THE IMPACT OF FINANCING CONSTRAINTS ON MARKUPS: THEORY AND EVIDENCE FROM ITALIAN FIRM LEVEL DATA

by

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Abstract

In this paper we look at both the theoretical and empirical behavior of price-cost margins when capital market imperfections affect firms' markup policies. We present a model of a firm operating in an industry with differentiated products and facing imperfect markets for financing operations. The model results in an Euler equation for the optimal price path which is estimated using data for several hundreds Italian firms over the period 1981-1993. The empirical results suggest that: (i) capital market imperfections are present in the sense that firms in our sample pay a premium on external finance which significantly depends on the debt to sales ratio; (ii) according to our estimates constrained firms find it optimal to cut price compared to unconstrained firms; (iii) as firms are more likely to be financially constrained in recessions, our results imply that financial market imperfections tend to make markups procyclical.

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1. Introduction

How do capital market imperfections affect firms' markup policies? Do these imperfections tend to make markups procyclical or countercyclical? These are the two main issues we address in this paper.

The literature on the impact of financing constraints on firms' real decisions has received great impetus in recent years following the advances in the theory of information and incentives and the increased availability of panel data on individual firms. As well documented in Hubbard (1996), capital market imperfections are likely to play a role in all types of investment decisions taken by optimizing firms, namely investment in fixed capital, human capital, knowledge capital, and investment in inventories. One area of this literature that is still largely unexplored concerns the impact of financing constraints on another type of investment decision that forward-looking firms typically make, that is, investment in market shares by appropriately pricing their products.

Most theoretical papers on this subject rely on models of customer markets (Greenwald, Stiglitz, and Weiss, 1984; Bils, 1989; Gottfries, 1991) and/or markets with consumer switching costs (Klemperer, 1987, 1995; Chevalier and Scharfstein, 1995, 1996). These models study imperfectly competitive firms which compete for a customer base that changes slowly over time as customers purchase a good repeatedly and only occasionally compare prices. In this case firms charge a low price for their product to attract new customers as a larger customer base tomorrow implies higher profits in the future. They therefore price below the single period profit maximizing level. A refinement of these models is the case in which customers face a fixed cost of switching to a different supplier. In any period firms trade off the benefits from charging a low price to attract first time buyers with the costs of not charging a high price to locked-in customers. Also here firms charge a price below the single period level to build a base of locked-in customers.

The story just described generally applies to firms that are not liquidity constrained and/or not in a recessionary period. In fact, when a firm is cash constrained or faces an increasing cost of external debt, it will cut investment in market share and customer base and charge a high price in order to generate cash for debt service, thereby foregoing future profits. In summary, the firm's intertemporal pricing strategy previously described is disrupted by the presence of financing constraints.

Another aspect that has attracted the attention of economists trying to build models able to explain the empirical regularity of procyclical factor prices is the behavior of price-cost margins. In particular, if markups are countercyclical, this could explain why the increase in output that follows a positive demand shock is generally accompanied by an increase in the real wage. There are a few alternative explanations for countercyclical markups (see Galeotti and Schiantarelli, 1994, and Sembenelli, 1996): among them, one explanation stresses the impact of capital market imperfections on firms' pricing strategies (Greenwald, Stiglitz, and Weiss, 1984; Chevalier and Scharfstein, 1995, 1996). As argued above, firms under the threat of liquidation are less likely to set low prices in product differentiated industries in order to gain market shares. Since it is in recessionary periods that firms may find it more difficult to raise external funds because the value of collateral is low, they will have a greater incentive to raise price and increase current cash flow in order to meet their liabilities and to finance operations.

The empirical evidence bearing upon the impact of financing costraints on the firm's pricing strategies and the cyclicality of markups is scant and appears to be mostly, if not exclusively, based upon the predictions of models of customer markets. According to this theory, we should expect prices to be affected by financial variables, especially for firms that are thought to be constrained and in periods of low demand. Thus, the data should support the existence of a positive correlation between price and debt. Indeed, this is what emerges from the existing empirical evidence in Chevalier and Scharfstein (1995, 1996), Chevalier (1995), and Phillips (1995). In addition, these studies find that leveraged firms during recessionary periods tend to raise price markups (Chevalier and Scharfstein, 1995, 1996).

Despite the evidence supporting the existence of a link between capital market imperfections and markups in product markets with consumer switching costs, there are a few issues that are still unresolved. Firstly, as noted by Chevalier and Scharfstein

(1996), it is difficult to draw macro-economic inferences from empirical papers where very specific models are applied to very specific industries.[1] Secondly, there might be other, and perhaps more important, channels through which capital market imperfections affect firms' pricing decisions. Indeed, Hendel (1996) presents a theoretical model where financially constrained firms tend to reduce prices in bad times in order to raise cash at the expense of inventories. His model produces opposite predictions relative to the theoretical models discussed above, as we should expect procyclical markups, at least in inventory-intensive firms.[2] Thirdly, and more generally, the idea that financially constrained firms tend to raise prices in recessions does not appear to square well with the common wisdom, widely accepted among business people, that troublesome firms in a downturn cut prices in order to generate cash.

