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MARK UP FLUCTUATIONS IN U.S. MANUFACTURING AND TRADE: NEW EMPIRICAL EVIDENCE BASED ON A MODEL OF OPTIMAL STORAGE

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RÉSUMÉ

Une firme rationnelle qui vend un bien stockable est indifférente entre la vente d'une unité d'output additionnelle "aujourd'hui" et sa vente dans des périodes futures. Par conséquent, elle égalise le revenu marginal "aujourd'hui" à la valeur présente attendue du revenu marginal dans les périodes futures (moins le coût marginal du stockage). L'étude utilise cette condition d'Euler afin d'évaluer les propriétés cycliques des "mark-ups" des prix de vente par rapport aux revenus marginaux dans le secteur manufacturier ainsi que dans la vente en détail et en gros aux Etats-Unis. Des données désagrégées sont utilisées pour ces trois secteurs. L'étude conclut que les "mark-ups" sont généralement procycliques.

Mots-clés: comportement cyclique des "mark-ups", secteur manufacturier, vente en gros et de détail, stockage optimal, cycle économique.

ABSTRACT

An optimizing firm which sells a storable good equates the marginal revenue of that good "today" to the expected discounted marginal revenue in future periods (net of the marginal cost of storage). The paper uses this Euler condition to obtain information on the time series behavior of mark ups in U.S. manufacturing, wholesale trade and retail trade. Data at the two-digit SIC level are used. Mark ups appear to be procyclical in most of the two-digit sectors.

Key words: cyclical behavior of mark ups, manufacturing, wholesale and retail trade, optimal storage, business cycles.

1. Introduction

Much research has been devoted to the cyclical behavior of mark ups of sales price over marginal cost, but no consensus has been reached on whether mark ups are pro- or countercyclical. The goal of the present paper is to provide new empirical evidence on the cyclical behavior of mark ups. Information about the behavior of mark ups is important because it allows to discriminate between alternative models of firm and market behavior (see, e.g., Rotemberg and Woodford (1991) and Galeotti and Schiantarelli (1994) for a discussion of this point and for detailed references to the relevant literature). Also, variations in mark ups can have important macroeconomic consequences (e.g., Fitoussi and Phelps (1988), Rotemberg and Woodford (1992)), as well as consequences for the income distribution (e.g., Kalecki (1938)).

The key difficulty in computing mark ups of prices over marginal cost is the fact that marginal cost is not directly observable. Several methods for estimating marginal cost have been explored, with differing empirical conclusions concerning the cyclical behavior of mark ups.[1]

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[1] Domowitz et al. (1986) use data on average variable costs to estimate mark ups. Their approach is only justified if marginal cost schedules are horizontal (as then average variable costs equals marginal costs). The Domowitz et al. results suggest that mark ups are procyclical (particularly in highly concentrated industries). If marginal cost schedules are horizontal and fixed costs are zero, then the profit rate of a firm (the ratio of its profits to the value of sales) is an increasing function of its mark up. Empirically, profit rates are strongly procyclical (e.g., Machin and Van Reenen (1993)), which might suggest that mark ups too are procyclical. However, procyclical profit rates might merely reflect the existence of large fixed costs, as the ratio of fixed costs to sales falls when sales rise, and hence procyclical profit rates might be consistent with countercyclical mark ups.

Other researchers have attempted to use less crude specifications of cost functions (or, equivalently, of production functions). A key problem faced by this work is that the 'true' production functions of firms are unknown and that accurate data on effective utilization rates of factors of production are not available. This approach has been used, e.g., in papers by Bils (1987), Rotemberg and Woodford (1991), Morrisson (1993), Portier

The present paper proposes a new approach for studying the behavior of mark ups which focuses on mark ups of prices over marginal revenues. Note that optimal firm behavior implies that marginal revenues are equated to marginal cost. If this condition is satisfied, then the mark up concept used in earlier research is identical to that used in the present paper.

The paper exploits the prediction that an optimizing firm which sells a storable good equates its marginal revenue 'today' to the present discounted marginal revenue in future periods (minus the marginal benefit of storage). This Euler condition can be used to extract information on the behavior of mark ups from time series on sales prices. The Euler condition is estimated and tested using U.S. data for manufacturing, wholesale trade and retail trade. Data at the two-digit level of the Standard Industrial Classification (SIC) are used. The Euler condition which was just discussed appears to be consistent with the data. It appears that mark ups are procyclical in a majority of the two-digit sectors considered in this study. Among two-digit manufacturing industries, mark ups tend to be most procyclical in the sectors which are relatively weakly concentrated.

