza della pressione della domanda sulle politiche di prezzo delle imprese. La pressione della domanda è misurata da tre diversi indicatori settoriali, tutti provenienti dalle inchieste congiunturali dell'ISAE presso le imprese manifatturiere: il livello degli ordini, le attese sull'andamento a breve termine degli ordini stessi e l'utilizzo della capacità produttiva.

I risultati ottenuti con i vari indicatori e con due distinte procedure di stima, pur nella loro diversità, concordano nell'indicare una pronunciata differenziazione settoriale della relazione tra ciclo economico e *markup*. In particolare, a seconda del metodo di stima il *markup* risulta prociclico (aumenta quando la pressione della domanda si accresce) in due o cinque branche manifatturiere, e risulta invece anticiclico (si riduce all'aumentare della pressione della domanda) in due o tre branche. Nelle restanti branche il *markup* non mostra alcuna relazione sistematica con il ciclo. Questa marcata differenziazione settoriale dei risultati conferma che il *markup* e il suo andamento ciclico dipendono dalle caratteristiche di prodotto e di processo produttivo specifiche di ciascun mercato, che influenzano le politiche di prezzo e i comportamenti strategici delle imprese. Questo risultato contribuisce a spiegare le evidenze empiriche spesso contraddittorie, ottenute con dati aggregati, riportate nella letteratura. Una ulteriore analisi delle determinanti del *markup* ha mostrato che, come previsto dalla teoria economica, il suo livello medio è correlato negativamente con la "pressione competitiva" settoriale, sia di origine interna (misurata inversamente dal grado di concentrazione interna del settore) che estera (misurata dal grado di esposizione al commercio estero). Inoltre, nei settori più concentrati emerge un andamento anticiclico del rapporto tra prezzo e costo marginale, come suggerito da alcuni recenti modelli di comportamenti collusivi tra imprese oligopolistiche.

Markup and the Business Cycle:
Evidence from Italian Manufacturing Branches

by Domenico J. Marchetti[*]

Abstract

This paper investigates the markup of price over marginal cost in Italian manufacturing branches. The approach used is an extension of Hall's model that addresses some measurement shortcomings and theoretical limitations that may affect this class of model. The hypothesis of perfect competition is rejected in the majority of sectors over the period 1977-1995. Data on the cyclical behavior of the markup are found to vary significantly across branches, thereby helping to explain the contradictory evidence regarding the whole manufacturing sector reported in the literature. At sectoral level, industry concentration is found to be associated with anticyclical markups, as suggested by recent theoretical contributions. Finally, the size of the markup is negatively affected by both domestic and foreign competitive pressure.

Contents

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1. Introduction[1]

The relevance of imperfect competition models has increased significantly in recent years in macroeconomics and industrial organization. The proper assessment of markups over marginal cost has important implications for identifying and modeling the market structure prevailing in the economy. Furthermore, markups and their cyclical behavior are important for the business cycle theory; in particular, countercyclical markups provide a channel through which changes in aggregate demand may affect output and employment levels, by shifting the labor demand curve upward (Rotemberg and Woodford, 1992).

The problem in estimating the markup is that marginal cost is not observable. Many studies in the literature on industrial organization have relied on the measured profit rate as a proxy for the markup (see Schmalensee, 1989, for a review); others have used estimates of firm-level demand and cost functions (see Bresnahan, 1989, for a survey).[2] An alternative approach has been developed within the macroeconomic literature based on the original contribution by Hall (1988). Hall's intuition was to measure marginal cost from observed variations in inputs used in the production process. His contribution aroused considerable attention; from the methodological point of view, it was criticized on the grounds of model misspecification by Waldmann (1992) and, especially, by Norrbin (1993). They stressed that the use of a value-added framework results in an omitted-variable bias, where the omitted variable, in conditions of imperfect competition, is materials growth. However, a number of economists have modified and improved Hall's approach in order to overcome its shortfalls while retaining its basic intuition (see, for example, Domowitz, Hubbard and Peterson, 1988, who extended Hall's analytical framework to gross output).

This paper contributes to this line of research. It provides a comprehensive analytical framework that strengthens and develops Hall's original contribution in several respects,

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[2] Contributions following dynamic production-theoretic approaches include Morrison (1993 and 1994), Chirinko and Fazzari (1994) and Galeotti and Schiantarelli (1998).

