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CAPITAL MARKET IMPERFECTIONS AND COUNTERCYCLICAL MARKUPS: THEORY AND EVIDENCE

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ABSTRACT

During recessions, output prices tend to rise relative to wages and raw-materials prices. One explanation of this fact is that imperfectly competitive firms compete less aggressively during recessions - that is, markups of price over marginal cost are countercyclical. We present a model in which markups are countercyclical because of capital-market imperfections. During recessions, liquidity-constrained firms try to boost short-run profits by raising prices to cut their investments in market share. We provide evidence from the supermarket industry in support of this theory. We show that during regional and macroeconomic recessions, the most financially constrained supermarket chains tend to raise their prices relative to less financially constrained chains.

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1. Introduction

Simple models of business cycles based on aggregate demand shocks imply that during booms, factor prices should fall relative to output prices. This follows from the standard assumption that, at high output levels, marginal products are low. However, this implication is difficult to square with the facts. During booms, wages and raw-materials prices tend to rise relative to output prices — that is, real factor prices are procyclical.[1]

A number of papers have argued that imperfect competition can reconcile procyclical real factor prices with aggregate-demand-driven business cycles. These papers build on the old idea in Pigou [1927] and Keynes [1939] that increases in aggregate demand may have little effect on prices — and thus large effects on output — because firms behave more competitively during booms. As a result, output prices fall relative to marginal cost (i.e., markups fall) and real factor prices rise.

There are at least three distinct reasons why markups may be countercyclical. First, demand may become less elastic during recessions, allowing imperfectly competitive firms to increase markups.[2] Second, as argued by Rotemberg and Saloner (1986) and Rotemberg and Woodford (1991, 1992), markups may be countercyclical because firms are less able to collude during booms. When demand is high, firms have greater incentives to cut prices because the short-run profits from stealing market share are high relative to the long-run profits from collusion. Finally, Greenwald, Stiglitz and Weiss (1984), Gottfries (1991), and Klemperer (1992) have suggested that markups may be countercyclical because of capital-market imperfections. During a recession — when firms have low cash flow and greater difficulty raising external funds — they will try to boost current profits to meet their liabilities and finance investment. They may do so by increasing prices and foregoing attempts to build market share.

[1]See, for example, Barsky and Solon (1989) and Murphy, Shleifer and Vishny (1989).

[2]See, for example, Bils (1989), Klemperer (1993), Okun (1981), and Stiglitz (1984) for reasons why elasticities of demand may be procyclical.

Our goal is to analyze the link between capital-market imperfections and countercyclical markups and to test its empirical relevance. The starting point for our work is the large theoretical and empirical literature suggesting that information and incentive problems in the capital market can limit the ability of cash-constrained firms to make valuable investments.[3] We build on this literature by focusing on how liquidity constraints affect pricing behavior.[4] Just as capital market imperfections can prevent firms from choosing investment projects that maximize the discounted value of profits, they can also prevent firms from choosing *prices* that maximize the discounted value of profits.

In Section 2, we formalize the idea that liquidity constraints can affect pricing behavior. We start with a simple model of competition based on Klemperer's (1987a,b) model of markets with consumer "switching costs."[5] In this class of models, firms try to build market share by keeping prices down in the short run. Market share has value in this model because consumers find it costly to switch firms, and this gives firms market power over their repeat customers. This model by itself can predict procyclical or countercyclical markups depending on the nature of the demand shocks and the parameters of the model.

However, if firms are liquidity constrained and capital markets are imperfect, markups tend to be more countercyclical. We make this point by examining a model in which firms need to raise external funds to finance their operations. We model a particular type of incentive problem in which debt emerges as the optimal financial contract along the lines of Hart and Moore (1989) and Bolton and Scharfstein (1993). Since firms may default, they

[3]See, for example, Myers and Majluf (1984) Bernanke and Gertler (1989) for theoretical models along these lines and Fazzari, Hubbard and Petersen (1988) and Hoshi, Kashyap and Scharfstein (1991) for empirical evidence.

[4]Fudenberg and Tirole (1986) and Bolton and Scharfstein (1990) have also recognized that liquidity constraints can have product-market effects. Their point is that if firms invest less when they have less cash flow, rivals have an incentive to ensure that cash flows are low. At the extreme, cash constrained firms may completely disinvest (i.e. exit the market), so that this theory can help to explain predatory practices.

[5]See, also Farrell and Shapiro (1987) and Klemperer (1993) for a review of this approach.

have less incentive to build market share because they may not reap the benefits of the investment. During a recession, this effect is particularly strong because the probability of default is high. Thus, the model illustrates that capital market imperfections combined with a market-share model of product-market competition can explain countercyclical markups.

We then empirically analyze the effects of capital market imperfections on product-market competition in the supermarket industry. We study a single industry to avoid the problems associated with cross-industry comparisons of competition[6], a feature of existing studies of cyclical variation in markups. These difficulties also raise problems for the existing empirical studies of the movement of markups over the business cycle.[7] We study the supermarket industry in particular because firms compete in many local markets. This allows us to use price data for a cross-section and time-series while still examining a single industry.[8]

We present three pieces of evidence that suggest the importance of capital market imperfections in generating countercyclical markups. The first is from examining local price changes following the severe recession that occurred in the oil producing states as a result of the halving of oil prices in 1986. In some cities, national supermarket chains have large market shares, while in others, local and regional chains have a larger presence. We would expect the liquidity of the local and regional chains to be more adversely affected by the downturn since the national chains have operations in non-oil states that were experiencing high economic growth during this period. Thus, if there are capital market imperfections

[6]See Bresnahan (1989) for a discussion of the limitations of such studies.

[7]See, for example, Rotemberg and Saloner (1986), Rotemberg and Woodford (1991,1992) and Domowitz, Hubbard, and Petersen (1986).

[8]We are aware of one other study which estimates changes in markups in a single industry in local markets. Using the seasonal pattern of gasoline demand, Borenstein and Shephard (1993) find that markups in retail gasoline markets are higher when demand in the near future is expected to be high. They interpret these results as consistent with models of tacit collusion such as Rotemberg and Saloner (1986). Since we would not expect liquidity to vary over the predictable seasonal demand cycle, this evidence does not bear on the question of how liquidity affects markups.

and firms price for market share, we would expect prices to fall by less (or rise more) in cities where local and regional chains have a large presence. Indeed, they do.

The second piece of evidence comes from examining the local price responses to the most recent macroeconomic recession of 1990-91. During the latter half of the 1980s many supermarket chains undertook leveraged buyouts (LBOs), thereby increasing their debt ratios dramatically. We would expect these firms to be more liquidity constrained in response to an adverse shock and to cut prices less (or raise them more) in a downturn. This also seems to be the case, particularly in cities that did very poorly in the recession.

The third piece of evidence is from an examination of firm-level pricing in the period following the macroeconomic recession of 1990-1991. We would expect that LBO firms would cut prices less than their less leveraged rivals in cities which continue to perform poorly following the recession. We would also expect firms to cut prices less in poorly-performing cities if their rivals are highly leveraged. We find evidence for both of these effects.

The empirical results are consistent with our model of product-market competition in which firms price for market share and in which liquidity constraints affect pricing behavior. The results are inconsistent with the Rotemberg and Saloner (1986) and Rotemberg and Woodford (1991, 1992) tacit-collusion models of countercyclical markups. As discussed above, these models predict that in booms there is a greater temptation to deviate from the collusive outcome by cutting prices and thereby increasing short-run profits. However, adding liquidity constraints to their model tends to reverse the prediction of countercyclical markups. If firms are more liquidity constrained in recessions, then they will be *more* tempted to cheat on the collusive arrangement because they need to increase short-run profits. Thus, their model predicts that prices should fall *more* in busts in markets where firms are most cash constrained. By contrast, we find that prices fall *less*.

Although our principal focus is on countercyclical markups, the paper adds support to recent work on the link between capital markets and product markets. Chevalier (1993) also looks at the effects of liquidity on supermarket pricing. The paper shows that following an LBO — an event which reduces corporate liquidity— local supermarket prices tend to rise if there are already many other LBO firms in the market. We are taking the same basic approach, only studying different events that reduce liquidity.