Section 2 of the paper presents the model of optimal storage which will be used to obtain information on the behavior of mark ups. Section 3 discusses the econometric method used to estimate and test the model. Section 4 presents the data and section 5 discusses empirical results. Section 6 concludes.

(1994), Galeotti and Schiantarelli (1994), Appelbaum (1982), Chirinko and Fazzari (1994) and by Domowitz et al. (1988). The first four studies suggest that mark ups are countercyclical. The findings of Appelbaum are mixed (inspection of Appelbaum's estimated mark up series suggest that mark ups are procyclical for 2 of the four sectors considered by that author and countercyclical in the remaining two). Chirinko and Fazzari as well as Domowitz et al. suggest that mark ups are procyclical or acyclical (depending on the industry).

2. Mark Ups and Optimal Storage

A risk neutral firm is considered which sells a storable good. The objective of the firm is to maximize the expected discount value of its profits. Let $R_t=R_t(S_t)$ be a function which specifies how much revenue the firm obtains in period t if it sells S_t units of its merchandise. R_t is assumed to be increasing and strictly concave in S_t. Furthermore, let Y_t be the firm's production of the good in period t (for a retail or wholesale firm, Y_t is interpreted as purchases of goods for resale). Let I_t be its stock of final goods inventories at the end of period t. Throughout the following analysis, the decisions of the firm concerning $\{Y_t\}$ will be taken as given and the focus will be on the firm's decisions concerning the timing of its sales.

The intertemporal decision problem of the firm is

$$\text{Max } E_\tau \sum_{t=\tau}^{t=\infty} B_{\tau,t} \cdot R_t(S_t) \tag{1}$$

subject to

$$I_t = I_{t-1}\cdot(1-c_{t-1}) + Y_t - S_t \tag{2}$$

$$\text{and} \quad S_t, I_t \geq 0 \text{ for all } t \geq \tau. \tag{3}$$

Here E_τ denotes expectations conditional on information available in period τ. $B_{\tau,t}$ is the discount factor used by the firm to discount its period t revenues back to period τ: $B_{\tau,\tau}=1$ and $B_{\tau,t}=B_{\tau,t-1}\cdot(1/(1+r_{t-1}))$ for $t>\tau$, where r_{t-1} is the one-period discount rate used by the firm to discount period t revenues back to t-1. Equation (2) if the law of motion of the firm's stock of inventories (this specification of the law of motion follows Miron and Zeldes (1987)). c_{t-1} denotes the fraction of inventories lost between periods t-1 and t. Clearly, storage generates costs (these costs reflect wear and tear, the rental cost of storage space, labor cost of handling inventories etc.). On the other hand, the literature on storage commonly assumes that storage generates a 'convenience yield' which might for example reflect the fact that higher inventories help a firm satisfy regular customers (see e.g., Brennan (1958)). In (2), the term $c_{t-1} \cdot I_{t-1}$ represents thus the *net* cost of storage, i.e. the storage costs proper minus the convenience yield (c_{t-1} may thus be negative--if the convenience yield is sufficiently large). Following much previous research on storage, it will be assumed that the net marginal cost of storage is a non-decreasing function of the stock of inventories: $\partial^2(c_{t-1} \cdot I_{t-1})/\partial I_{t-1}^2 \geq 0$.[2]

A key first order condition of the firm's optimization problem is:

$$R'_t = E_t \; (1/(1+r_t)) \cdot R'_{t+1} \cdot (1-\gamma_t), \tag{4}$$

where $R'_t \equiv \partial R_t(S_t)/\partial S_t$ is the marginal revenue of the firm in period t, while $\gamma_t \equiv \partial(c_t \cdot I_t)/\partial I_t$ is the net marginal cost of storage.

This Euler condition says that the added revenue from selling an additional unit of merchandise in period t equals, in expected present value terms, the added revenue which the firm obtains if it puts an extra unit of its merchandise into storage at date t in order to sell it at date t+1.[3]

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[2] See, e.g., Brennan (1958), Telser (1958), Blinder (1982) and Miron and Zeldes (1987). This condition, plus the assumed strict concavity of the revenue function of the firm, ensures that the firm's decision problem is well-behaved.

[3] Equation (4) is only a valid first order condition if the non-negativity constraints on inventories and sales (see (3)) do not bind.