concerning both methodological issues and the scope of the investigation. First, with regard to the methodology, this paper uses a model in which production is measured by gross output rather than by value added and intermediate goods are therefore included among inputs (see Norrbin, 1993, on the problems arising from the use of value added data). Second, data on electricity consumption are used to derive a better measure of capital services (see Burnside, Eichenbaum and Rebelo, 1995, who stress the need for this kind of adjustment). Third, the model used here allows for estimating returns to scale - i.e., the usual assumption of constant returns is relaxed. While some or all of these single modeling features are already known in the literature, to the author's knowledge this is the first attempt to combine them together in a comprehensive and consistent framework. The model is extended to allow for movements of the markup over the business cycle.[3] To this end and in order to obtain robust results, several alternative measures of sectoral cycles were used (the level of orders, order expectations, and the capacity utilization rate). The effect of domestic and foreign competition on the markup and its cyclical behavior were also analyzed. As stressed above, such extensions are useful to assess the empirical relevance of recent models in both macroeconomics and industrial organization. In fact, some recent studies of economic fluctuations rely on the cyclical variation in the markup as a transmission mechanism (Blanchard and Fischer, 1991, Mankiw and Romer, 1992, and Rotemberg and Woodford, 1992). In particular, a counter-cyclical markup will shift out the labor demand curve when demand rises; the level of employment and output will rise. Real wages will also rise, reconciling the predictions of economic theory with the stylized facts of business cycles in industrialized economies. However, economic theory makes no clear prediction concerning the cyclical behavior of the markup. For example, in the "customer market" model by Phelps and Winter (1970) with monopolistic competitors, pricing involves a tradeoff between increasing future market shares (by lowering prices) and exploiting current customers (by raising prices). Given the stream of expected future profits, high current demand raises the incentive to exploit current customers by increasing the markup. On the other hand, in Rotemberg and Saloner's (1986) model of implicit collusion between

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3 Applications of Hall's model to cyclical movements of the markup include Beccarello (1996), Domowitz *et al.* (1988), Hasken, Martin and Small (1995), Oliveira Martins, Scarpetta and Pila (1997) and Sembenelli (1996).

oligopolies, an increase in current demand raises the incentive to deviate by reducing prices; the oligopoly has therefore to lower its equilibrium markup in order to reduce this incentive and maintain discipline[4]. Another explanation of countercyclical markups is that the elasticity of demand may significantly decrease during periods of low demand, allowing imperfectly competitive firms to increase markups (Stiglitz, 1984).[5]

The model developed in this paper was applied to the data on Italian manufacturing branches, disaggregated at roughly two-digit SIC level, over the period 1977-1995. The main findings are the following. First, perfect competition is rejected in most industries; however, the extent of market power appears moderate, consistently with other evidence available in the literature.[6] Second, returns to scale appear to be approximately constant in the large majority of branches, at least at a five percent confidence level. Third, and more interestingly, results on the cyclical movements of the markup were found to vary significantly across branches, as should be the case if market power and firms’ pricing policies depend on the microeconomic characteristics of each sector. This result helps to explain the contradictory evidence found in the literature for the manufacturing sector as a whole (and, in general, when aggregate data are used), in Italy as elsewhere. Fourth, industry concentration is found to be associated with anticyclical markups, as suggested by Rotemberg and Saloner’s model (1986). Finally, the size of the markup is negatively affected by both domestic and foreign competitive pressure.

This paper is presented as follows: the basic model is described in Section Two, together with sectoral results on markups and returns to scale. Section Three contains an analysis of the cyclical behavior of the markup and its interaction with the degree of domestic and foreign competitive pressure. The conclusions follow. The Appendix contains a description of the data.

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4 However, the opposite result is obtained by the implicit collusion model of Green and Porter (1984).

5 Other contributions to the huge literature on the cyclicality of markup include Greenwald, Stiglitz and Weiss (1984), Bils (1987), Chatterjee and Cooper (1989), Gottfries (1991), Chatterjee, Cooper and Ravikumar (1993) and Chevalier and Scharfstein (1995).

6 See for example Oliveira Martins, Scarpetta and Pilat (1997) and Sembenelli (forthcoming).

2. Markups and returns to scale

The basic model used in this paper is derived, with several extensions, from that originally proposed by Hall (1988). As already mentioned, Hall's intuition was to measure marginal cost as the observed change in input cost as output rises or falls from one year to the next. Consider the following production function:

(1) $$Y = F\,(L, K, M; \Theta),$$

where Y is gross output, L, K and M are, respectively, the input of labor, capital and intermediate goods, and Θ is an index of technical progress. The function F is assumed to be homogeneous of degree γ in L, K e M, and degree one in Θ; it should be stressed that, since γ can be either lower than, equal to or greater than one, returns to scale are not assumed to be constant. As an attempt to reduce significantly the usual measurement errors that typically affect data on capital inputs, the latter variable was measured by weighting the data on capital stock with an index of intensity of use. This index was computed on the basis of the cyclical component of sectoral electricity consumption[7] (on the advantages of using data on electricity consumption when measuring capital inputs, see Burnside, Eichenbaum and Rebelo, 1995, and Burnside, 1996).