The paper is organized as follows. In Section 2 we outline a simple model which shows how capital market imperfections can generate countercyclical markups. In Section 3 we begin discussion of our empirical approach. Section 4 presents the results from the oil shock and Section 5 analyzes the effect of leverage on pricing in the most recent recession. Section 6 concludes the paper with a discussion of the results and related research.

2. The Model

In this section we present a simple model that illustrates how capital market imperfections can generate countercyclical markups. As a benchmark case, we first analyze a model in which financing issues are not important. The basic point of this model is very similar to Bils (1989) and Stiglitz (1984). We then introduce capital market imperfections and compare the equilibria.

The basic model of product-market competition follows Klemperer (1993), a simplified version of his earlier models of markets with switching costs. Two firms, A and B compete for two periods, $\tau = 1, 2$. Their marginal cost of production is constant and equal to c_τ in period τ. Consumers have a reservation value of R for each unit they purchase.

There are two types of consumers. The first are "old-timers," who purchased from firm A or firm B in the past. These consumers incur a switching cost, s, if they buy from the other firm in period 1. Thus, for an old-timer of firm A to buy from firm B, B's price would have to be at least s less than A's. This means that old-timers have relatively inelastic demand so that each firm has some monopoly power over its old-timers. Each firm has α old-timers and they consume only in the first period.

The second type of consumer is a "newcomer." Newcomers consume in both periods.

They are distributed with uniform density on the line segment, $[0,1]$, with firm A located at 0 and firm B located at 1. In the first period, they bear a "transportation cost" of t per unit of distance travelled along the line to the firm of their choice. One can take this transportation cost at face value as might be reasonable in retail markets (such as supermarkets). Thus, a consumer located at $y \in [0,1]$ would incur a cost of ty to buy from A and $t(1-y)$ to buy from B. Alternatively, one can view this cost as stemming from non-spatial product differentiation: it measures how far each firm's product is from a consumer's ideal set of product characteristics. In this interpretation, a consumer located at y derives utility $R - ty$ from product A and $R - (1-t)y$ from product B.

For simplicity, we assume that transportation costs for newcomers are zero in the second period. However, in the second period, newcomers (like old-timers in the first period) incur a switching cost, s, to buy from a different firm.

In a more general model, one might assume that there are overlapping generations of consumers, each of whom consumes over two periods. In any period, $\tau = 1, 2, 3, \ldots$, there are old-timers who have switching costs and newcomers who must decide which firm to buy from (taking into account that in the following period they will become old-timers with switching costs). Firms face a tradeoff between attracting newcomers through a low price versus taking advantage of old-timers through a high price. We will see that this basic tradeoff emerges in our model as well, though the analysis is simpler than in the full-scale overlapping generations model.

Because we are ultimately interested in how changes in demand affect equilibrium prices, we allow demand to vary across the two periods. The expected demand of newcomers in the first period is $\bar{\theta}$ and their expected demand in the second period is normalized to one. The demand of old-timers is fixed.

For each firm, the first-period demand of newcomers can be high (θ_H) with probability μ or low (θ_L) with probability $1 - \mu$. We interpret a high value of μ as a boom and a low value of μ as a bust. While, the value of μ is the same for both firms, the actual realization of demand, θ_H or θ_L, is firm-specific. We think of this firm-specific demand realization as stemming from some unmodelled aspect of a firm's product that affects the relative demand of newcomers.[9] Firms choose prices before they know this demand realization.

This assumption implies that during booms the demand of newcomers rises relative to the demand of old-timers. This is a reasonable assumption if we think of a boom as increasing the number of consumers in the market. If, however, a boom increases the demand of all consumers, then the relative demands of newcomers and old-timers should remain fixed. Bils (1989) presents indirect evidence that during booms newcomers are relatively more important. Advertising expenditures — arguably directed at attracting new customers — are highly procyclical. He also finds that in some durable-goods industries, during booms demand is more likely to come from first-time buyers than from buyers who are replacing their existing durables.[10]

Finally, in order to compete in this market, firms must invest an amount I at date 0, the beginning of the first period. One can think of this as an initial investment or as the investment needed to continue existing operations. There are two types of firms: those that have enough cash to finance investment out of their own pockets; and those that need to raise I from outside investors. The former case is the standard one analyzed in the literature so we will start by analyzing such a model as a benchmark. We will then examine the effect of external financing and capital-market imperfections on product-market equilibria.

[9]The assumption that demands θ_H and θ_L are firm-specific will later eliminate any need to consider financial contracts which are dependent on the other firm's actions.

[10]This interpretation is not exactly correct if $\theta_L < 1$. In this case, there are an additional $1 - \theta_L$ consumers who enter the market in the second period. These consumers cannot have switching costs. However, in a more general model, second-period demand could depend on first-period demand and provided it is always less than first-period demand, there is no problem with this interpretation.

A. Equilibrium without External Financing

To solve for the equilibrium in this two-period model, we need to first solve for the equilibrium in the second period. As noted above, after purchasing from a firm in the first period, the consumer incurs a switching cost, s, to buy from the other firm, but no transportation cost to buy from either firm. If this switching cost is high enough, each firm can charge the consumer's reservation price, R, without fear of being undercut by its rival. While in the standard Bertrand pricing model a firm would only have to cut the price an infinitesimal amount below R to $R - \epsilon$ to steal away its rival's customers, in this model the firm would have to cut the price a discrete amount to $R - s - \epsilon$. Thus, while the firm may sell more units at this lower price, it earns considerably less on its first-period customers — these customers would have bought from the firm in the second period even at the higher price of R. Indeed, if switching costs are so high that the firm would lose money on these new customers ($R - s < c_2$), then it would never pay to charge $R - s$ and the second-period equilibrium price would be the monopoly price, R. Also, if s is large enough, it would never pay for a firm to cut its first-period price to attract old-timers from the other firm.[11] To keep the model simple we maintain this assumption.

It follows that the second period profits for each firm, $k = A, B$, depend on their first period markets shares, σ_1^k. In particular, we can write firm k's second-period profits as:

$$\pi_2^k(\sigma_1^k) = (R - c_2)\sigma_1^k, \tag{1}$$

In the first period, firms take into account the fact that their second-period profits are higher if they capture more of the market in the first period. If firm A charges p_1^A and firm B charges p_1^B in the first period, a newcomer located at point y will buy from A rather than

[11]The condition for this is more complicated. However, it suffices to assume that $s > (R - c_1)/2 + (R - c_2)/(4\alpha + \bar{\theta})$.

B provided

$$p_1^A + ty \leq p_1^B + t(1-y) \tag{2}$$

or

$$y \leq \frac{1}{2} + \frac{p_1^B - p_1^A}{2t}. \tag{3}$$

Newcomers will buy from B if the inequality is reversed.

Note that inequality (3) is only valid if prices plus transportation costs are less than the consumer's reservation value, R. We assume that the parameters are such that this condition is met. Also note that the consumer's choice of whether to buy from A or B depends only on the first period price; in the first period the consumer does not care who he will end up buying from in the second period since $t = 0$ then and both firms charge a price of R.

From (3) it follows that the market shares of firm A and B for the newcomers in period 1 are given by:

$$\sigma_1^A = \frac{1}{2} + \frac{p_1^B - p_1^A}{2t} \tag{4}$$

and

$$\sigma_1^B = \frac{1}{2} + \frac{p_1^A - p_1^B}{2t}. \tag{5}$$

In addition, old-timers will buy from A in the first period. Thus, first period profits for firm A in state i can be written as:

$$\pi_1^A(p_1^A, p_1^B, \theta_i) = (p_1^A - c_1)[\alpha + \theta_i \sigma_1^A] \tag{6}$$

$$= (p_1^A - c_1)[\alpha + \theta_i(\frac{1}{2} + \frac{p_1^B - p_1^A}{2t})]. \tag{7}$$

and analogously for B.