Recent research has tested an Euler condition which pertains to the optimal intertemporal scheduling of *production*, namely the condition according to which an optimizing firm which produces a storable good equates its marginal cost in any given period to the expected discounted marginal cost in the following period (minus the net marginal cost of storage).[4] Note that, when marginal revenue is equated to marginal cost, this Euler condition is equivalent to the Euler condition considered in the present paper.

When firms face infinitely elastic demand curves, then the marginal revenue of their good equals its price. However, the following analysis allows for the possibility that marginal revenue and price differ. Let μ_t be the mark up of price (p_t) over marginal revenue:

$$\mu_t \equiv (p_t - R'_t)/R'_t. \tag{5}$$

Using (5), the Euler condition (4) can be written as:

$$1 = E_t(1/(1+r_t)) \cdot (p_{t+1}/p_t) \cdot ((1+\mu_t)/(1+\mu_{t+1})) \cdot (1-\gamma_t). \tag{6}$$

The tests presented below assume that the mark up depends on the firm's sales as well as on macroeconomic conditions. Specifically, it will be assumed that

$$1+\mu_t = \exp(b_0 + b_1 \cdot \hat{S}_t + b_2 \cdot \hat{u}_t), \tag{7}$$

It will be assumed throughout this paper that this condition is satisfied. In the data used in the empirical analysis, neither sales nor storage fall to zero in any period.

[4]Tests of this condition have yielded mixed results (e.g., Miron and Zeldes (1987) reject this condition, while test results by Kashyap and Wilcox (1993) and Eichenbaum (1989) are more favorable).

where b_0, b_1 and b_2 are parameters. $\hat{S}_t$ and $\hat{u}_t$ denote deviations of sales and of the unemployment rate from the respective trends of these series. Sales and the unemployment rate are used in detrended form in (7) because otherwise mark ups would be non-stationary: sales and the unemployment rate have upward trends in the data set used in this study.[5]

Finally, the net marginal cost of storage γ_t is assumed to be linearly related to $\hat{I}_t$, the deviation of the stock of inventories from the trend of that variable:

$$\gamma_t = a_0 + a_1 \cdot \hat{I}_t, \quad a_1 \geq 0 \tag{8}$$

Using equations (7) and (8), the Euler condition (6) can be written as:

$$1 = E_t(1/(1+r_t)) \cdot (p_{t+1}/p_t) \cdot \exp(-b_1 \cdot (\hat{S}_{t+1} - \hat{S}_t) - b_2 \cdot (\hat{u}_{t+1} - \hat{u}_t)) \cdot (1 - a_0 - a_1 \cdot \hat{I}_t). \tag{9}$$

Note that (9) does not permit to estimate the average level of the mark up (the parameter b_0 cannot be estimated from (9)).

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[5] Using sales and the unemployment rate in detrended rather than in undetrended form in (7) only has a minor effect on the estimation results because the key Euler condition to be tested below features first differences of these variables (see (9)).

3. Econometric Techniques

The Generalized Method of Moments (GMM) (Hansen (1982)) is used to estimate and test the Euler condition (9).

Let $\eta_{t+1} \equiv 1-(1/(1+r_t))\cdot(p_{t+1}/p_t)\cdot\exp(-b_1\cdot(\hat{S}_{t+1}-\hat{S}_t)-b_2\cdot(\hat{u}_{t+1}-\hat{u}_t))\cdot(1-a_0-a_1\cdot\hat{I}_t)$ and $Z_t \equiv (1,(1/(1+r_{t-1}))\cdot(p_t/p_{t-1}),\ \hat{S}_t,\ \hat{I}_t,\ \hat{u}_t,\ (1/(1+r_{t-2}))\cdot(p_{t-1}/p_{t-2}),\ \hat{S}_{t-1},\ \hat{I}_{t-1},\ \hat{u}_{t-1})$. Note that (9) implies $E_t\eta_{t+1}=0$. The GMM tests presented below use the following condition:

$$E\{\eta_{t+1}\cdot Z_t\}=0, \tag{10}$$

as well as the following first-moment conditions:

$$\sigma_S^2=E\{\hat{S}_t^2\},\ \sigma_u^2=E\{\hat{u}_t^2\},\ \sigma_{IP}^2=E\{\hat{IP}_t^2\},\ \sigma_{S,u}=E\{\hat{S}_t\cdot\hat{u}_t\},$$
$$\sigma_{S,IP}=E\{\hat{S}_t\cdot\hat{IP}_t\} \text{ and } \sigma_{u,IP}=E\{\hat{u}_t\cdot\hat{IP}_t\}. \tag{11}$$