It is assumed that firms' behavior is well approximated by a sequence of static optimizations; in other words, we did not consider dynamic investment strategies. Firms are assumed to be price-takers in the factor markets; on the other hand, the model allows for market power in the final good market. With these assumptions, as is well-known, profit maximization requires that the marginal product of each factor and the corresponding remuneration in real terms be equalized through the markup μ:

(2) $$F_j = \mu \frac{p_j}{p} \qquad \text{for j} = L, K \text{ and } M$$

7 Energy consumption was detrended using the Hodrick-Prescott procedure. The index of intensity of use was computed by normalizing to one the mean of the cyclical component over the period considered.

where F_j is the derivative of the production function with respect to input j, p_j and p are the prices, respectively, of input j and the final good.[8] The markup μ depends on the firm's market power.[9] By assuming a neoclassical production function and taking the logarithmic differentiation of equation (1), one obtains:

$$dY = \frac{F_L L}{Y} dL + \frac{F_K K}{Y} dK + \frac{F_M M}{Y} dM + d\theta \tag{3}$$

where dX is defined as the logarithmic difference of X (for $X = Y, L, K$ and M). Solow (1957) showed that, with perfect competition and constant returns to scale (here, respectively, γ = 1 and μ = 1), total factor productivity growth, represented by $d\theta$, can be measured by using jointly equations (2) and (3) and data on factor remuneration. In our case, by substituting equation (2) in (3) and using the homogeneity conditions of the function F, one obtains:

$$dY - dK = \mu\left[\frac{p_l L}{pY}(dL - dK) + \frac{p_m M}{pY}(dM - dK)\ \right] + (\gamma - 1)dK + d\theta\,. \tag{4}$$

Assuming that the dynamics of technical progress, $d\theta$, is adequately approximated by an underlying rate of growth plus a stochastic disturbance, equation (4) can be written as:

$$dy_{it} = \mu_{it}(a_L dl_{it} + a_M dm_{it}) + (\gamma - 1)dK_{it} + \delta_{\theta i} + u_{it} \tag{5}$$

where dx is defined as the logarithmic difference of X (for $X = Y, L$ and M) minus the logarithmic difference of capital, index i refers to the firm or sector, and a_L and a_M are the revenue shares of labor and intermediate goods (they are reported in Table 1). If μ is assumed to be constant, it can be estimated through equation (5). With the exception of dK, which is needed to allow for decreasing or increasing returns to scale, this is the equation estimated by Hall (1988), plus later contributions (see, especially, Norrbin, 1993, who

8 Traditional optimization conditions are derived assuming mobility of production factors. The lack of labor market rigidities is a strong assumption for the Italian economy; however, it is partly mitigated by the annual frequency of the data used. Furthermore, the hypothesis of quasi-fixity of labor can be incorporated in the model by including a new parameter (see Sembenelli, forthcoming); the estimates of this extended model show that the results reported in the next section are quite robust to this assumption.

9 It can be shown that μ is equal to η/(η-1), where η is the demand elasticity faced by the firm.

substituted the value added data used by Hall with gross output data and included intermediate goods among production factors).[10]

The estimation of models such as equation (5) requires the use of instrumental variables, because of the correlation between residuals (which represent technological shocks) and regressors (which are the quantities of inputs used in production). Instruments therefore need to be uncorrelated with technological shocks while being highly correlated with the right-hand side variables. Ideal candidates are sectoral or aggregate demand variables; I used the rate of growth of world imports, oil prices, the effective exchange rate and government expenditure, current and lagged values, plus the lagged values of sectoral rates of growth of inputs. Since shocks are presumably correlated across sectors in a given period, a 3SLS estimator was used in order to obtain more efficient estimates. However, the use of instrumental variables in this context is not immune to criticism. Nelson and Startz (1990) showed that, when a relatively poor first-stage regression property is accompanied by a small sample, instrumental variable procedures are potentially more biased than simpler non-instrumental procedures. Given the difficulty of evaluating the trade-off between the use of consistent but potentially inefficient instrumental estimates and of biased but more efficient OLS estimates, I chose to report throughout the paper both 3SLS and SUR estimates results; in most cases, the substance of the results is the same.

Equation (5) was estimated from the data on thirteen Italian manufacturing branches, over the period 1977-1995 (results are reported in Table 2). Overall, the fit of the model is quite satisfactory (see also the diagnostics reported, for each sector, in Table 3).[11] The main results are the following. First, price is found to be significantly higher than marginal cost ($\mu > 1$) in ten branches out of thirteen, according to SUR estimates, and in eight branches according to 3SLS estimates. The null hypothesis of perfect competition is therefore rejected in the majority of sectors. According to SUR estimates, the average markup estimate in the whole manufacturing sector is around sixteen per cent; according to the 3SLS results, which are somewhat less accurate, it is twenty-four per cent. On one hand, therefore, this evidence

10 For the Italian economy, a model very similar to equation (5) was estimated with firm-level data by Sembenelli (forthcoming), who obtained aggregate estimates of μ and γ equal to, respectively, 1.08 and .93.

11 Residual autocorrelation is significant only in one or two sectors, and residual normality is accepted in all but one sector; for 3SLS estimates, instrument validity has been verified with the usual Sargan's test.

clearly enhances the relevance of imperfect competition models for describing the behavior of Italian manufacturing firms, at least in the majority of branches; on the other hand, presumably because of the significant exposure to foreign competition, the extent of the market power of Italian enterprises appears to be moderate and not significantly different from that of firms in other countries, according to results obtained by similar studies (see for example Norrbin, 1993, and Oliveira Martins *et al.*, 1997).