Firm A chooses p_1^A given its conjecture about p_1^B to maximize the discounted value of its profits over two periods. Assuming the discount rate is zero, this amounts to maximizing:

$$(p_1^A - c_1)[\alpha + \bar{\theta}\sigma_1^A] + (R - c_2)\sigma_1^A. \tag{8}$$

The first-order conditions for this problem are:

$$\alpha + \bar{\theta}[\frac{1}{2} + \frac{p_1^B}{2t} - \frac{p_1^A}{t} + \frac{c}{2t}] - \frac{(R - c_2)}{2t} = 0. \tag{9}$$

This equation defines firm A's pricing reaction curve as a function of firm B's price:

$$p_1^A = \frac{\alpha t}{\bar{\theta}} + \frac{t + c_1}{2} + \frac{p_1^B}{2} - \frac{R - c_2}{2\bar{\theta}}. \tag{10}$$

As is standard, firm A's optimal price is increasing in its rival's price; in the terminology of Bulow, Geanakopolos, and Klemperer (1985), prices are "strategic complements."

In a symmetric equilibrium, $p_1^A = p_1^B$, $\sigma_1^A = \sigma_1^B$. We write the equilibrium price as $p_1^*(e_A, e_B)$, where $e_k = 1$ if the firm k needs external financing and $e_k = 0$ if firm k does not need external financing. Thus, the equilibrium price when both firms are internally financed is:

$$p_1^*(0,0) = \frac{2\alpha t}{\bar{\theta}} + t + c_1 - \frac{R - c_2}{\bar{\theta}}. \tag{11}$$

The markup of price over marginal cost, which we write in analogous fashion as $m_1^*(e_A, e_B) = p_1^*(e_A, e_B) - c_1$, in this case is just $m_1^*(0,0) = p_1^*(0,0) - c_1 = 2\alpha t/\bar{\theta} + t - (R - c_2)/\bar{\theta}$.

In a one period model with newcomers only, each firm would charge a price of $t + c_1$. However, in our model prices can be greater or less that $t + c_1$ depending on the relative importance of old-timers and newcomers. If there are many old-timers (α large), firms charge higher prices because old-timers have relatively inelastic demand due to switching costs. This effect raises prices by $2\alpha t/\bar{\theta}$. If there are many newcomers (α low), firms tend to charge lower prices as they compete for market share of newcomers who they can later charge the monopoly price, R. This effect lowers prices by $(R - c_2)/\bar{\theta}$. In fact, this effect can be so strong that firms charge prices below marginal cost in the first period.

In this model, markups can be countercyclical or procyclical depending on the parameters. If we think of μ as measuring the level of demand, then given that price is additive in marginal cost, markups will be countercyclical if $dp_1^*(0,0)/d\mu < 0$ and procyclical if the inequality is reversed. Differentiating (11) with respect to μ we have:

$$\frac{dm_1^*(0,0)}{d\mu} = \frac{dp_1^*(0,0)}{d\mu} = [-2\alpha t + R - c_2]\frac{\theta_H - \theta_L}{\bar{\theta}^2}. \tag{12}$$

The first term in brackets tells us that markups tend to fall during booms because the increased demand of newcomers makes it more important to price for market share than to take advantage of old-timers. The second term in brackets tells us that markups tend to rise during booms because the increase in the current demand of newcomers relative to their future demands makes it less attractive to price low to increase future monopoly profits. Whether markups are countercyclical or procyclical depends on the relative strength of these effects. In the next section, we show that capital market imperfections tend to make markups more countercyclical.

B. Equilibrium with External Financing

In this section, we investigate the effect of external financing in an imperfect capital market on product-market equilibrium. There are many ways to introduce such imperfections. We choose a variant of Bolton and Scharfstein (1990,1993) and Hart and Moore (1989) because it allows us to analyze optimal financial contracts in a simple model.[12] The basis of these models is the assumption that corporate cash flow is observable to the manager

[12] This discussion of the model closely follows the simpler version in Gertner, Scharfstein and Stein (1993).

and investors, but is not "verifiable" — i.e. it cannot be observed by outside parties and therefore contracts cannot be made contingent on its realization. Moreover, the manager can, if he chooses, costlessly divert all of the cash flow to himself. This formulation captures the notion that managers can spend corporate resources on perks, pet projects, etc. and that such spending cannot be directly controlled through contractual means. Therefore, there is an agency problem associated with external financing.

The only way to get managers to pay out cash flow is to threaten to liquidate the firm's assets if they do not. However, liquidation is inefficient in that the firm's assets are worth less if owned and managed by the investors. In particular, the firm's assets are worth a fraction, $\lambda < 1$, of the remaining cash flow. Thus, for example, if the firm k is liquidated at date 1, it would be worth $\lambda\pi_2^k(\sigma_1^k)$ in the hands of the investor.

As Hart and Moore (1989) and Bolton and Scharfstein (1990, 1993) have shown, the optimal contract in this case calls for a repayment of D at date 1; if no such payment is made, the investor has the right to seize the project's assets. This contract gives the manager some incentive to pay out D if he has the cash to do so. If the manager fails to pay, the asset may be liquidated and he will lose out on any cash that he can divert to himself at date 2.

If the assets have not been seized at date 1, then the investor has no further leverage over the manager and he will therefore divert all of the period-2 cash flow of $\pi_2^k(\sigma_1^k)$ to himself. Working backwards this means that the maximum payment than can be extracted from the manager at date 1 is $\pi_2^k(\sigma_1^k)$; incentive compatibility requires that $D \leq \pi_2^k(\sigma_1^k)$.

If, however, the manager does not have enough cash to make the payment D, say because $\pi_1^k(\sigma_1^k) < D$, then the manager would instead choose to pay nothing and have the asset liquidated. His first period payoff would therefore be $\pi_1^k(\sigma_1^k) < D$ and he would receive no cash in the second period.

To make the problem interesting, suppose that in high demand states cash flow is enough to cover the payment D and in low demand states cash flow is less than D, i.e.,

$\pi_1^k(\theta_H) > D > \pi_1^k(\theta_L)$. The manager's expected payoffs over the two periods, V^k, can be written as:

$$V^k = \mu[\pi_1^k(\theta_H) - D + \pi_2^k(\sigma_1^k)] + (1-\mu)\pi_1^k(\theta_L). \tag{13}$$

The investor will be willing to lend provided his expected payoffs are non-negative:

$$\mu D + (1-\mu)\lambda\pi_2^k(\sigma_1^k) - I \geq 0. \tag{14}$$

Competition among investors ensures that condition (14) is met with equality. Note that D is chosen taking into account the product market equilibrium that follows in periods 1 and 2. However, if this value of D, $D^* = [I - (1-\mu)\pi_2^k]/\mu$, is greater than $\pi_2^k(\sigma_1^k)$, then the contract would not be incentive compatible. Thus, there would be no incentive compatible contract that earns non-negative profits for the investor and the firm would not be able to finance the requisite investment. We assume for the remainder that the parameters are such that $D^* \leq \pi_2^k(\sigma_1^k)$, i.e., incentive compatible contracts are feasible.

Before characterizing the product-market equilibrium, we should note three assumptions of our model. First, we have assumed that contracts cannot be made contingent on product-market prices. This seems like a reasonable assumption in many cases, particularly for supermarkets (the focus of our empirical study) where the range of products is large and price flexibility is important. Second, we have assumed that the investor will actually follow through with liquidation if the firm defaults, even though it is *ex post* inefficient for the investor to do so. In some situations the investor and the manager will be able to renegotiate around the *ex post* inefficiency and the threat of default is not credible. However, the same qualitative results go through if the investor has some of the bargaining power in renegotiation. These issues are taken up in more detail in Hart and Moore (1989) and Bolton and Scharfstein (1993) and are not essential for the purposes of this model.[13] Finally,

[13]In particular, efficiency would be increased by $(1-\lambda)\pi_2^k(\sigma_1^k)$ if the manager and the

our assumption that the actual realization of demand, θ_H or θ_L, is firm-specific eliminates the possibility of making the repayment amount for one manager dependent on whether the other manager repays.