Our paper represents a new addition to this relatively unexplored literature both theoretically and empirically. By modeling the optimal price decision of a firm which operates in an industry with differentiated product and faces imperfect capital markets, we provide an alternative channel through which financing constraints can affect firms' markup policies. The basic idea is that firms may find it rational to cut price today in order to increase sales beyond the single period profit maximizing level if this allows them to face a relatively lower cost of debt tomorrow. This happens to be the case if the premium on external finance that banks are expected to set tomorrow is inversely correlated with firms' today sales.[3] This represents an alternative explanation of the relationship between capital market imperfections and firms' pricing and markup decisions. On the empirical side, we present fresh econometric evidence bearing on the effects of capital market imperfections on firms' pricing policies by estimating a dynamic structural markup equation for a large sample of Italian firms operating in

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[1] Chevalier (1995) and Chevalier and Scharfstein (1996) study the pricing behavior of supermarket chains after they undertook LBOs in the late 80s and during the most recent recession. Phillips (1995) look at five industries in which a high number of firms were involved in LBOs. Chevalier and Scharfstein (1995) look instead at two-digit manufacturing industries.

[2] Hendel (1996)'s model predicts procyclical prices as well as procyclical inventories for constrained firms. In his model firms hold two types of assets: liquid (cash) to pay back debt and non-liquid (inventories) to satisfy demand. In a recession firms in financial trouble face a trade-off between maximizing current profits and securing survival. They will tend to deviate from one period profit maximization by cutting inventories and reducing prices in order to generate the liquid assets needed to service their debt.

industries with differentiated product. To this end we use a newly developed panel dataset.

We are well aware of recent criticism raised, among others, by Bresnahan (1989) concerning the problems associated with comparisons of competition among firms operating in different industries. However, following Sutton (1991), we minimize these problems not only by estimating the model only for those firms for which the embodied assumptions are plausible, i.e. firms operating in product differentiated industries, but also by checking the robustness of our conclusions with respect to different firms' strategic behavior.

The remainder of the paper is organized as follows. In Section 2 the optimal intertemporal price strategy of a firm producing a differentiated product is modelled. In choosing a price path, the firm faces both adjustment costs for output and imperfections in the capital market. Also, in order to incorporate oligopolistic interactions in the model, both the direct and the strategic effect of price decisions on output levels are taken into account. Section 3 discusses in details the implications that can be drawn from the model concerning the impact of capital market imperfections on firms' markup policies. For given demand conditions, the crucial parameter turns out to be the degree of tightness of product competition. The economic intuition behind this result is straightforward. Since becoming larger is a way for firms to lessen financing constraints, a monopolistic firm has an obvious incentive to reduce the output price below the unconstrained optimal level in order to raise sales. In oligopoly, however, the direct effect of a price reduction must be compared and contrasted with the strategic effect due to rivals' behavior. In particular, if rival firms do not match the reduction in price, the incentive to cut price for firms facing imperfections in capital markets becomes larger compared to the monopoly case. On the contrary, if rival firms react through a price war, the predictions made for the monopoly case might even be reversed. In Section 4 the characteristics of the dataset used in the empirical investigation are highlighted and the relevant descriptive statistics are commented upon. Section 5 presents the econometric estimates of the model. The main results can be

[3] Obviously, this assumption is consistent with the empirical regularity of a lower the cost of debt for large firms relative to small ones.

summarized as follows. Firstly, capital market imperfections are present in the sense that the firms in our sample pay a premium on external finance which significantly depends on the debt to sales ratio. Secondly, according to our estimates constrained firms find it optimal to cut their price compared to unconstrained firms. This evidence corroborates the empirical findings of other papers which typically refer to the U.S. experience (Chevalier and Scharfstein, 1995, 1996; Chevalier, 1995; Phillips, 1995). Thirdly, as firms are more likely to be financially constrained in recessions, our results imply that financial market imperfections tend to make markups procyclical. Interestingly, this result runs contrary to the predictions of customer markets/switching costs models and is instead in agreement with the predictions of the theoretical model by Hendel (1996). Finally, Section 6 concludes the paper.

2. The Model

We model the optimal price decision of a firm producing a differentiated good based upon the assumption of profit maximizing behavior. The firm operates in an imperfectly competitive market for her product and the price is used as a strategic variable. Moreover, the firm faces imperfect capital markets for the funds needed to finance her operations.

The existence of differentiated products leads to equilibrium prices which are higher than the corresponding marginal costs, thus generating positive price-cost margins. We assume that changing production levels is a costly activity for two reasons. Firstly, given capacity, using more variable inputs entails additional expenses: this fact is captured by the usual cost function that depends upon variable factor prices as well as the amount of output. Secondly, enlarging the productive capacity entails costs associated with changing the amounts of quasi-fixed inputs such as capital. These adjustment costs are usually taken to be increasing at the margin. Since the focus of this paper is on prices and markups, we take the decisions concerning quasi-fixed factors as predetermined. We then introduce an adjustment cost function which depends upon the rate of change of production as a shortcut for input adjustment costs. We borrow this approach from the literature on finished goods inventories and the production smoothing motive (Ramey, 1991; Galeotti, Guiso, Sack, and Schiantarelli, 1996, among others).

Because of capital markets imperfections, we assume that the cost of external funds is higher than that of internally generated funds. We model this aspect through an increasing cost function of external debt (see, for instance, Bond and Meghir, 1994). Debt is taken to be primarily given by bank credit, the major source of both short and long term financing for Italian firms. In addition, we will assume that the firm does not raise funds through equity issues, another assumption which is quite plausible for the Italian case over our sample period.

The firm's demand for her product can be represented as follows:

$$q_t = D(p_t, v_t) \tag{1}$$

where q is the quantity of output produced and p is the corresponding price while the variable v represents demand shifters which include the price of rivals' product.