In spite of the difficulties involved in estimating simultaneously the markup and the returns to scale parameter, the estimates of the latter are also satisfactory - i.e. they are not implausibly large or small, although in a few cases they are statistically different from one and lead to the rejection of the hypothesis of constant returns. At a five percent confidence level the hypothesis of constant returns is accepted by the data in most branches - nine or eleven out of thirteen, according to the estimator being used. According to both estimators, returns to scale are found to be increasing in transportation equipment, which is typically a capital-intensive highly-concentrated industry in which technology has scope for economies of scale. On the other hand, there is some evidence of decreasing returns in the mineral products, electrical goods, food products, textiles and clothing sectors, which are, on average and in relative terms, less capital-intensive and less concentrated. It should be stressed that simultaneous estimates of the markup and of the returns to scale parameter at sectoral level are a novelty in the literature, to the author’s knowledge (see Sembenelli, 1995, for joint aggregate estimates with data from Italian firms). An accurate analysis at branch level goes beyond the objectives of this paper (and would probably require more disaggregated data). Nevertheless, the sectoral pattern of the results suggests that allowing for sector-specific parameters yields significant gains in the flexibility of the model and its ability to capture the phenomena of interest.

3. Markups, the business cycle and industry concentration

In this section the analysis is extended to both the cyclical behavior of the markup and some of its structural determinants. Following Domowitz *et al.* (1988), Haskel *et al.* (1995) and Beccarello (1996), the markup is assumed to vary across sectors and over time according to:

(6) $$\mu_{it} = \overline{\mu}_i + \beta_{1i} ciclo_{it}$$

where $\overline{\mu}_i$ is the sectoral average markup, which reflects the market structure prevailing in branch i, and $ciclo_{it}$ is a measure of the sectoral cycle of demand and economic activity.[12]

By substituting (6) in (5), one obtains:

(7) $$dy_{it} = \overline{\mu}_i dx_{it} + \beta_{1i} dx_{it} ciclo_{it} + (\gamma_i - 1) dK_{it} + \delta_{\theta i} + u_{it}$$

where dx_{it} is the sum of the logarithmic differences of labor and intermediate goods, minus the logarithmic difference of capital, weighted by the respective revenue shares. The variable $ciclo_{it}$ is a measure of sectoral cycles. In order to obtain robust results, three different measures were used, obtained from business survey data: the current level of orders, short-term order expectations and the rate of capacity utilization.[13]

The estimates of equation (7) for each branch, with the different measures of $ciclo_{it}$, are reported in Table 4. The substance of the results proved to be robust to the choice of the cyclical variable. The values of sectoral markups, implicitly provided by combining the estimates of $\overline{\mu}$ and β_1, are consistent with the direct estimates obtained in the previous section. The main finding reported in the Table is that the cyclical behavior of the markup is found to vary significantly across sectors. In particular, according to most cyclical measures and estimation procedures, the markup is found to be procyclical in at least two branches,

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12 Although widely utilized, the assumption of a linear relationship between the markup and the business cycle is valid at a first approximation. In principle, one would need a second-order Taylor approximation of the Solow residual (see Rotemberg and Woodford, 1992). However, the latter approach has its own shortcomings, since, in order to be implemented, it requires further assumptions on the specific form of the production function and on the values of the elasticities of substitution between, respectively, value added and materials and labor and capital.

13 Data are taken from the EU-harmonized survey of industrial enterprises, carried out monthly in Italy by Isae, the National Institute for Economic Analysis (former Isco). For the first two variables, as usual, the net balances of, respectively, positive (‘high level’, ‘expected increase’) and negative (‘low level’, ‘expected decrease’) replies were used. This is one of the most common methods to extract quantitative information from qualitative surveys, chosen for its semplicity and robustness; other methods have been proposed in the literature, but they typically provide similar results (see for example Pesaran, 1987). Since the net balance of the level of orders has a negative value in many observations, in order to ease the interpretation of the results (particularly, the computation of elasticities), I used a monotonic transformation of the balance itself, i.e. the balance plus 100, indexed (1990 = 100). This transformation leaves the dynamics of the original variable unchanged.

agricultural and industrial machinery and electrical goods, and countercyclical also in at least two branches, chemicals and food products. There is weaker evidence (supported only by instrumental estimates) that the markup is procyclical in another three branches, i.e. textiles and clothing, paper and printing and plastics and rubber, and countercyclical in one more branch, timber and furniture. In two sectors (metals and metal products) the markup appears substantially acyclical. Only in three sectors did the different cyclical measures and estimation procedures fail to provide relatively robust and unambiguous evidence: non-metallic minerals, office equipment and precision instruments, and transport equipment, for which the results on the cyclicity of the markup depend crucially on the variables or estimator being used.