In (11), $\hat{IP}_t$ denotes detrended aggregate U.S. industrial production; σ_S^2, σ_u^2, σ_{IP}^2, $\sigma_{S,u}$, $\sigma_{S,IP}$ and $\sigma_{u,IP}$ are variances and covariances of detrended sales, the detrended unemployment rate and of detrended aggregate industrial production (note that as these series are detrended, they have zero means). The GMM estimates presented below are based on the assumption that $\hat{S}_t^2$, $\hat{u}_t^2$, $\hat{IP}_t^2$, $\hat{S}_t\cdot\hat{u}_t$, $\hat{S}_t\cdot\hat{IP}_t$ and $\hat{u}_t\cdot\hat{IP}_t$ are moving average processes of order 12, i.e. that $E_{t-13}\hat{S}_t^2=\sigma_S^2$, $E_{t-13}\hat{u}_t^2=\sigma_u^2$ etc.. Conditions (10) and (11) yield a total of 15 moment conditions involving 10 parameters (i.e. there are 5 degrees of freedom).

Using (10) alone (without employing (11)) suffices to test the optimal storage model and to estimate its parameters.[6] (11) is used for the

[6] It appears that estimates of the model parameters and tests of the overidentifying restrictions are quite similar, irrespective of whether (10) is used alone or whether (10) and (11) are used jointly. To save space, only results which jointly use (10) and (11) are hence presented.

following reason: to assess the cyclicality of the mark up, the correlation between the mark up and the (detrended) aggregate unemployment rate, as well as the correlation between the mark up and (detrended) aggregate U.S. industrial production will be estimated. Denote these correlations by $\rho_{\mu,u}$ and $\rho_{\mu,IP}$ respectively. $\rho_{\mu,u}$ and $\rho_{\mu,IP}$ are functions of b_1, b_2, σ^2_S, σ^2_u, σ^2_{IP}, $\sigma_{S,u}$, $\sigma_{S,IP}$ and of $\sigma_{u,IP}$.[7] Joint estimation of (10) and (11) using GMM yields estimates of these parameters, as well as a covariance matrix of these estimates. This allows one to test statistical hypotheses concerning the correlations $\rho_{\mu,u}$ and $\rho_{\mu,IP}$.

4. The Data

The model is estimated using data for subsectors of U.S. manufacturing, wholesale trade and retail trade. 28 sectors defined at the two-digit SIC level are considered. A description of the sectors can be found in Appendix A. The discussions below focus on estimation results obtained for monthly time series for the period 1967:1-1994:9 (Appendix C provides estimation results based on annual data).

All sectoral data on prices, inventories and sales were obtained from the Bureau of Economic Analysis and from the Census Bureau. The time series on sales and inventories are expressed in constant dollars. Inventories are measured at the end of each month. For manufacturing, the inventory series

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[7] For small values of $\hat{S}_t$ and $\hat{u}_t$, we have: $(1+\mu_t-\exp(b_0))/\exp(b_0) \cong b_1\hat{S}_t+b_2\hat{u}_t$ (see (8)), which implies that (approximately) $\rho_{\mu,u}=(b_1\sigma_{S,u}+b_2\sigma^2_u)/[((b_1)^2\sigma^2_S+(b_2)^2\sigma^2_u+2b_1b_2\sigma_{S,u})\cdot\sigma^2_u]^{0.5}$. A similar expression holds for $\rho_{\mu,IP}$.

measure inventories of finished goods. Wholesale trade inventories represent stocks of merchandise owned by merchant wholesalers. Retail trade inventories represent stocks of goods held by stores and by warehouses that maintain supplies of merchandise intended for distribution to retail store (see Commerce Department (1994 a,b)).

The time series on constant dollar sales and inventories are only available in seasonally adjusted form (based on the X11 procedure). The price indexes too are seasonally adjusted.[8]

The discount rate r_t used for the tests is the U.S. prime loan rate (series FYPR from Citibase). The U.S. unemployment rate and the aggregate U.S. industrial production series used in the econometric analysis too are taken from Citibase (series LHUR and IP).

The time series for sales, inventories, the unemployment rate and aggregate industrial production used in this study were detrended by regressing logarithms of these series on a quadratic time trend. Additional information on the data is provided in Appendix B.