The firm chooses price and debt policies in order to maximize the following objective:

$$E_t \sum_{s=t}^{\infty} \beta_{t,s} \Big\{ (1-\tau_s)\big[p_s D(p_s, v_s) - c\big(w_s, D(p_s, v_s)\big) - h\big(D(p_s, v_s), D(p_{s-1}, v_{s-1})\big) \\ - i\big(b_{s-1}, p_{s-1} D(p_{s-1}, v_{s-1})\big) b_{s-1} \big] + (b_s - b_{s-1}) \Big\} \tag{2}$$

where E_t is the expectation operator, $\beta_{t,s}$ is the discount factor between periods t and s, τ is the corporate income tax rate, $c(.)$ is the firm's minimum variable cost function which depends, besides output, upon the price (vector) of variable inputs w, $h(.)$ is the adjustment cost function for output, and $i(.)$ is the cost of external debt function which depends upon the value of production and upon the (end of period) stock of outstanding debt b.

Note that the product $i(.)b$ is equal to the amount of interest payments due on external funds. We presume that, because of the existence of imperfect capital markets, the interest rate depends positively upon the end of period debt-to-size ratio. In the present framework it is natural to proxy size with the amount of sales, so that the debt-to-output ratio is our measure of leverage (see also Faini and De Melo, 1990). We therefore presume, ceteris paribus, that the cost of external funds is lower the higher revenues are. As for output production, we assume that the cost of adjusting production levels is increasing and convex in the rate of change of output, i.e. increasing in today's production but negatively related to yesterday's output level. Finally, as usual, variable costs are increasing both in output and in input prices.

Let us first consider the optimality condition for debt which is:

$$1 - E_t \beta_{t,t+1} \left\{ 1 + \left(1 - \tau_{t+1}\right) \left[i_{t+1} + \frac{\partial i(t+1)}{\partial b_t} b_t \right] \right\} = 0 \tag{3}$$

This equation is an arbitrage condition which yields an interior solution for debt. The optimal stock of debt is given by the level at which the after tax rate of return on assets equals the interest rate on debt.[4] This equality holds in expectation for all periods from t onwards.[5]

The optimality condition for the price control is quite a lengthy expression, which can be simplified by first introducing the following variable:

$$\mu_t = \frac{\partial D(t)}{\partial p_t} + \frac{\partial D(t)}{\partial v_t} \frac{\partial v_t}{\partial p_t} \tag{4}$$

Let v_t represent the vector of the prices charged by the other firms in the industry. The variable μ_t summarizes the impact of a price change on our firm's production level and is given by the sum of two terms: the first is the direct effect, while the second one is the strategic effect. While the former effect is always negative, we take the latter to be positive. This assumption implies that consumers view the products in the industry as substitutes (so that $\partial D(t) / \partial v_t > 0$) and that firms in the industry treat prices as strategic

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[4] The discount rate in (3) is equal to $\beta_{t,t+1} = (1 + r_{t+1})^{-1}$, where r is the (exogenously given) before tax nominal rate of return on firm's assets.

[5] Although assumed to hold for the current and all future periods, the optimality condition (3) will not be exploited in the econometric analysis below.

complements (so that $\partial v(t)/\partial p_t > 0$). The optimality condition for the firm's output price is then given by the following Euler equation:

$$\left(1-\tau_t\right)\left\{q(t)+\mu_t\left[p_t-\frac{\partial c(t)}{\partial q_t}-\frac{\partial h(t)}{\partial q_t}\right]\right\} \tag{5}$$
$$-E_t\beta_{t,t+1}\left(1-\tau_{t+1}\right)\left\{\mu_t\frac{\partial h(t+1)}{\partial q_t}+\frac{\partial i(t+1)}{\partial\left(p_t q_t\right)}\left[q(t)+\mu_t p_t\right]b_t\right\}=0$$

Equation (5) states that along the optimal path marginal benefits and marginal costs of changing the output price must offset each other. First of all, note that a price change affects the firm's production level via the product demand as given in (1). We allow for strategic considerations in that the firm's price affects demand also via the impact upon the rivals' price (see (4)). According to (5) costs include the marginal production cost and the marginal cost of adjusting output today triggered by a price change; benefits comprise marginal revenue, the saving in adjustment cost due to not having to adjust output tomorrow, and the lower interest payments due to spreading a given amount of debt on a larger firm's size (recall that this effect is negative). Let us now define the following variable:

$$\lambda_t=\left(\frac{\partial D(t)}{\partial v_t}\frac{\partial v_t}{\partial p_t}\right)\Big/\frac{\partial D(t)}{\partial p_t} \tag{6}$$

In view of the assumptions made about the components of (4) λ_t is non positive.[6] In the case of a monopolistic firm $\lambda_t=0$. More generally the size of λ_t will depend on the size of the strategic effect compared to that of the direct effect, the former depending in turn on the degree of product differentiation, measured by $\partial D(t)/\partial v_t$, and on the tightness of price competition, measured by $\partial v_t/\partial p_t$.

[6] Clearly, μ in (4) and λ in (6) are related, as $\mu_t=(1+\lambda_t)(\partial D(t)/\partial p_t)$.