Overall, in spite (or, perhaps, because) of the pronounced heterogeneity in the results, the broad message conveyed by the data seems quite clear. There appears to be no relationship between markup and the business cycle that is valid for the whole economy; in some sectors the markup appears to be positively correlated with economic fluctuations, in others the correlation is negative, in others no significant correlation is found whatsoever. This basic finding, often neglected in the macroeconomic literature, has a straightforward economic interpretation: it suggests (or rather confirms) that the markup and its cyclical behavior depend, ultimately, on the characteristics of product and production process, which are specific to each market and which are the key determinants of firms' optimal strategic behavior.[14] Economy-wide results on the matter are therefore potentially misleading; indeed, the evidence obtained in this paper can help to explain the contradictory findings reported in the empirical literature using aggregate data.

Finally, this paper attempted to provide an at least partial explanation of the results just reported by analyzing the role of some structural determinants of the markup and their interaction with the business cycle. In particular, two variables representative of, respectively, domestic and foreign competitive pressure were taken into consideration. The former is industry concentration, measured by the ratio of the sales of the four largest firms in the sector to total sectoral sales (so-called C4; obviously, the higher is C4 the lower is the competitive pressure arising from domestic firms). With regard to external competition, I considered the degree of openness to foreign trade, measured by the ratio of imports to domestic production. The following specification of the markup was adopted, along the lines of the model proposed by Domowitz *et al.*:

(8)
$$\mu_{it} = \overline{\mu} + \beta_1 ciclo_{it} + \beta_2 C4_{it} + \beta_3 ciclo_{it} C4_{it} + \beta_4 imp_{it}$$

where $C4_{it}$ and imp_{it} are the above measures of, respectively, domestic and foreign competition.[15] The term $ciclo_{it}C4_{it}$ has been included in the equation because the effect of the interaction between industry concentration and the business cycle on the markup is an interesting issue, as mentioned elsewhere in this paper.

By substituting (8) in (5), one obtains:

(9)

$$dy_{it} = \overline{\mu} dx_{it} + \beta_1 dx_{it} ciclo_{it} + \beta_2 dx_{it} C4_{it} + \beta_3 dx_{it} ciclo_{it} C4_{it} + \beta_4 dx_{it} imp_{it} + (\gamma - 1) dK_{it} + \delta_{\theta i} + u_{it}$$

The results of the estimation over the period 1982-1995 (the only one for which a measure of industry concentration was available) are reported in Table 5. In spite of a few differences in the results across cyclical variables and estimators, some broadly consistent findings emerge, as follows. First, by combining the estimate of the coefficient β_2 with that of β_3 (the latter times the mean value of the variable *ciclo*), there emerges a positive correlation between the size of the markup and industry concentration, as predicted by microeconomic theory. Analogously, the estimated sign of β_4 indicates that the size of the markup is negatively affected by external competitive pressure. These two results, consistent with the predictions of standard economic theory, are reassuring about the ability of the

14 Gavosto, Sabbatini and Sestito (1994) also obtained evidence of significant sectoral differences in the cyclical behavior of price over marginal cost, though markups were found to be countercyclical in most branches.

15 Domowitz et al. use a measure of industry concentration corrected by exposure to foreign trade, i.e. C4A = C4(1-imp). In our case it seemed preferable to consider the two variables separately, since the role of each is of interest. Furthermore, in the Italian economy import penetration varies significantly over time, unlike industry concentration; the estimated effect of the variable C4A would therefore mainly reflect that of the variable imp only.

model to capture some of the key features of the phenomenon of interest. The sign and significance of the estimate of β_1 vary significantly over estimators and measures of sectoral cycles, presumably reflecting the difficulty of identifying a relationship between the markup and the business cycle that is valid economy-wide. The most interesting result, however, comes from the statistical significance and the sign of the estimate of β_3, which suggest that the markup is anticyclical in more concentrated sectors. This finding can clearly be interpreted as evidence in favor of oligopolistic models with anticyclical markups, such as that by Rotemberg and Saloner (1986).[16] With oligopolistic competition, during economic expansions the incentive to deviate from collusive behavior is greater, and needs to be diminished by decreasing the equilibrium markup. This result also helps to explain the significant sectoral differences in the response of the markup to economic fluctuations.

4. Conclusions

This paper investigates the markup of price over marginal cost in Italian manufacturing branches. The analytical framework is derived from Hall (1988), with several extensions and modifications. The contribution to the existing literature is two-fold, concerning both (i) the methodology used, and (ii) the sectoral pattern of the evidence found on the cyclical movements of the markup. On the modeling side, this paper uses a specification that makes it possible to reduce or avoid many of the measurement shortcomings and theoretical limitations known in the literature. While the single modeling features used here are already known in the literature, they had not previously brought together. Overall, the accuracy and reliability of the estimates of the markup are enhanced by (i) the simultaneous estimate of the returns to scale parameter, (ii) the use of gross output rather than value added data and the inclusion of intermediate goods among inputs, and (iii) the measurement of capital services with the help of data on electricity consumption. One shortcoming of the analysis presented here is the level of disaggregation of the data used, roughly two-digit SIC level. On one hand, the results are potentially subject to aggregation bias. On the other hand, these data have the advantage of being comprehensive and available for a relatively long sample

16 In general, countercyclical markups have been found by a number of very recent empirical studies, including Oliveira Martins and Scarpetta (1998).

period; in any case, the size of the markup estimates for Italian manufacturing industries presented here is in line with the findings of other studies which use more disaggregated data. Also, this aggregation level is consistent with that used by most contributions to the literature, making it possible to compare the respective results.