Suppose that firm A needs to raise I externally. After the financial contract is signed, firm A chooses p_1^A taking D and p_1^B as given. The first-order condition for p_1^A is:

$$\frac{\partial V^A}{\partial p_1^A} = \alpha + \mu[\frac{\partial \pi_1^A(\theta_H)}{\partial p_1^A} + \frac{\partial \pi_2^A(\sigma_1^A)}{\partial p_1^A}] + (1-\mu)\frac{\partial \pi_1^A(\theta_L)}{\partial p_1^A} \quad (15)$$

$$= \alpha + \bar{\theta}[\frac{1}{2} + \frac{p_1^B}{2t} + \frac{c_1}{2t} - \frac{p_1^A}{t}] - \mu\frac{R - c_2}{2t} = 0. \quad (16)$$

The first-order condition (16) resembles the first-order condition with internal financing, (9), with one exception. With internal financing, firms are never liquidated and receive all of the second-period profits. Therefore, a marginal increase in p_1^A reduces second period profits by $(R - c_2)/2t$. However, with external financing, the firm is liquidated with probability $1 - \mu$, so that the manager only gets second-period profits with probability μ. Thus, a marginal increase in p_1^A only reduces second-period profits by $\mu(R - c_2)/2t$. This means that for each p_1^B, firm A will charge a higher price when it is externally financed than when it is internally financed. With external financing, firms are less interested in building market share because they get less of the gains from doing so; in effect, they are more "short-term oriented."

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investor could reach some agreement not to liquidate. For example, if the firm defaults in high demand state, then the investor might agree not to liquidate in exchange for some payment from the manager. Thus, the payoff to the manager from defaulting would exceed $\pi_1^k(\theta_H)$. This in turn lowers the maximum value of D that is incentive compatible. The exact amount depends on the relative bargaining powers of the two parties. The contract analyzed above is optimal if the investor has all the bargaining power and the qualitative results go through provided the manager does not have all of the bargaining power. Thus, we continue to characterize the contract along the lines discussed in the text on the assumption that either renegotiation is infeasible or that the investor has all the bargaining power in renegotiation.

Thus, the reaction curve is given by:

$$p_1^A = \frac{\alpha t}{\bar{\theta}} + \frac{t + c_1}{2} + \frac{p_1^B}{2} - \mu\frac{R - c_2}{2\bar{\theta}}. \tag{17}$$

If both firms need external financing, then the symmetric equilibrium price, $p_1^*(1,1)$ is given by:

$$p_1^*(1,1) = \frac{2\alpha t}{\bar{\theta}} + t + c_1 - \frac{\mu}{\bar{\theta}}(R - c_2). \tag{18}$$

Thus, equations (11) and (18) imply that for all $\mu < 1$ the equilibrium price is higher when firms are externally financed than when they are internally financed.

One can see this in Figure 1 which shows both firms' reaction curves under the two financing regimes. Point (*) is the equilibrium when both firms are internally financed. If firm A is externally financed, its reaction curve shifts upward and to the left while if firm B is externally financed its reaction curve shifts outward and to the right. This shifts the equilibrium to (**), at a higher price.

If only one of the firms, say firm A, is externally financed, then only its reaction curve shifts and the equilibrium is at (***). The equilibrium price for firm A, $p_1^{*A}(1,0)$, and for firm B, $p_1^{*B}(1,0)$ are given by:

$$p_1^{*A}(1,0) = \frac{2\alpha t}{\bar{\theta}} + t + c_1 - \frac{\mu + \frac{1}{3}(1-\mu)}{\bar{\theta}}(R - c_2) \tag{19}$$

$$p_1^{*B}(1,0) = \frac{2\alpha t}{\bar{\theta}} + t + c_1 - \frac{\mu + \frac{2}{3}(1-\mu)}{\bar{\theta}}(R - c_2). \tag{20}$$

where $p_1^{*A}(1,0) > p_1^{*B}(1,0)$.

Prices are lowest when both firms are internally financed; highest when both firms are externally financed; and in between these prices when only one of them is externally financed. That is, $p_1^*(1,1) > p_1^{*A}(1,0) > p_1^{*B}(1,0) > p_1^*(0,0)$. Note that even if firm B can finance internally, its price will be higher when A is externally financed because prices are strategic complements.

C. Comparing Markup Cyclicality

When both firms are internally financed, the markup moves with demand (as measured by μ) according to equation (12) in Section 2.A. We saw that the markup could be countercyclical or procyclical depending on the relative importance of old-timers and newcomers. When both firms are externally financed our measure of markup cyclicality is given by:

$$\frac{dm_1^*(1,1)}{d\mu} = \frac{dp_1^*(1,1)}{d\mu} = -\frac{2\alpha t}{\bar{\theta}^2}(\theta_H - \theta_L) - \frac{(R - c_2)}{\bar{\theta}^2}\theta_L < 0. \tag{21}$$

Thus, when both firms are externally financed, markups are countercyclical. Moreover, markups are always more countercyclical when both firms are externally financed: $dp_1^*(1,1)/d\mu < dp_1^*(0,0)/d\mu$. Recall, that even in the absence of external financing, there are two effects at work that could make markups procyclical or countercyclical. First, markups tend to be countercyclical because a reduction in newcomer demand relative to old-timer demand makes pricing for market share less attractive. Second, markups tend to be procyclical because a decrease in current demand relative to future demand increases the incentive to invest in market share to increase future monopoly profits. When firms are externally financed and demand (μ) is low, firms have less incentive to price for market share; they are more likely to be liquidated and be unable to take advantage of their locked-in customers. This effect tends to make markups more countercyclical.

There are similar effects when only firm A is externally financed.

$$\frac{dp_1^A(1,0)}{d\mu} = -\frac{2\alpha t}{\bar{\theta}^2}(\theta_H - \theta_L) + \frac{(R - c_2)}{\bar{\theta}^2}[\frac{1}{3}\theta_H - \theta_L] \tag{22}$$

$$\frac{dp_1^*(1,0)}{d\mu} = -\frac{2\alpha t}{\bar{\theta}^2}(\theta_H - \theta_L) + \frac{(R-c_2)}{\bar{\theta}^2}[\frac{2}{3}\theta_H - \theta_L]. \tag{23}$$

There are a number of points that follow from (22) and (23). First, markups could be countercyclical or procyclical, but in either case they tend to be more countercyclical than when both firms are internally financed and less countercyclical than when both firms are externally financed. Second, these equations tell us that the markup of A — the externally financed firm — is more likely to be countercyclical than B's. But, it is interesting to note that even though B is not externally financed, its markup could be countercyclical and is certainly less procyclical than if none of its competitors were liquidity constrained. Thus, markup cyclicality depends on both the firm's own liquidity as well as its rivals' because prices are strategic complements.

D. Discussion and Implications

The model, narrowly interpreted, suggests that firms are less inclined to invest in market share during downturns because the increased probability of liquidation makes them care less about the future. However, in many cases complete liquidation is unlikely. The essence of the model does not depend on this extreme assumption. In fact, it only requires that when firms have difficulty making debt payments they are unable to take full advantage of their locked-in customers. For example, they may be forced to scale back their operations or limit their expansion into related product lines.

We have shown that external financing leads to countercyclical markups because externally financed firms tend to increase markups when demand is low. The model takes as fixed whether or not a firm is externally financed. Yet, during a downturn, firms tend to rely more heavily on external financing as cash flow tends to fall faster than investment needs. Because externally financed firms have higher markups, an increase in the number of externally financed firms during a downturn will make markups even more countercyclical.

There are a number of empirical implications that emerge from the theoretical model.

1. A firm's markup should be more countercyclical if it is more liquidity constrained.

2. A firm's markup should be more countercyclical the more liquidity constrained its rivals are.

3. Average industry-wide markups should be more countercyclical if firms are more liquidity constrained.

We will first present evidence on industry-wide markups (implication 3) in Sections 4 and 5 and then present evidence on firm-level markups (implications 1 and 2) in Section 6.

3. The Empirical Approach

In our empirical analysis, we examine the interaction between liquidity and pricing in the supermarket industry at the local level. The most direct approach would seem to be to measure markups and then see whether they are related to measures of the liquidity of firms in the local market. There are two difficulties with this approach — one conceptual and the other practical. The conceptual difficulty with this approach is that while liquidity may affect prices — the mechanism explored in the model — prices almost certainly affect liquidity. This endogeneity problem makes it difficult to establish a causal link between prices and liquidity.