Divide now equation (5) by p_t and by $\partial D(t)/\partial p_t$ to obtain the following condition that describes the optimal price path:

$$\left(1-\tau_t\right)\left\{\frac{q(t)}{p_t}\frac{\partial p_t}{\partial D_t}+\left(1+\lambda_t\right)-\frac{\partial c(t)}{\partial q_t}\frac{1}{p_t}\left(1+\lambda_t\right)-\frac{\partial h(t)}{\partial q_t}\frac{1}{p_t}\left(1+\lambda_t\right)\right\} \tag{7}$$
$$-E_t\beta_{t,t+1}\left(1-\tau_{t+1}\right)\left\{\frac{\partial h(t+1)}{\partial q_t}\frac{1}{p_t}\left(1+\lambda_t\right)+\frac{\partial \tilde{\imath}(t+1)}{\partial\left(p_t q_t\right)}\left[\frac{q(t)}{p_t}\frac{\partial p_t}{\partial D_t}+\left(1+\lambda_t\right)\right]b_t\right\}=0$$

Now let $(\partial p_t / \partial D_t)(q_t / p_t) = \varepsilon_t$ be the inverse of the direct effect price elasticity and let marginal cost be given by $\partial c(t)/\partial q_t = \eta_t (c_t / q_t)$, where η_t denotes the cost elasticity of output, the reciprocal of the scale elasticity. Using these definitions and dividing equation (7) by $\left(1-\tau_t\right)$ we obtain:

$$\varepsilon_t+\left(1+\lambda_t\right)-\eta_t\frac{c_t}{q_t}\frac{1}{p_t}\left(1+\lambda_t\right)-\frac{\partial h(t)}{\partial q_t}\frac{1}{p_t}\left(1+\lambda_t\right) \tag{8}$$
$$-E_t\beta_{t,t+1}\frac{\left(1-\tau_{t+1}\right)}{\left(1-\tau_t\right)}\left\{\frac{\partial h(t+1)}{\partial q_t}\frac{1}{p_t}\left(1+\lambda_t\right)+\frac{\partial \tilde{\imath}(t+1)}{\partial\left(p_t q_t\right)}\left[\varepsilon_t+\left(1+\lambda_t\right)\right]b_t\right\}=0$$

Observe now that the second and third terms of equation (8) can be rewritten as follows:

$$\left(1+\lambda_t\right)\left(\frac{p_t q_t - c_t}{p_t q_t}\right)+\left(1+\lambda_t\right)\left(1-\eta_t\right)\frac{c_t}{p_t q_t}=\left(1+\lambda_t\right)\left[PCM_t+\left(1-\eta_t\right)\frac{c_t}{p_t q_t}\right] \tag{9}$$

where PCM_t is the firm's price-cost margin. Substitute (9) into (8) and divide throughout by $(1+\lambda_t)$ to finally obtain the following expression for the firm's price-cost margin:

$$PCM_t = (\eta_t - 1)\frac{c_t}{p_t q_t} - \frac{\varepsilon_t}{(1+\lambda_t)} + \frac{\partial h(t)}{\partial q_t}\frac{1}{p_t} \tag{10}$$

$$+\rho_{t+1}\left[\frac{\partial h(t+1)}{\partial q_t}\frac{1}{p_t}\right] + \rho_{t+1}\left\{\frac{\partial i(t+1)}{\partial (p_t q_t)}\left[\frac{\varepsilon_t}{(1+\lambda_t)}+1\right]b_t\right\} + v_{t+1}$$

In writing down equation (10) we have replaced expected values with realizations, thereby introducing a forecast error v_{t+1} which is by assumption orthogonal to the agent's information set and have defined $\rho_{t+1} = E_t \beta_{t,t+1}(1-\tau_{t+1})/(1-\tau_t)$ as the after tax discount rate between *t* and *t+1*.

In order to make the Euler equation (10) for the firm's price operational we need to parametrize the adjustment cost and the external debt functions respectively. To this end we posit the following simple functional forms:

$$h(\cdot) = \frac{\alpha_1}{2}\left(\frac{q_t - q_{t-1}}{q_{t-1}}\right)^2 q_{t-1} \tag{11}$$

$$i(\cdot) = \alpha_2 + \alpha_3\left(\frac{b_{t-1}}{p_{t-1}q_{t-1}}\right) \tag{12}$$

Using (11) and (12) into (10) we obtain:

$$PCM_t = (\eta_t - 1)\frac{c_t}{p_t q_t} - \frac{\varepsilon_t}{1+\lambda_t} + \alpha_1\left[\frac{q_t - q_{t-1}}{p_t q_{t-1}} - 0.5\rho_{t+1}\frac{q_{t+1}{}^2 - q_t{}^2}{p_t q_t^2}\right] \tag{13}$$

$$-\alpha_3\left[\rho_{t+1}\left(\frac{b_t}{p_t q_t}\right)^2\left(\frac{\varepsilon_t}{1+\lambda_t}+1\right)\right] + v_{t+1}$$

After some straightforward algebra and assuming that η_t, ε_t and λ_t are both time and firm invariant, we can rewrite equation (13) as follows:

$$\overline{PCM_t} = \gamma_1 + \gamma_2\left[\frac{q_t - q_{t-1}}{p_t q_{t-1}} - 0.5\rho_{t+1}\frac{q_{t+1}{}^2 - q_t{}^2}{p_t q_t^2}\right] + \gamma_3\rho_{t+1}\left(\frac{b_t}{p_t q_t}\right)^2 + v_{t+1} \tag{14}$$

where $\overline{PCM_t} = (p_t q_t - \eta c_t) / p_t q_t$ and where, relative to (13), we have: $\gamma_1 = -\varepsilon/(1+\lambda)$, $\gamma_2 = \alpha_1$, and $\gamma_3 = -\alpha_3\left[1+\varepsilon/(1+\lambda)\right]$. In equation (14) the dependent variable is modified in order to allow for the existence of variable returns to scale. Among other things, this specification improves the quality of our accounting measure of PCM as a proxy for the ratio of price to marginal costs. In fact, when returns to scale are decreasing (η>1) marginal costs are higher than total average costs c_t , while the opposite occurs when returns to scale are increasing (η<1).