The other main contribution of this paper comes from the results on the cyclical behavior of the markup. Whereas price is found to be greater than marginal cost in the majority of branches, the relationship between the markup and the business cycle varies significantly across sectors. Accordingly, there is no evidence of a clear-cut relationship between markup and economic fluctuations for the manufacturing sector as a whole. These findings are robust to the choice of the measure of sectoral cycles. They are consistent with the assumption that the markup and its cyclical behavior are ultimately determined by the characteristics of product and production process, which differ from market to market. Although largely known and debated within the literature on industrial organization, the implications of such issues are often overlooked in the macroeconomic literature. In this regard, the results presented suggest that a note of caution should be used in empirical studies that analyze the cyclical movements of the markup using aggregate data covering the whole economy or manufacturing sector; similarly, caution should be used when interpreting the results of theoretical models that assume a unique relationship between markup and cycle throughout the economy. Some general pattern, however, has been identified with regard to the effect of competitive pressure and market pressure on the markup and its cyclical variations. In particular, there is evidence of anticyclical markups in more concentrated industries; this finding supports implicit collusion models à la Rotemberg and Saloner (1986). Finally, the results presented confirm the role of both domestic and external competitive pressure in lowering firms' gains over marginal cost. Further investigation of the empirical relevance of specific industrial organization models of oligopolistic pricing strategies over the cycle is an interesting topic for future research with firm-level data.

Appendix

Data

The classification used in this paper corresponds roughly to that of the forty-four Nace branches (see Eurostat, 1979). The level of disaggregation is the highest possible, given data availability; in particular, food products, beverages and tobacco on one hand, and textiles, clothing, leather and footwear on the other hand, have been aggregated in two sectors, because of the lack of disaggregated data on the stock of capital. Data on sectoral production at constant and current prices from 1970 to 1995 were obtained from the Italian National Statistical Institute (ISTAT). These data are used by ISTAT to compute value added at constant prices, through so-called “double deflation”, i.e. by subtracting the use of intermediate goods from production, both deflated. Data on value added, labor units and their remuneration, gross of social benefits, are from National Accounts. Data on the use of intermediate goods at constant and current prices were obtained by subtracting the corresponding value added data from production. To compute the shares of input remuneration on the value of production, in order to obtain data as consistent as possible with the analytical framework, I used data on employees’ remuneration gross of social benefits, whereas the value of production was taken net of indirect taxes and production incentives. Sectoral data on the stock of capital are those computed by ISTAT with a version of the permanent inventory method (see Lupi and Mantegazza, 1994). Data on industrial energy consumption by sector were obtained from the national electricity board (ENEL). An industry concentration index (so-called C4) was computed as a ratio of the sales of the four largest firms in each sector (Centrale dei Bilanci balance sheet data) to total sectoral sales (ISTAT data). Sectoral imports, used to compute a measure of the degree of openness to foreign trade, are from ISTAT.

Table 1

AVERAGE REVENUE SHARES OF LABOR AND INTERMEDIATE GOODS

	Labor	Intermediate goods
1. Ferrous and non-ferrous ores and metals	.15	.72
2. Non-metallic mineral products	.26	.53
3. Chemical products	.19	.69
4. Metal products other than machinery and transportation equipment	.26	.55
5. Agricultural and industrial machinery	.25	.60
6. Office machinery and precision instruments	.30	.62
7. Electrical goods	.28	.59
8. Transportation equipment	.26	.62
9. Food products, beverages and tobacco	.11	.77
10. Textiles, clothing, leather and footwear	.23	.61
11. Timber and furniture	.21	.60
12. Paper and printing	.24	.61
13. Rubber and plastic products	.23	.61

Table 2

MARK-UP AND RETURNS TO SCALE

Equation (5): $dy_{it} = \mu_i dx_{it} + (\gamma_i - 1) dK_{it} + \delta_{\theta i} + u_{it}$