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[8]For two-digit manufacturing sectors, seasonally unadjusted producer price indexes are available from the Bureau of Labor Statistics, but these data cover the period 1985-94 only. Using the unadjusted prices series to estimate the model gives results very similar to those reported below.

For the sectors considered in this study, non-seasonally adjusted (NSA) as well as seasonally adjusted (SA) series for *current* dollar sales and inventories can be obtained from the Bureau of Labor Statistics and from the Census Bureau. Following a suggestion in Reagan and Sheehan (1985, p.234), NSA *constant* dollar series for inventories and shipments can be estimated by multiplying the SA constant dollar series for these variables by ratios of the corresponding NSA current dollar series to the SA current dollar series. The model was also estimated using NSA constant dollar series which were constructed according to this method. The key results concerning the cyclical behavior of mark ups are similar to those reported below. The model was also estimated using seasonally adjusted series on sales and inventories which were obtained by regressing the NSA constant dollar series (constructed according to the method suggested by Reagan and Sheehan) on monthly seasonal dummies; again, the results are basically unchanged.

5. Findings

Table 1 presents the main results. Panels (a), (b) and (c) of the Table show results for manufacturing, wholesale trade and retail trade respectively. Column (1) lists the sectors. Columns (2)-(4) report estimates of the parameters b_1, b_2 and a_1 (standard errors are shown in parentheses). Column (5) reports probability values of Hansen's (1982) J test of the overidentifying restrictions implied by conditions (10) and (11). The remaining columns show correlations between mark ups and the detrended economy wide unemployment rate ($\rho_{\mu,u}$) as well as correlations between markups and detrended aggregate U.S. industrial production ($\rho_{\mu,IP}$).[9] The figure reported in parentheses next to a given correlation coefficient is the probability value from a generalized Wald test (Amemiya (1985, p.145)) of the hypothesis that that correlation equals zero.

At the 10% level, Hansen's (1982) J test fails to reject the overidentifying restrictions for 21 of the 28 two-digit sectors (at the 1% level these restrictions fail to be rejected for 27 of the 28 sectors only).

Estimates of a_1 are positive in 19 of the 28 two-digit sectors, which is consistent with the assumption that the (net) marginal cost of storage is an increasing function of the stock of inventories. However, these estimates of a_1 are often statistically insignificant.

4.1. *Manufacturing Mark Ups*

Manufacturing mark ups are negatively related to sectoral sales and to the

[9] These correlations are computed from GMM estimates of b_1, b_2, σ^2_S, σ^2_u, σ^2_{IP}, $\sigma_{S,u}$, $\sigma_{S,IP}$ and of $\sigma_{u,IP}$ (see discussion above).

economy-wide unemployment rate (b_1 and b_2 are negative in most of the two-digit manufacturing sectors). In roughly three-fourth of the two-digit manufacturing industries at least one of the two coefficients b_1, b_2 is statistically significant at the 10% significance level (or below).[10] Hence, the hypothesis of a constant mark up is rejected for most two-digit manufacturing industries.

Mark ups are procyclical in a majority of the two-digit manufacturing sectors: the correlation between the mark up and the unemployment rate ($\rho_{\mu,u}$) is negative for 15 of the 20 manufacturing sectors; 13 of these negative correlations are statistically significant at the 10% level. Positive correlations between the mark up and aggregate industrial production obtain in 14 of the manufacturing sectors (11 of these positive correlations are statistically significant at the 10% level). The arithmetic average of the estimates of $\rho_{\mu,u}$ and of $\rho_{\mu,u}$ which obtain for the two-digit manufacturing sectors are -.49 and .30 respectively.

It seems interesting to investigate whether the cyclical behavior of mark ups depends on industry concentration.[11] To this end, the estimates of $\rho_{\mu,u}$ and of $\rho_{\mu,IP}$ reported in Table 1 for manufacturing sectors SIC 20-38 were regressed on a constant and on a four-firm concentration index. The concentration index used in these cross-section regressions is taken from Rotemberg and Saloner (1986, p.401).[12] The regression results are:

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[10] All significance levels discussed here and in what follows pertain to one-sided tests.

[11] There exists a vast literature on the relation between industry concentration (and, more generally, market structure) and the behavior of prices and mark ups (see, e.g., Scherer (1980) and Encaoua and Michel (1986), for detailed references to that literature).