In estimating (14) we expect γ_1 to be negative and γ_2 to be positive. In particular, the last regressor of the equation measures the impact of imperfect capital markets on the firm's markup. The sign of γ_3 is not univocally defined and is discussed in the next section. Finally, since the true value of η is unknown, we will check the robustness of our findings with respect to alternative plausible values for the cost elasticity.

3. Capital Market Imperfections and Firms' Markup Decisions

From equation (13) it appears that the impact of capital market imperfections on markup decisions depends crucially upon the sign of the following partial derivative:

$$\frac{\partial PCM_t}{\partial \alpha_3} = -\rho_{t+1}\left(\frac{b_t}{p_t q_t}\right)^2\left(\frac{\varepsilon_t}{1+\lambda_t}+1\right) \tag{15}$$

In particular, following an increase in the premium on external finance parametrized here by α_3, firms will have an incentive to cut prices if

$$\lambda_t > |\varepsilon_t| - 1 \tag{16}$$

Obviously, if the inequality is reverse, firms will instead react to an increase in financial constraints by raising prices.

To make things simple, let us start from the benchmark case of a monopolisitc firm, where λ_t is equal to zero. Since ε_t is bounded between zero and one in absolute value, condition (16) always holds and consequently expression (15) is univocally signed and it is negative. This implies that monopolistic firms find it optimal to respond to an increase in the tightness of financing constraints by lowering the markup. Also, the more elastic market demand is, the bigger is the price cut, following a given increase in the premium on external finance, α_3. The intuition behind this result is simple: if financial market imperfections become more important, firms will cut prices to increase sales. The incentive to do so is higher when demand is elastic since in this case total sales are more sensitive to a price reduction.

Things become more complicated when we relax the assumption of a monopoly market structure and allow firms to compete in an oligopolisitic setting. In fact, in this case the strategic effect of a price change is not zero and it depends both on the degree of product differentiation and the tightness of price competition (see (6)). This can be easily understood if we rewrite condition (16) as follows:

$$\frac{1}{|\varepsilon_t|} - \omega_t \theta_t > 1 \qquad (17)$$

where ω_t denotes the cross-price elasticity of demand, $(\partial D_t / \partial v_t)(v_t / q_t)$, and where θ_t denotes the conjectural elasticity, $(\partial v_t / \partial p_t)(p_t / v_t)$. Condition (17) has a straightforward economic interpretation: for given values of the parameters defining the demand conditions in the industry, ε_t e ω_t, the incentive to cut prices in order to increase sales becomes weaker the more aggressive price competition gets. Also, in some circumstances the negative strategic effect can more than offset the positive direct effect of a price cut on sales and consequently inequality (17) may not hold.[7] For instance, this happens to be the case if a price war follows the decision of financing constrained firms to cut prices.

Summarizing, our model suggests that firms facing imperfections in capital markets have a natural tendency to cut their output price in order to reduce the premium on the cost of external finance. This effect is stronger, the more elastic market demand

[7] Formally inequality (17) holds only if $\theta_t < \left(1 - |\varepsilon_t|\right) \big/ \left(|\varepsilon_t| \omega_t\right)$.

is, the more products in the industry are differentiated, and the softer is rivals' behavior. However, if rivals react very aggressively to price reductions, our overall conclusions may not hold and financially constrained firms might find it rational to raise their price. It is then an empirical matter to discriminate between these alternative hypotheses. This is the issue to which we now turn.

4. Data Description

The dataset used in the econometric analysis below is based on an unbalanced panel constructed by CERIS-CNR by merging balance sheet data collected by Mediobanca, a large investment bank, with industry level data provided by ISTAT, the Italian Central Statistical Office. In its latest version, the panel includes some 1,318 manufacturing firms with no less than five consecutive observations over the 1977-1993 period. The total number of firm-year observations is equal to 11,127.[8]

For our empirical analysis we have extracted observations relative to privately-owned firms producing differentiated products, thus obtaining a smaller sample of 5,110 firm-year observations relative to 599 companies. Table 1 provides a description of the unbalanced structure of the sample. Even if the database covers the 1977-1993 period, the estimation period is 1981-1993, since four cross sections are lost in constructing lags and taking first differences.

In order to identify firms operating in industries with product differentiation, the methodology developed by Davies and Lyons (1996) has been adopted. In particular, firms are supposed to produce differentiated goods if the main industry in which they operate is advertising intensive or R&D intensive, or both. The term "intensive" refers here to advertising-to-sales or R&D-to-sales ratios higher than 1%. This definition is based on the observation that in most cases, (both horizontal and vertical) product

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[8] The documentation concerning the characteristics of the dataset is contained in an appendix available from the authors upon request (see Margon, Sembenelli, and Vannoni, 1995). The industries with product differentiation are listed in that appendix and also in Davies and Lyons (1996). The after tax nominal discount rate used in estimation is based on the yield of 12 month Treasury Bills (BOT) plus a 3% constant risk premium and on the statutory rates of company income taxes at both regional (ILOR) and national (IRPEG) levels.

differentiation is neither intrinsic to the product nor obtainable by simple design without any major investment. More often, product differentiation is a costly activity, requiring investments in R&D or advertising.[9]

Since our analysis also focuses on the impact of financing constraints on the behavior of the markups over the cycle, we have referred to the detrended industrial production series calculated by Schlitzer (1993) as the indicator of the general business cycle. Accordingly, 1977, 1980-1982, 1989-1993 are defined as recessionary years, while 1978-1979 and 1983-1988 are considered expansionary periods. This classification is rather robust to the use of alternative indicators of demand, like GDP or industry specific indicators.