		SUR		3SLS	
		μ	γ	μ	γ
1.	Ferrous and non-ferrous ores and metals	1.08 (.03)	1.07+ (.04)	.95 (.06)	1.04 (.07)
2.	Non-metallic mineral products	1.18++ (.03)	.86-- (.04)	1.20++ (.09)	.87 (.09)
3.	Chemical products	1.07++ (.03)	.98 (.02)	1.13 (.11)	1.19 (.15)
4.	Metal products other than machinery and transportation equipment	1.17++ (.05)	1.10+ (.05)	1.29++ (.09)	1.01 (.13)
5.	Agricultural and industrial machinery	1.23++ (.09)	1.05 (.07)	1.37++ (.14)	0.85 (.16)
6.	Office machinery and precision instruments	1.26++ (.05)	1.13+ (.08)	1.39++ (.07)	1.27 (.17)
7.	Electrical goods	.91-- (.03)	.93-- (.02)	.95 (.09)	0.98 (.12)
8.	Transportation equipment	1.20++ (.04)	1.11++ (.03)	1.24++ (.10)	1.22++ (.07)
9.	Food products, beverages and tobacco	1.00 (.03)	.83-- (.02)	1.26++ (.07)	1.05 (.12)
10.	Textiles, clothing, leather and footwear	1.28++ (.05)	.98 (.03)	1.47++ (.14)	.80-- (.06)
11.	Timber and furniture	1.27++ (.03)	1.05 (.03)	1.78++ (.22)	1.21 (.18)
12.	Paper and printing	1.18++ (.03)	1.03 (.02)	.77 (.19)	.77 (.17)
13.	Rubber and plastic products	1.19++ (.04)	1.02 (.04)	1.27 (.24)	.89 (.21)
Unweighted sectoral mean		1.16	1.01	1.24	1.01

Note: annual data, period 1977-1995. White-consistent standard errors are reported in parentheses.
++ and + : significantly greater than one, respectively, at the 5 and 10 percent level;
-- and - : significantly smaller than one, respectively, at the 5 and 10 percent level.

Table 3

MARK-UP AND RETURNS TO SCALE: DIAGNOSTICS

Equation (5): $dy_{it} = \mu_i dx_{it} + (\gamma_i - 1)dK_{it} + \delta_{\theta t} + u_{it}$

	SUR				3SLS				
	BG	LB	BP	JB	BG	LB	BP	JB	SA
1. Ferrous and non-ferrous ores and metals	1.21 [.876]	5.48 [.242]	3.19 [.074]	1.60 [.449]	3.14 [533]	4.81 [.307]	.56 [.453]	1.14 [.565]	1.44 [.963]
2. Non-metallic mineral products	5.05 [.282]	5.65 [.227]	5.55 [.019]	.28 [.867]	4.03 [.402]	3.45 [.486]	1.87 [.172]	.80 [.670]	10.60 [.102]
3. Chemical products	23.36 [.000]	15.59 [.004]	1.16 [.280]	1.25 [.535]	14.45 [.006]	15.20 [.004]	3.10 [.078]	1.16 [.561]	2.38 [.882]
4. Metal products other than machinery and transportation equipment	3.16 [.532]	4.35 [.361]	5.78 [.016]	1.09 [.581]	5.02 [.285]	1.97 [.741]	2.36 [.124]	.037 [.982]	3.53 [.739]
5. Agricultural and industrial machinery	6.69 [.153]	6.79 [.147]	.65 [.420]	4.00 [.136]	1.26 [.869]	1.56 [.816]	1.33 [.249]	.324 [.850]	3.94 [.685]
6. Office machinery and precision instruments	.42 [.981]	1.09 [.896]	1.00 [.317]	2.35 [.309]	10.66 [.031]	4.29 [.038]	2.92 [.087]	.63 [.727]	2.70 [.845]
7. Electrical goods	5.29 [.259]	5.86 [.210]	.96 [.327]	1.12 [.572]	.90 [.924]	1.26 [.868]	1.97 [.160]	1.25 [.536]	10.40 [.109]
8. Transportation equipment	10.89 [.028]	7.17 [.127]	1.73 [.188]	.33 [.849]	.17 [.997]	.39 [.983]	.11 [.736]	.61 [.735]	4.28 [.638]
9. Food products, beverages and tobacco	3.72 [.445]	2.87 [.580]	2.97 [.085]	1.25 [.536]	4.61 [.329]	5.26 [.261]	1.32 [.250]	1.37 [.505]	2.34 [.886]
10. Textiles, clothing, leather and footwear	.67 [.955]	.31 [.989]	.38 [.537]	10.66 [.005]	7.28 [.122]	2.77 [.595]	1.51 [.219]	.01 [.998]	1.45 [.963]
11. Timber and furniture	3.73 [.444]	3.28 [.511]	2.03 [.154]	.30 [.860]	2.07 [.723]	2.18 [.703]	.14 [.707]	.51 [.773]	2.70 [.845]
12. Paper and printing	1.94 [.747]	4.89 [.299]	4.14 [.042]	2.64 [.267]	6.12 [.190]	5.96 [.202]	.48 [.488]	1.03 [.597]	1.87 [.931]
13. Rubber and plastic products	.19 [.996]	2.18 [.703]	6.76 [.009]	1.74 [.418]	3.61 [.460]	5.48 [.241]	.03 [.856]	3.50 [.173]	.92 [.988]

BG = Breusch-Godfrey LM test of order 1-4;
LB = Ljung-Box Q test of order 1-4;
BP = Breusch-Pagan test of heteroschedasticity;
JB = Jarque-Bera test of normality;
SA = Sargan’s test of instrument validity.
Note: P-values in square brackets. Tests were computed on residuals of each sector-specific equation.