The practical difficulty is that to measure markups one has to observe both prices and marginal costs. While a number of studies try to measure markups, they rely on strong assumptions about the form of the production function.[14]

We take a different approach. We undertake three "experiments", examining events which reduced supermarkets' liquidity and were likely to have had differential impacts on firms with different characteristics.

First, we study supermarket prices during the deep recession in the oil-producing states brought on by the halving of oil prices in 1986. We would expect the liquidity of local and

[14]See, for example, Bils (1987) and Rotemberg and Woodford (1992).

regional supermarket chains to have been more adversely affected by this shock than the liquidity of national supermarket chains with operations in non-oil-producing states. If liquidity affects pricing in the way predicted by our model, then average supermarket prices in a city should fall less if a city is dominated by local and regional chains.

We also examine supermarket pricing during the macroeconomic recession of 1990-91. Many supermarket chains undertook leveraged buyouts (LBOs) during the 1980s, increasing their leverage dramatically. We would expect the recession to have impacted the liquidity of these firms more than the firms that did not undertake LBOs. Thus, city-wide prices should fall less (or rise more) in local markets dominated by LBO chains.

Finally, we examine supermarket pricing in the period following the macroeconomic recession of 1990-1991, a period when many states were still experiencing downturns. We again compare the pricing behavior of LBO and non-LBO chains, this time utilizing firm-specific pricing data. We examine whether LBO firms in depressed cities cut prices less than their less-leveraged rivals (implication 2 above) and whether firms in depressed cities cut prices less when their rivals were LBO firms (implication 3 above).

Our approach avoids the conceptual and practical difficulties discussed above. By measuring how prices change during these events, we are examining the relationship between pricing and totally exogenous changes in liquidity, thus avoiding the endogeneity problem.

Our approach also does not require us to measure marginal costs, a feature of other attempts to measure markup variation over time. We are studying whether price changes across cities vary with the liquidity of chains in the city. While costs clearly change over time and across cities, these changes should be uncorrelated with whether firms are national or local, LBO or non-LBO. Thus, ignoring costs may introduce some noise into the estimates, but not any biases.

There are four potential difficulties with our approach. First, we are only examining a single industry so it is difficult to draw macroeconomic conclusions from our results. Second, this approach does not allow us to determine whether markups are countercyclical, only that liquidity constraints move prices in the direction of being countercyclical.

A third concern is that switching costs — the basis of the incentive to price for market share — may not be applicable to the supermarket industry. While there is no direct evidence of switching costs in this industry, there is some evidence that firms can raise prices in the short run without losing all of their customers. Devine and Marion (1979) reports on an experiment in which they place advertisements in local newspapers in Ottawa-Hull, Canada, listing representative prices charged by local supermarkets. They find that many consumers switched supermarkets in response to the new information. This suggests that consumers have imperfect information about prices; therefore, as in our model with switching costs, firms can raise profits in the short run by increasing prices.[15]

A final concern is that the industry may not be particularly cyclical. It is probably true that individual demand is not very income elastic. However, at the local level, demand may vary a lot with economic conditions as individuals migrate into the area during booms and out of the area during busts. Indeed, this is why Blanchard and Katz (1992) find that regional unemployment seems to be mean reverting as workers move out of regions in recession to seek employment elsewhere.

4. The Oil Shock

We start by examining the regional downturn which occurred when oil prices dropped by half in the first half of 1986. This caused severe recessions in the oil-producing states — Texas, Louisiana, Oklahoma, Colorado, Montana, Wyoming, and Alaska. The rest of the country was expanding during this period. We chose the oil shock because it is the cleanest

[15]This raises the question of why supermarkets themselves did not publish price comparisons. Unlike the researchers in this study, supermarket chains would have an incentive to publish information only on those products for which they had lower prices. Therefore, the published information would not credibly communicate overall price differences between supermarkets.

example of a regional shock. Other regional shocks include the farm crisis and the decline of the Rust Belt. We do not examine these, however because the farm crisis had little effect on cities and because the Rust Belt was more of a sustained decline than an unanticipated shock.

We will examine price changes in cities in oil-producing states over the period of the oil-price collapse. Oil prices declined dramatically in the first and second quarters of 1986. We examine supermarket price changes beginning with the quarter before the decline, the fourth quarter of 1985. We choose the first quarter of 1987 as an endpoint because employment troughs in Texas, the biggest of these states in population, in that quarter. Oil prices are recovering somewhat at this time and climb to a local maximum in 1987:2.[16] We hypothesize that supermarket chains that operate only in the oil states would have been severely affected by the downturn, while supermarket chains that have some of their operations elsewhere would still have had significant cash flows from their other operations. These national supermarket chains are not likely to have been liquidity constrained during the regional downturn. We test this idea by estimating the relationship between price changes in a city and measures of the extent to which chains in the city have operations outside the oil states.

A. Data

For this analysis, we use two types of data: price data at the city level, and measures of the relative importance of local and national chains at the city level.

Prices. Quarterly price data are drawn from the American Chamber of Commerce Researchers Association *Cost of Living Index.* The ACCRA data is collected in surveys by local chambers of commerce under guidelines set by the American Chamber of Commerce Researchers Association. Included in these data are quarterly prices for 27 specific grocery

[16]The LBO of Safeway, an important competitor in the oil states, occurs in 1986:4. However, Chevalier (1993) suggests that effects of LBOs are not apparent in prices until three to four quarters following an LBO.

products (for example, 18 oz. Kellogg's Corn Flakes, a 12 oz. can of Minute Maid frozen orange juice). The recorded price is the average price of a sample of supermarkets in the city. We use ACCRA's index of grocery prices which is composed of a weighted basket of grocery products. The index for a city is the weighted sum of the price of each item in the ACCRA basket divided by the price of that item in all cities in the ACCRA sample. For each sample period, ACCRA covers approximately 260 cities. The dependent variable in the specifications below is the percentage change in the price index over the period. That is, the dependent variable is the price index in 1987:1 less the price index in 1985:4 divided by the price index in 1985:4.

Chain locations. The annual publication *Supermarket News Distribution Study of Grocery Store Sales* lists the supermarkets operating in all Metropolitan Statistical Areas in the United States as well as the number of stores they operate in each of those MSAs. In our examine of the oil shock, we use the 1986 edition of the Supermarket News, which contains data from 1984. Later, when we examine the 1981-82 recession, we use the 1982 edition of Supermarket News, which contains data from 1980. From these data, we calculate the share of stores in a city owned by national chains in each MSA. We define a national chain as a supermarket chain that operates in more than two of the nine U.S. Census Regions. We determine the number of regions in which a supermarket chain operates using the Supermarket News data. Thus, for each city j, we calculate $NATSHARE_j$, the share of the total stores in the city which are operated by national chains.

We also construct a crude measure of each supermarket chain's exposure to the oil price-induced regional recession. For each chain i, we calculate $NOIL_i$, the share of the total stores that each firm has listed in Supermarket News that are located outside the oil-producing states. This measure is a crude one because we cannot measure the total share of a firm's stores which are located outside the oil-producing states, only the share of stores in MSAs which are located outside the oil-producing states. To calculate a measure of the degree to which the supermarkets operating in city j are exposed to the regional shock, we sum the $NOIL_i$'s weighted by the market share of chain i in city j, m_{ij} Thus, this variable, which we call $NOILSHARE_j$ is given by:

$$NOILSHARE_j \equiv \sum_i m_{ij} NOIL_i$$

There are a total of 42 MSAs in the oil states. Price data are not available for all of these MSAs. There are 20 cities in these states which have price data for the fourth quarter of 1985 and the first quarter of 1987. There are data for another 2 cities if we substitute data from 1985:3 for data from 1985:4. We could add no observations by extending the period to 1987:2. We calculate one price index per MSA by averaging the price indices of all observations within the MSA that are available for both 1985:4 and 1987:1. The price data for a given MSA are comparable in the two quarters because information from a constant set of cities is used to construct the quarterly data. For the majority of MSAs in the Supermarket News data, the only price data available were from the central city of the MSA.