In Table 2, we report descriptive statistics for the main variables used in the empirical analysis over both the full period (1977-1993) and the estimation period (1981-1993). The same statistics are also provided separately for recessionary and expansionary periods. In what follows we offer a few comments pertaining to the estimation period. However, very similar considerations hold for the statistics computed over the full sample.

The price-cost margin, PCM hereafter, has been calculated as the ratio of operating profits to sales, operating profits being given by the difference between value added and labour costs. This variable has been adopted as the accounting proxy for the ratio of price to marginal cost.[10] PCM is lower during recessions than during expansions and this fact provides support to the idea of procyclical behavior of markups. The same pattern is found for the average value of EMPLOYEES, whereas financial LEVERAGE, defined as the ratio of total financial debt to sales, is higher in recessions than in expansions. As can be seen from the statistics on SALES and DEBT, the countercyclical behavior of LEVERAGE depends more upon the procyclical behavior of SALES than upon the procyclical behavior of DEBT. Incidentally, this is what one

[9] This opens up the possibility that financially constrained firms in product differentiated industries cut on R&D and advertising activities in bad times. Unfortunately, at the present stage data limitations prevent us from pursuing this line of research.

[10] However, there exists a growing body of applied papers which obtain the markup over marginal cost as a parameter or a combination of parameters from the econometric estimation of structural models (see, among others, Galeotti and Schiantarelli, 1994; Sembenelli, 1996; and the references therein).

would expect if capital market imperfections were likely to be more important in bad times.

We are aware that the debt to sales ratio departs from the standard measure of financial leverage, computed as the ratio of the market value of debt to the market value of debt plus equity. However, since data on market values are not available, we tried to minimize potential biases involved in the measurement of firm's total assets from accounting data, by choosing a relatively non-controversial variable.

5. Empirical Results

Equation (14) has been estimated for the sample of 599 firms producing differentiated goods described in the previous section. The estimation technique used is the Generalized Method of Moments (GMM) discussed in Arellano and Bond (1991). Given the dynamic nature of our model and the endogenous nature of regressors, this estimation method allows to obtain consistent estimates of the coefficients by using appropriate lags of regressors as instruments. In all estimated equations, the error term is modelled as the sum of a firm specific effect and a white noise idiosyncratic shock. To deal with firm specific effects we estimate the model in first differences, thereby introducing first order autocorrelation in the error term. As the validity of instruments depends upon the absence of autocorrelation and differencing introduces first order correlation, valid instruments are dated t-2 or earlier. Appropriate tests for first and second order residual autocorrelation (m_1 and m_2) are reported in the tables. Moreover, we also report the Sargan test on the correlation of instruments with the error term. Finally, Wald tests for the joint significance of regressors (W_1) are reported.

In the first column of Table 3 the results obtained from estimating equation (14) under the assumption of constant returns to scale (η=1) are presented. The Sargan test does not point to any misspecification of the model. As expected, the m_1 statistic suggests the presence of first order autocorrelation, while the m_2 statistic leads us to reject the hypothesis of second order autocorrelation, in line with the assumed stochastic structure of the disturbances. Moreover, all coefficients are significantly different from zero. In particular, the coefficient of the adjustment cost function $\alpha_1=\gamma_2$ is positive as predicted by the theory and statistically significant. We note that this fact holds true for all the estimated equations presented in this paper.

By taking the ratio $\gamma_3 / (\gamma_1 - 1)$ we can recover the point estimate of α_3 which is equal to 0.050. The fact that this coefficient is positive and significant implies that firms are paying a positive premium on external funds due to the existence of imperfect capital markets. As it has already been discussed in Section 4, the impact of capital market imperfections on markup decisions depends upon the sign of the derivative in (15): if it is negative, then capital market imperfections induce firms to lower markups (by cutting the output price) in order to mitigate agency problems. By replacing $\varepsilon/(1+\lambda)$ with $-\gamma_1$ in (15) it can be easily seen that this is indeed the case: firms have an incentive to cut price in order to boost their sales and in turn to lessen financing constraints. In order to understand the relative importance of the direct as opposed to the strategic price effect on output, we should be able to measure separately ε and λ. Unfortunately, since the model is underidentified, we cannot disentangle the two effects. What we can say is that, given demand conditions, firms are not competing too aggressively, so that it is rational for the firm to reduce her price, and hence the markup, as financing constraints become more severe.

One potential limitation of the results presented in the first column of Table 3 is that all parameters are assumed to be constant over time. Since the literature suggests that financing constraints may vary over the cycle, we have reestimated equation (14) by allowing the parameters to differ across expansions and recessions (Bernanke, Gertler, and Gilchrist, 1996). To this end we have used a dummy variable taking on the value one in expansionary years and zero otherwise.[11] Results are reported in the second column of Table 3. They imply a coefficient α_3 equal to 0.059 during recessionary periods and to 0.053 in expansionary ones. Although point estimates suggest that financing constraints are slightly more severe during recessions, the hypothesis that the two coefficients are equal cannot be rejected at conventional statistical levels.[12]

[11] See Section 4 for the precise definition.