Table 4

MARK-UP AND THE BUSINESS CYCLE

Equation (7): $dy_{it} = \overline{\mu}_i dx_{it} + \beta_{1i} dx_{it} ciclo_{it} + (\gamma_i - 1) dK_{it} + \delta_{\theta i} + u_{it}$

ESTIMATES OF βi WITH DIFFERENT MEASURES OF SECTORAL CYCLES

	Order-book level		Order expectations		Capacity utilization rate	
	SUR	3SLS	SUR	3SLS	SUR	3SLS
1. Ferrous and non-ferrous ores and metals	.002 (.001)	-.004 (.003)	.003 (.002)	-.007-- (.002)	.010+ (.006)	.001 (.003)
2. Non-metallic mineral products	-.007-- (.001)	.020++ (.005)	-.004-- (.001)	.023++ (.003)	-.009 (.008)	.036++ (.004)
3. Chemical products	-.009-- (.001)	-.009-- (.004)	-.016-- (.004)	-.016- (.008)	-.032-- (.004)	-.016 (.021)
4. Metal products other than machinery and transportation equipment	.001 (.002)	-.002 (.002)	.010++ (.004)	.001 (.005)	-.020 (.013)	.007 (.010)
5. Agricultural and industrial machinery	.006++ (.002)	.008 (.008)	.020++ (.003)	.022++ (.011)	.058++ (.018)	.033++ (.009)
6. Office machinery and precision instruments	.003 (.003)	.014++ (.003)	-.008-- (.003)	.007++ (.004)	.032+ (.018)	-.007 (.007)
7. Electrical goods	.014++ (.001)	.010++ (.001)	.014++ (.003)	.006++ (.001)	.057++ (.007)	.007++ (.001)
8. Transportation equipment	.001 (.001)	.002 (.003)	-.005-- (.002)	-.016-- (.004)	.011++ (.004)	.006 (.004)
9. Food products, beverages and tobacco	-.008- (.004)	-.011- (.007)	-.005 (.006)	-.010-- (.004)	-.042-- (.017)	-.009-- (.004)
10. Textiles, clothing, leather and footwear	-.001 (.002)	.017++ (.003)	.001 (.002)	.014++ (.003)	.040 (.031)	.082++ (.016)
11. Timber and furniture	.001 (.001)	.001 (.009)	-.001 (.002)	-.037-- (.014)	.005 (.004)	-.065-- (.015)
12. Paper and printing	.001 (.001)	.013++ (.002)	.001 (.001)	.011++ (.003)	.005 (.003)	.014++ (.002)
13. Rubber and plastic products	.001 (.001)	.024++ (.003)	.001 (.001)	.025++ (.003)	-.001 (.006)	.058++ (.005)

Note: annual data, period 1978-1995. White-consistent standard errors are reported in parentheses.
++ and + : significantly greater than zero, respectively, at the 5 and 10 percent level;
-- and - : significantly smaller than zero, respectively, at the 5 and 10 percent level.

Table 5

MARK-UP, BUSINESS CYCLE AND INDUSTRY CONCENTRATION

Equation (9):

$$dy_{it} = \overline{\mu} dx_{it} + \beta_1 dx_{it} ciclo_{it} + \beta_2 dx_{it} C4_{it} + \beta_3 dx_{it} ciclo_{it} C4_{it} + \beta_4 dx_{it} imp_{it} + (\gamma - 1) dK_{it} + \delta_{\vartheta i} + u_{it}$$

	Level of orders		Order expectations		Capacity utilization rate	
	SUR	3SLS	SUR	3SLS	SUR	3SLS
$\overline{\mu}$	1.180++	1.035	1.240++	.806--	1.197++	1.199
	(.011)	(.031)	(.023)	(.060)	(.033)	(.203)
β1	.001	.001++	-.001--	.003++	-.001	-.001
	(.001)	(.001)	(.001)	(.001)	(.001)	(.003)
β2	.318++	1.241++	.727++	3.493++	.773++	2.261++
	(.060)	(.111)	(.062)	(.117)	(.191)	(.721)
β3	-.003--	-.008--	-.007--	-.029--	-.010--	-.025--
	(.001)	(.001)	(.001)	(.001)	(.002)	(.010)
β4	-.058-	-.207--	.063++	-.317--	-.058--	-.214--
	(.031)	(.029)	(.022)	(.022)	(.023)	(.045)
γ	1.036++	.996	1.032++	.987--	1.040++	1.001
	(.003)	(.004)	(.003)	(.003)	(.002)	(.006)
μ (1)	1.18	1.16	1.17	1.16	1.19	1.17

Note: annual data, period 1982-1995. White-consistent standard errors are reported in parentheses.
++ and + : significantly greater than zero, respectively, at the 5 and 10 percent level; for $\overline{\mu}$ and γ: significantly greater than one, respectively, at the 5 and 10 percent level.
-- and - : significantly smaller than zero, respectively, at the 5 and 10 percent level; for $\overline{\mu}$ and γ: significantly smaller than one, respectively, at the 5 and 10 percent level.
(1) Calculated according to equation (8) using the estimated coefficients reported above and the average value of the respective regressors.

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