Quarterly data on employment at the state level are obtained from DRI. We use employment data to measure the state of the economy for two reasons. First, very few measures are available quarterly at the state level. Second, Blanchard and Katz (1992) argue that changes in employment are the best measures of regional fluctuations. An alternative measure which is also available quarterly is unemployment, but Blanchard and Katz show that this measure is mean reverting as workers leave the state during a downturn. For the regressions which examine the oil shock period, we construct the percent change in state employment, ΔEMP, between 1985:4 and 1987:1.[17] For the regressions which examine the 1981-1982 recession, we construct the percent change in state employment between 1981:2

[17]The percent change in employment from 1985:3 to 1987:1 is used for those observations for which 1985:3 price data were used.

and 1982:4.

The means and standard deviations for all variables used in this section are shown in Table 1.

B. Regression Results

Table 2 reports regression results for various specifications. The first column reports the regression of the percent change in the price index, $\Delta PRICE$ on $NATSHARE$, the share of total stores accounted for by national firms in the city. The coefficient on $NATSHARE$ is negative with a t-statistic of 2.84. The estimated coefficient implies that a one standard deviation increase in $NATSHARE$ from its mean value of 0.44 to 0.62 would decrease the expected percentage change in the price index from its mean of -0.035 to - 0.066. For reference, the standard deviation of percentage price changes for all cities in the ACCRA data base is 0.048. The results are essentially unchanged when we control for the change in employment in the state over the period.

We repeat the regressions in columns 1 and 2 in columns 3 and 4, except that we substitute $NOILSHARE$ for $NATSHARE$. $NOILSHARE$ is intended to measure more directly the importance of operations outside the oil states to the chains in each city. The coefficient for $NOILSHARE$ is negative and significant at the one percent level. The coefficient implies that a one standard deviation increase in $NOILSHARE$, from its mean of 0.29 to 0.41 would decrease the expected percentage change in the price index from its mean of -.035 to -0.068.

We interpret the $NATSHARE$ coefficient as measuring liquidity effects. However, a possible objection to this interpretation is that the coefficient of $NATSHARE$ could simply be capturing secular price decreases of national chains over the period. For example, if national, but not regional chains were adopting cost-saving technologies over this period, then prices might be expected to fall in cities dominated by national chains.

We can check for this possibility by examining the relationship between national share variables and supermarket price changes during the same period in 82 cities outside the oil region. We repeat the specifications of Table 2, columns 1 and 2, using data for the same time period for cities outside the oil region. The results for this regression are shown in Table 3. The coefficient of $NATSHARE$ for these regressions is negative, but the t-statistic is only -0.264. The results are unchanged when one controls for employment changes, as shown in column 2. Thus, there is no evidence that the significance of $NATSHARE$ in the regression equations for the oil states is due to secular price decreases of national chains.

We also check the results against another alternative hypothesis. We interpret the results of Table 2 to suggest that national supermarket chains use funds generated in other parts of the country to buffer them from the regional shock. However, it may be that national chains have better access to the private and public sources of capital than do regional chains. Thus, the importance of "nationalness" in our results could be due to the ability of national chains to mitigate liquidity constraints by using the capital markets.[18]

To explore this explanation, we estimate the relationship between price changes and $NATSHARE$ during a national recession. If prices in cities with large national chains fall more in a national recession than prices in cities with smaller regional chains, this would suggest that are results are driven by the greater access to capital markets of national chains, rather than the greater access to internal funds from operations outside the oil states.

In columns 3 and 4 of Table 3, we report the results of regressing price differences in 102 MSAs from the second quarter of 1981 to the fourth quarter of 1982. This is the quarter prior to the peak of the cycle in July 1981 and the quarter of the trough of the cycle as determined by the National Bureau of Economic Research (NBER). We find that the coefficient of $NATSHARE$ is negative, but insignificant at standard confidence levels. Column 2 shows that adding ΔEMP to the specification leaves the results essentially unchanged. We

[18]Kashyap, Lamont and Stein (1992) find an effect along these lines: firms with greater access to capital markets tend to cut back less on inventory investment during recessions.

conclude from these results that national chains are able to keep prices low during downturns because they can reallocate internal cash flows from better performing divisions outside the oil states.

5. LBOs and the 1990-91 Recession

The second episode that we examine is the recession of 1990-91. Prior to this recession, many supermarket chains had undertaken LBOs. One of the main effects of an LBO, (or even one of the functions of an LBO, according to Jensen (1986)), is to constrain the amount of cash available to the firm's managers. A firm with high leverage and little cash would presumably be more affected by shocks to its cash flows than less leveraged firms. While the recession would presumably reduce the cash flows of all firms, we expect the recession to have a larger impact on LBO firms. Thus, we test whether prices fall less (or rise more) in MSAs dominated by LBO firms.

A. Data

The peak of the cycle according to the NBER was July 1990 and the trough was March 1991. As with the other episodes, we calculate the price changes from one quarter before the peak to the quarter of the trough. Thus, we examine price changes over the period 1990:2 to 1991:1.[19] The price data, as before, are from ACCRA.

For information about supermarket locations, we use the 1992 edition of Progressive Grocer's *Market Scope*, which contains data for 1991. Progressive Grocer lists all of the supermarkets operating in each of the 100 largest MSAs in the United States and lists the number of stores in each chain. The Progressive Grocer data lists store names, not the names of parent companies. Store names were matched to parent company names using the *Retail Tenants Directory*, *Thomas's Grocery Register*, and supermarket firms' annual 10-K

[19]Some have argued that the recession should really be dated from 1990:2 to 1991:4 because the recovery in 1991:1 and 1991:2 was minimal. The results presented here are very similar for that time period.

disclosures.[20] Progressive Grocer only covers the 100 largest MSAs.

The information on LBOs was obtained in two ways. First, we searched for listings of supermarket LBOs in quarterly editions of *Mergers and Acquisitions*, which contains information on all ownership transactions (including LBOs) of greater than $1 million. Second, we also searched all references to transactions involving the supermarket parent companies in the sample using indices to Supermarket News, Supermarket Business, and Progressive Grocer. From these sources, a list of LBOs was assembled. All of the LBOs examined in this study were consummated between 1981 and 1990.

To match the price and location data, we extracted ACCRA data for all cities within the Progressive Grocer MSAs. We calculate one price index per MSA by averaging the price indices of all observations within the MSA that are available for both 1990:2 and 1991:1. The price data for a given MSA are comparable in the two quarters because information from a constant set of cities is used to construct the quarterly data. For the majority of MSAs in the Progressive Grocer data, the only price data available were from the central city of the MSA.

We construct the variable $LBOSHARE_j$ which is the share of the total stores in city j owned by firms which undertook LBOs prior to the second quarter of 1990. Means and standard deviations of all variables used in this section are in Table 4.

B. Regression Results

We regress the percent change in the price index in 54 MSAs from 1990:2 to 1991:1 on $LBOSHARE$. These results are reported in Table 5, column 1. The coefficient of

[20]The Progressive Grocer data was used in this part of the study rather than the Supermarket News data because it is higher quality data. Supermarket News, however, publishes data for all MSAs, while Progressive Grocer has data for only the 100 largest MSAs. We use the Supermarket News data for the oil episode for two reasons: we needed to obtain data for as many cities in the oil producing states as was possible; and we needed to measure the nationalness of the supermarket chains.

$LBOSHARE$ is positive, but statistically insignificant at standard confidence levels. The coefficient suggests that, as $LBOSHARE$ increases one standard deviation from its mean of 0.25 to 0.44, the predicted price index change in the city increases from its mean of 0.006 to 0.008.

The poor explanatory power of $LBOSHARE$ may be due merely to the fact that there was a considerable amount of heterogeneity across cities in the severity of the recession; in cities that were doing relatively well we would not expect $LBOSHARE$ to have much of an effect. Column 2 reports the results of including the percent change in employment in the state over this recessionary period, ΔEMP. The coefficient of $LBOSHARE$ remains positive and statistically insignificant.

This specification, however, does not completely capture the effects of the heterogeneity across cities, because $LBOSHARE$ may only matter in cities which were severely affected by the recession. Thus, we include an interaction term, $EMPLBO$, which is $LBOSHARE$ multiplied by the ΔEMP. We expect a negative coefficient of $EMPLBO$ if the LBO share leads to higher prices in MSAs that suffered most during the recession. Column 3 shows that the interaction term is indeed negative, and is statistically significant at the 6% confidence level. The coefficient for $LBOSHARE$ itself remains statistically insignificant, but becomes negative.