[12] An even less restrictive approach would be to allow the coefficients to be estimated separately for each year. When we do this, even if the relevant parameters are not always precisely estimated, we find that

The results presented in Table 3 have been obtained under the assumption of constant returns to scale. This hypothesis has been introduced by imposing $\eta=1$ in equation (13), where η represents the reciprocal of the scale elasticity. In order to check the robustness of our findings with respect to different hypotheses concerning the degree of scale returns, we have reestimated the model assuming different plausible values for the parameter η. In Table 4 estimates of equation (13) are reported under two alternative assumptions, namely $\eta=1.1$ (decreasing returns to scale) and $\eta=0.9$ (increasing returns to scale). Both estimates confirm previous results on the existence of capital markets imperfections and their effects on firms' markup policies.[13]

One controversial aspect of results commented upon so far is that the parameter of the agency cost function, α_3, does not seem to depend on general macro-economic conditions. To shed further light on this issue we have followed an approach which is very common in the literature on financing constraints. This approach consists in splitting the sample according to firm specific variables proxying for the extent of agency problems and testing the model on each sub-sample. We experimented different sample splits.[14] The most interesting results have been obtained by using the firm's financial position at the beginning of each time period as sample splitting criterion. Accordingly, for each year we have calculated mean values across firms of the debt to sales ratio and we have constructed a firm-year specific dummy which is equal to one (resp. zero) if the debt to sales ratio is higher (resp. lower) than the yearly average across firms. This implies introducing a non-linearity in the agency cost function, where the α_3 parameter is allowed to take two different values depending on whether the firm's financial position is above (resp. below) a time-dependent threshold.

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the overall results confirm the main findings just presented. We do not report these results for reason of space.

[13] This result holds even for more extreme departures from the constant returns to scale assumption.

[14] The applied literature on financing constraints has often adopted firm size as a sample splitting criterion. The idea is that size helps mitigating agency problems as small firms are more likely to have a lower collateral relative to liabilities than large firms (see the discussion in Schiantarelli, 1996). When we distinguish between small and large firms on the basis of employment, we find that both types of firms pay a premium on external funds. However, we cannot reject the hypothesis that the two coefficients α_3 are equal at conventional levels. Similar difficulties are encountered in the case of investment when splitting the data according to size (see Devereux and Schiantarelli, 1990; Galeotti, Schiantarelli, and Jaramillo, 1993; Rondi, Sembenelli, and Zanetti, 1994).

The basic results are presented in the first column of Table 5. The point estimates of α_3 are 0.087 and 0.055 for high and low leveraged firms respectively. Moreover, the two coefficients are statistically different at conventional statistical levels. Thus, this result suggests that the agency cost function is non-linear, as not only the premium on external finance but also α_3 depend on firm's debt to sales ratio. However, this happens to hold only in expansionary periods. In fact, as the second column of Table 5 shows, when we allow the coefficients to depend both on the firm's financial position (high/low leverage) and on general macro-economic conditions (expansions/recessions), the implied point estimates of α_3 show that in recessionary periods the two parameters are not significantly different from each other (0.085 for high leveraged firms and 0.077 for low leveraged firms) whereas they are different and significantly so in expansionsionary periods (0.083 for high leveraged firms and 0.025 for low leveraged firms). These results suggest that, everything else equal, financial market imperfections are higher in bad times, since, at least for low leveraged firms, α_3 is found to be lower when the economy is buoyant. This implies that the countercyclical behavior of financing constraints induces a procyclical behavior of markups. This finding is in line with the predictions of the theoretical model by Hendel (1996) and contrary to the countercyclical explanation put forth by Chevalier and Scharfstein (1995, 1996).

6. Conclusions

In this paper we have investigated, both theoretically and empirically, the effects of capital markets imperfections on firms' markup policies and on their cyclical behavior. This is an important, yet still relatively unexplored area.

We have presented a model of a firm operating in an industry with differentiated products. The model results in an Euler equation describing the optimal intertemporal price strategy of the firm which faces imperfect capital markets and costs of changing output production levels. The wedge between the cost of external finance and internally generated funds driven by capital market imperfections has been modeled through an increasing cost function of external debt. In addition, we have taken into account the oligopolistic interaction among firms by considering both the direct and the strategic effects of price changes on output levels.

We have discussed the implications of the model as far as the impact of capital markets imperfections on markup policies is concerned: in particular, the model suggests that, for given demand conditions, the tightness of product competition is the crucial parameter. Whereas in monopoly the firm tends to cut her price (and lower markup) in order to relax financing constraints, in an oligopolistic setting the direct effect of a price reduction by the firm must be compared with the strategic effect due to rivals' behavior, after taking into account the degree of product differentiation. If rivals do not react or react softly to a price reduction, then firms have a greater incentive to reduce markups when financing constraints become more severe; on the contrary, if firms react aggressively the previous conclusions may even be reversed and firms may find it rational to raise prices.

The empirical results suggest that capital market imperfections are present in the sense that firms in our sample pay a premium on external finance which significantly depends on the debt to sales ratio; moreover, according to our estimates, it is optimal for constrained firms to cut their price compared to unconstrained firms. Furthermore, whereas the premium on external finance does not depend upon general macroeconomic conditions for high leveraged firms, we find that low leveraged firms pay an higher premium in recessions than in expansions. As a consequence our estimates show that firms are more likely to be financially constrained in recessions. Hence our results imply that financial market imperfections tend to make markups procyclical.

Finally, to get a more complete picture of the determinants of observed markup behavior, it would be informative to disentangle the role played by demand conditions and by the nature of competition in explaining the relationship between capital markets imperfections and markups. More generally , additional evidence is needed, possibly stemming from modeling jointly the pricing, output and inventory decisions of firms. These issues are next in our future research agenda.