If employment growth is held at its mean of -2.2%, then a one standard deviation increase in the share of LBO firms from its mean of .25 to .44, raises the expected price increase from 0.6% to 1.0%. However, in a city which is badly hit by the recession, the effect of an increase in the LBO share is considerably larger. In a city with employment growth of -3.8% (one standard deviation below the mean), a one standard deviation increase in the LBO share from its mean more than doubles the expected price increase, from 0.7% to 1.7%. Thus, the effects are both statistically and economically significant.

6. LBOs Following the 1990-91 Recession: Firm-Specific Data

The theory outlined in Section 3 has implications for firm-level prices in addition to its implications for market-level prices analyzed above. First, it predicts that a firm's price will be more countercyclical if it is more liquidity constrained. And, second it predicts that a firm's price will be more countercyclical if its *rivals* are more liquidity constrained; this follows from the fact that prices are strategic complements.

In this section, we use local firm-level data on supermarket pricing. The data we have begin in the first quarter of 1991. According to the NBER, this is the end of the 1990-91 recession. However, the recovery from this recession was weak for several quarters following the trough. In fact, many states in the northeast and in California experienced negative growth in employment until the fourth quarter of 1992. Thus, even though our price data do not coincide with the macro recession, we can use the geographic heterogeneity in the recovery to investigate the impact of liquidity constraints on the pricing of LBO and non-LBO firms.

A. Data

The data on supermarket prices are from Information Resources, Inc.. IRI collects these data from electronic product scanners. The IRI data are firm-specific, but average together prices for all of a firm's stores within the market area defined by IRI. An IRI market area is generally somewhat larger than an MSA, and in some cases, an IRI market area covers an entire state.

The Progressive Grocer data described in Section 5 also contains data on store locations for IRI market areas. We used the 1992 edition of Progressive Grocer's *Market Scope*, which contains data for 1991, to measure the number of stores of different types in each IRI market.

In the analysis, we use a price index that is a quarterly average of prices for a basket of product types. A product type is a category such as dry pasta, ready to eat cereals, diet soft drinks, etc. The price of a product type observed for a supermarket chain in an IRI market area for a quarter is the average price of a unit of the good, averaged across all sales in the quarter. For example, prices for boxes of cereal of different brands and sizes are recorded in dollars per pound and averaged over the quarter. Out of the 50 product types with the highest dollar sales, 38 were scanned by all supermarkets in the IRI sample. We use these 38 product types for our sample.

We examine price changes over two periods: the period from 1991:1 to 1991:4 and the period from 1991:1 to 1992:4. We have 110 observations of firms in local markets for the shorter time period. We have a smaller set of firm-market pairs with complete data for the longer time period (89 observations).

To test the prediction that cash-constrained firms charge higher prices, we construct LBO, a dummy variable which equals one if the firm is an LBO firm. To measure the second effect, whether firms charge higher prices when their rivals are cash-constrained, we construct the measure $OLBOSHARE$. For each firm i in local market j, $OLBOSHARE_{ij}$ is the share of stores in market j owned by LBO chains other than firm i.

As mentioned, neither of the periods examined here coincide with a macro recession. However, overall economic growth was slow over this period, and some local areas were in recession. As in Section 5, we would expect the effects of cash constraints to be more pronounced in local economies which were doing poorly. As a measure of local market conditions, we use the percent change in employment in the state of the market area, ΔEMP. In some cases, the IRI market areas include counties from several states. In these cases, we construct ΔEMP as a weighted average of the percent change in employment in each of the states included in the market area. The weights are the share of the population in the IRI market area accounted for by residents of each state.

In addition, we construct $LBOEMP$, an interaction term between the LBO dummy and ΔEMP, the percent change in employment over the time period. $OLBOEMP$ is an interaction term between $OLBOSHARE$ and ΔEMP. These variables will enable us to see whether the effects of liquidity are more pronounced in market areas that are doing less well. Summary statistics for two time periods are shown in Table 6.

B. Regression Results

We regress the percent change in the price of the food basket in each of the 110 firm-market pairs from 1991:1 to 1991:4 on LBO, $OLBOSHARE$, $LBOEMP$, $OLBOEMP$, and ΔEMP. The estimates are OLS with OLS standard errors. Because there are multiple firm observations for a single city and multiple city observations for a single firm, OLS standard errors could be biased due to a correlation of the disturbance term across related observations. Moulton (1986) proposes a version of the Breusch and Pagan (1980) Lagrange multiplier method to test for the appropriateness of OLS standard errors in contexts very similar to ours. Following Breusch and Pagan (1980), we extend the test to allow for the possibility of two types of error correlation: intra-firm and intra-city. The test statistic which is distributed χ^2 is 1.7 for the shorter period and 2.3 for the longer period. Thus, in both cases, we fail to reject the null hypothesis that there is no intra-city or intra-firm correlation at the 25% confidence level. Therefore OLS estimates and standard errors are not subject to this potential problem.

The results for this regression are reported in the first column of Table 7. First, the regression shows that LBO firms tend to raise prices more than non-LBO firms; the coefficient of LBO is positive and statistically significant. This is also true of the coefficient of $LBOEMP$. Thus, LBO firms tend to raise price more relative to non-LBO firms in markets in which business conditions are worse.

The estimated coefficients imply that in an average city — one with average employment growth and an average share of other LBO firms — an LBO firm increases its priced by 2.7%, while a non-LBO increases its prices by only 2.0%. In a city with less than average economic growth, the differences are even larger; with employment growth one standard deviation below the mean, (a city with .5% employment growth), an LBO firm increases prices by 3.8% while a non-LBO increases prices by 1.4%.

This regression also shows that firms tend to raise prices more when their rivals are highly leveraged. The coefficient of $OLBOSHARE$ is positive and statistically significant. This is evidence both that leverage leads to higher prices (for rivals) and that prices are strategic complements. In addition, the coefficient of $OLBOEMP$ is negative and statistically significant. Thus, firms tend to raise price more when their rivals are leveraged and they are competing in a local market that is experiencing low economic growth.

The size of this effect is also economically significant. The coefficients imply that in an average city, a non-LBO firm would increase its prices by 2.0% if LBO chains have a 14.9% share, but by 2.6% if LBO chains have a 30.0% share (a one standard deviation increase in the LBO share). The effect is even larger in markets with low employment growth; with an employment growth is 0.5%, an increase in the LBO share by one standard deviation from 14.9% to 30.0% would more than double the non-LBO firm's price increase, from 1.4% to 2.9%.

The second column of Table 7 repeats this specification for the longer time period, 1991:1 to 1992:4. The results are qualitatively similar, except that the coefficient $OLBOEMP$ statistically significant only at the 12% level. The rest of the coefficients continue to be statistically significant at greater than the 10% level.[21]

7. Conclusion

The theory and evidence presented here suggest that capital-market imperfections induce liquidity-constrained firms to increase markups during recessions and lower them during booms. This, in turn, may amplify the effects of demand shocks on output. One might argue,

[21]The basic results in Table 7 are robust to the inclusion of other controlling variables, such as the store share of the firm, the store share of the firm interacted with the LBO dummy, the store share of the firm interacted with the employment change, and the store share of the firm interacted with both the LBO dummy and the employment change. None of these other variables had statistically significant coefficients in either time period, however.

however, that capital-market imperfections are not likely to have an effect on the macroeconomy because firms which are not liquidity constrained will take up the slack. Our model and evidence points to the limitations of this argument. Since prices are strategic complements, unconstrained firms increase their markups during recessions in response to their constrained rivals. Thus, in essence, even though some firms are not liquidity constrained, they act as if they are constrained. This suggests that shocks to one set of firms — rather than being stabilized by other firms in the industry — are transmitted to other firms in the industry.

Of course, it may be difficult to apply our results to the economy as a whole because we study only one industry. It remains to be seen whether liquidity constraints can explain countercyclical markups for the macroeconomy. The fact that we find evidence of countercyclical markups in an industry that is not particularly cyclical suggests that the effects may be even more important in other industries.

Our results also point to another way in which shocks can be transmitted through the economy. We find that firms with high cash flows in divisions outside the oil states were better able to invest in market share during the recession in the oil states. By analogy, one would expect firms with low cash-flow divisions to invest less in their other divisions. Indeed, Lamont (1993) finds that the non-oil divisions of oil companies cut investment following the large drop in oil prices in 1986. Thus, a shock to one sector of the economy was transmitted to other sectors of the economy through the internal capital allocation mechanisms of corporations. Of course, the higher cash flows of the non-oil divisions may have reduced the effects of the shock to the oil sector. Whether, on net, conglomerates tend to transmit shocks or stabilize them is an empirical issue.

Finally, we note that this paper fits into a large body of work indicating that liquidity constraints can also have real effects on capital investment, inventory investment, and employment.[22] The studies tend to look at each of these factors separately, without attempt-

[22] See, Bernanke, Gertler and Gilchrist (1993) for a review.

ing to relate the findings to each other. However, one would expect, for example, that if firms cut back on inventory investment during recessions because of liquidity constraints, they would also increase markups for the same reason. This suggests that one should look not just at the movements of inventories, but also look at the the co-movements of inventories with markups. This is a standard approach used to test other macroeconomic theories and it should be applied to these theories as well.

Table 1

Summary Statistics

This table reports summary statistics for three samples we analyze in Tables 2 and 3 — cities in oil states during the period 1985:4 to 1987:1; cities in non-oil states during the same period; and cities in the macroeconomic recession of 1981:2 to 1982:4. $\Delta PRICE$ is the percentage change in price over the relevant period. $NATSHARE$ is a market-share weighted measure of the fraction of a city's chains that are national. $NOILSHARE$ is a market-share weighted measure of the fraction of a city's chains that operate outside the oil-producing states. ΔEMP is the percentage change in employment in the city's state over the relevant period. Standard deviations are reported in parentheses below the means.

Variables	Oil States	Non-oil States	81-82 Recession
$\Delta PRICE$	-0.035 (0.057)	0.000 (0.043)	-0.002 (0.044)
ΔEMP	-0.048 (0.035)	0.008 (0.019)	-0.026 (0.024)
$NATSHARE$	0.445 (0.181)	0.315 (0.231)	0.314 (0.197)
$NOILSHARE$	0.295 (0.125)		
Number of Observations	22	82	102

Table 2

Regression Results for the Oil States

This table reports the results of regressing the percentage change in a city's price index over the period 1985:4 to 1987:1, $\Delta PRICE$, on measures of the types of stores that are in a particular city. $NATSHARE$ is a market-share weighted measure of the fraction of a city's chains that are national. $NOILSHARE$ is a market- share weighted measure of the fraction of a city's chains that operate outside the oil-producing states. ΔEMP is the percentage change in employment over the period in the city's state. t-statistics are in parentheses below the estimated coefficients.

Variables	1	2	3	4
$NATSHARE$	-0.170 (-2.840)	-0.154 (-2.493)		
ΔEMP		-0.352 (-1.089)		-0.257 (-3.178)
$NOILSHARE$			-0.271 (-3.254)	-0.451 (-1.539)
Constant	0.041 (1.433)	0.017 (0.461)	0.045 (1.701)	0.019 (0.613)
$\bar{R}^2$	0.287	0.329	0.346	0.419
Number of Observations	22	22	22	22

Table 3

Regression Results for the Control States and the 1981-82 Recession

This table reports the results of regressing the percentage change in a city's price index over two different time periods, $\Delta PRICE$, on the state employment change during the period, ΔEMP and $NATSHARE$, a market-share weighted measure of the fraction of a city's chains that are national. The regressions for the non-oil states refer to the states during the period 1985:4 to 1987:1 that are not oil producing states. The 1981-82 recession covers 1981:2 to 1982:4. t-statistics are in parentheses below the estimated coefficients.

Variables	Non-Oil States	Non-Oil States	81-82 Recession	81-82 Recession
$NATSHARE$	-0.006 (-0.264)	-0.008 (-0.403)	0.009 (0.408)	0.003 (0.115)
ΔEMP		0.360 (1.458)		0.266 (1.440)
Constant	0.004 (0.440)	0.002 (0.187)	-0.004 (0.530)	0.005 (0.448)
$\bar{R}^2$	0.001	0.027	0.002	0.017
Number of Observations	82	82	102	102

Table 4

Summary Statistics

This table reports summary statistics for the sample of 59 Metropolitan Statistical Areas for which we have price data in 1990:2 and 1991:1. *LBOSHARE* is a market-share weighted measure of the fraction of a city's chains that undertook leveraged buyouts during the 1980s. ΔEMP is the percentage change in employment in the city's state over the relevant period. *EMPLBO* is *LBOSHARE* multiplied by ΔEMP. Standard deviations are reported in parentheses below the means.

Variables	
Price Change	0.006 (0.029)
ΔEMP	-0.022 (0.016)
LBOSHARE	0.246 (0.194)
EMPLBO	-0.005 (0.006)
Number of Observations	59

Table 5

Regression Results for the 1990-91 Recession

This table reports the results of regressing the percentage change in a city's price index from 1990:2 to 1991:1, $\Delta PRICE$ on the state employment change during the period, $DeltaEMP$, and measures of the market shares of supermarket chains that undertook leveraged buyouts, $LBOSHARE$. $EMPLBO$ is $LBOSHARE$ multiplied by ΔEMP. t-statistics are in parentheses below the estimated coefficients.

Variables	1	2	3
$LBOSHARE$	0.014 (0.710)	0.015 (0.742)	-0.031 (-1.016)
ΔEMP		-0.076 (-0.321)	0.492 (1.333)
$EMPLBO$			-2.171 (-1.974)
Constant	0.002 (0.347)	0.000 (0.029)	0.013 (1.242)
$\bar{R}^2$	0.009	0.011	0.076
Number of Observations	59	59	59

Table 6

Summary Statistics for 1990-91 Recession: Firm-Specific Data

This table reports summary statistics for the firm-specific data around the time of the 1990-91 recessions, from 1991:1 to 1991:4 and from 1991:1 to 1992:4. $\Delta PRICE$ is the percentage change in a firm's price index for a particular city; ΔEMP, the state employment change during the period; LBO a dummy variable equal to one if the firm is undertook an LBO; $LBOEMP$, LBO multiplied by ΔEMP; $OLBOSHARE$, a measure of the market shares of the other supermarket chains that undertook leveraged buyouts; $OLBOEMP$, $OLBOSHARE$ multiplied by ΔEMP. Standard deviations are reported below the means.

Variables	1991:1-1991:4	1991:1-1992:4
$\Delta PRICE$	0.023 (0.028)	0.080 (0.031)
LBO	.382	.393
$LBOEMP$	0.007 (0.012)	0.010 (0.021)
$OLBOSHARE$	0.149 (0.151)	0.152 (0.146)
$OLBOEMP$	0.002 (0.004)	0.004 (0.007)
ΔEMP	0.020 (0.015)	0.030 (0.028)
Number of Observations	110	89

Table 7

Regression Results for the 1990-91 Recession: Firm-Specific Data

This table reports the results of regressing $\Delta PRICE$, the percentage change in a particular firm's price index for a particular city on the following regressors: ΔEMP, the state employment change during the period; LBO a dummy variable equal to one if the firm is undertook an LBO; $LBOEMP$, LBO multiplied by ΔEMP; $OLBOSHARE$, a measure of the market shares of the other supermarket chains that undertook leveraged buyouts; $OLBOEMP$, $OLBOSHARE$ multiplied by ΔEMP. There are two time periods: 1991:1 to 1991:4 and 1991:1 to 1992:4. t-statistics are in parentheses below the estimated coefficients.

Variables	1991:1-1991:4	1991:1-1992:4
LBO	.030 (3.233)	.026 (2.703)
$LBOEMP$	-1.116 (-2.936)	-0.414 (-1.712)
$OLBOSHARE$	0.109 (3.472)	0.122 (3.542)
$OLBOEMP$	-2.851 (-2.209)	-1.293 (-1.591)
ΔEMP	0.712 (2.588)	0.382 (1.839)
Constant	-0.003 (-0.440)	0.049 (4.972)
$\bar{R}^2$	0.178	0.192
Number of Observations	110	89

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