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Table 1: Characteristics of the Sample

Years of observations	Number of firms
5	121
6	78
7	87
8	78
9	55
10	37
11	34
12	25
13	16
14	22
15	14
16	5
17	27
Total number of observations: 5110	Total number of firms: 599

Table 2: Sample Descriptive Statistics

(a) Full Sample: 1977-1993

Variable	Total Period	Recessions	Expansions
	5110 Observations	2618 Observations	2492 Observations
PCM	0.107	0.103	0.111
	(0.082)	(0.088)	(0.075)
EMPLOYEES	1134	1054	1217
	(4427)	(4613)	(4222)
SALES	169557	165388	173937
	(510716)	(416898)	(593571)
DEBT	34307	35191	33379
	(111620)	(103735)	(119357)
LEVERAGE	0.227	0.242	0.212
	(0.236)	(0.239)	(0.233)

(b) Estimation Sample: 1981-1993

Variable	Total Period	Recessions	Expansions
	2714 Observations	1549 Observations	1165 Observations
PCM	0.105	0.099	0.113
	(0.078)	(0.079)	(0.076)
EMPLOYEES	1076	866	1356
	(3299)	(1656.)	(4648)
SALES	207335	193054	226352
	(571820)	(381295)	(753982)
DEBT	37603	37767	37517
	(93647)	(63927)	(122535)
LEVERAGE	0.217	0.236	0.192
	(0.218)	(0.242)	(0.178)

Note to the table: Average values. Standard deviations in parenthesis.

Table 3: Estimates of the Markup Equation with Constant Returns to Scale and Cyclical effects- Total Sample.

Variable	Coefficient	Variable	Coefficient
γ_1	-0.0033	$\gamma_1$exp	-0.0017
	(0.0001)		(0.0003)
γ_2	0.0431	$\gamma_1$rec	-0.0045
	(0.0010)		(0.0003)
γ_3	-0.0502	$\gamma_2$exp	0.0937
	(0.0019)		(0.0014)
		$\gamma_2$rec	-0.0051
			(0.0031)
		$\gamma_3$exp	-0.0538
			(0.0031)
		$\gamma_3$rec	-0.0598
			(0.0034)
W_1	2621.2	W_1	5792.4
	(3)		(6)
Sargan	173.44	Sargan	159.41
	(167)		(156)
m_1	-4.093	m_1	-4.472
m_2	-1.208	m_2	-1.701

Notes to the table:
(i) Equation (14) in the main text. Dependent variable: PCM. (ii) Sample period: 1981-1993. Number of firms: 599. Number of observations: 2,714. (iii) Asymptotic robust standard errors and degrees of freedom in parenthesis. (iv) W_1 is a Wald Test of joint significance of the regressors, asymptotically distributed as χ^2. (v) Sargan is a test of correlation among instruments and residuals, asymptotically distributed as χ^2. (vi) m_1 is a test for first order autocorrelation asymptotically distributed as N(0,1). (vii) m_2 is a test for second order autocorrelation, asymptotically distributed as N(0,1). (viii) Instruments used are a constant and the two regressors of equation (14) in the text, both dated (t-3)and earlier.

Table 4: Estimates of the Markup Equation with Variable Returns to Scale - Total Sample

Decreasing Returns to Scale ($\eta = 1.1$)		Increasing Returns to Scale ($\eta = 0.9$)	
Variable	Coefficient	Variable	Coefficient
γ_1	-0.0032	γ_1	-0.0034
	(0.0001)		(0.0001)
γ_2	0.0518	γ_2	0.0344
	(0.0011)		(0.001)
γ_3	-0.0572	γ_3	-0.0437
	(0.0019)		(0.0018)
W_1	3210.9	W_1	2130.0
	(3)		(3)
Sargan	173.94	Sargan	173.54
	(167)		(167)
m_1	-4.089	m_1	-4.108
m_2	-1.210	m_2	-1.182

Notes to the table: See Table 3.

Table 5: Estimates of the Markup Equation with Constant Returns to Scale and Cyclical Effects High-Low Leveraged Firms

Variable	Coefficient	Variable	Coefficient
$\gamma_1$high	-0.009004 (0.000318)	$\gamma_1$high-rec	-0.008619 (0.000501)
$\gamma_1$low	0.000659 (0.000513)	$\gamma_1$high-exp	-0.010155 (0.000632)
$\gamma_2$high	0.005276 (0.002675)	$\gamma_1$low-rec	-0.003218 (0.000708)
$\gamma_2$low	0.099525 (0.002726)	$\gamma_1$low-exp	0.007073 (0.000978)
$\gamma_3$high	-0.087379 (0.003742)	$\gamma_2$high-rec	0.008713 (0.005702)
$\gamma_3$low	-0.054669 (0.005496)	$\gamma_2$high-exp	0.000109 (0.004408)
		$\gamma_2$low-rec	0.051159 (0.003017)
		$\gamma_2$low-exp	0.132671 (0.004913)
		$\gamma_3$high-rec	-0.084014 (0.004728)
		$\gamma_3$high-exp	-0.082122 (0.004463)
		$\gamma_3$low-rec	-0.076300 (0.014514)
		$\gamma_3$low-exp	-0.024904 (0.006811)
W_1	3462.12 (6)	W_1	3015.12 (12)
Sargan	157.53 (151)	Sargan	146.07 (145)
m_1	-5.001	m_1	-4.703
m_2	-0.378	m_2	-0.568

Notes to the table: see Table 3.

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