[12] The values of the concentration index for SIC 20-38 are shown in Appendix A. SIC 20-38 are used because Rotemberg and Saloner only report concentration indexes for these sectors (concentration indexes for most of the remaining two-digit industries considered in Table 1 do not seem to be

$$\hat{\rho}^i_{\mu,u} = \underset{(0.36)}{-1.34} + \underset{(0.88)}{2.08}\cdot C^i + \varepsilon^i; \qquad R^2=.24. \qquad (13a)$$

$$\hat{\rho}^i_{\mu,IP} = \underset{(0.32)}{1.08} - \underset{(0.78)}{1.91}\cdot C^i + \eta^i; \qquad R^2=.25. \qquad (13b)$$

Here $\hat{\rho}^i_{\mu,u}$ and $\hat{\rho}^i_{\mu,IP}$ are the estimates of $\rho_{\mu,u}$ and $\rho_{\mu,IP}$ for sector i; C^i is the concentration index for that sector, while ε^i and η^i are regression residuals. The figures reported in parentheses below the regression coefficients are standard errors.

The regression results suggest that the correlation $\rho_{\mu,u}$ ($\rho_{\mu,IP}$) is positively (negatively) related to industry correlation.[13] Statistically, this relation is highly significant. Thus, mark ups tend to be more procyclical in two-digit manufacturing sectors in which concentration is relatively weak than in sectors in which concentration is high. The finding of a negative relation between concentration and the correlation of mark ups and aggregate industrial production is compatible with similar results by Rotemberg and Woodford (1991) (but note that Rotemberg and Woodford argue that mark ups are countercyclical; i.e. they conclude that mark ups are more countercyclical in highly concentrated sectors than in less concentrated sectors). It contrasts with the findings of Domowitz et al. (1986) who argue that increases in concentration are associated with more procyclical price-cost margins.

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readily available).

[13]This conclusion can also be reached by noting that for the sectors (among SIC 20-38) for which the concentration index is smaller than the median concentration index (which equals .345), the average values of $\rho_{\mu,u}$ and $\rho_{\mu,IP}$ are -.78 and .58 respectively. For the remaining sectors, the average values of $\rho_{\mu,u}$ and $\rho_{\mu,IP}$ are -.32 and .14 respectively.

4.2. *Mark Ups in Trade*

In 7 of the 8 trade sectors, at least one of the two coefficients b_1, b_2 is statistically significant at the 10% level. Hence, the hypothesis of a constant mark ups is clearly rejected for the trade sectors too. Mark ups in trade are negatively related to the unemployment rate (estimates of b_2 are generally negative). Mark ups appear to be procyclical in most of the two-digit trade sectors. The arithmetic averages of the correlations $\rho_{\mu,u}$ and $\rho_{\mu,IP}$ estimated for the 8 two-digit trade sectors are -.68 and .43 respectively. In 7 of the 8 two-digit trade sectors, correlations between mark ups and the unemployment rate are negative (5 of these 7 correlations are statistically significant at the 5% level). Positive correlations between mark ups and industrial production obtain in 6 of the trade sectors (5 of these positive correlations are significant at the 10% level).

4.3. *Estimation Results For Annual Time Series*

All estimation results discussed so far pertain to monthly data. Results for annual data are reported in Appendix C. The key qualitative findings are unchanged when annual data are used. In particular, the estimation results confirm that mark ups are procyclical in a majority of the two-digit industries and that mark ups tend to be most procyclical in manufacturing industries in which concentration is relatively low (see Appendix C).

6. Conclusion

The evidence presented in this paper suggests that mark ups are procyclical in most U.S. two-digit manufacturing and trade sectors. In manufacturing, mark ups tend to be particularly procyclical in those sectors which are relatively weakly concentrated.

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TABLE 1. GMM Estimation Results

(1) Sector	(2) b_1	(3) b_2	(4) $a_1 \cdot 10^2$	(5) p-value of J test	(6) $\rho_{\mu,u}$	(7) $\rho_{\mu,IP}$
			(a) Manufacturing			
20	-.38 (.12)**	-.10 (.13)	.10 (2.27)	.39	-.88 (.00)	.55 (.12)
21	-.05 (.02)*	.35 (.21)‡	.87 (.80) §	.18	.99 (.00)	-.85 (.00)
22	-.00 (.09)	-.37 (.06)**	.68 (1.25)	.13	-.99 (.00)	.79 (.00)
23	-.03 (.04)§	-.11 (.05)*	.35 (.71)	.53	-.99 (.00)	.78 (.00)
24	.00 (.11)	-.52 (.12)**	-.54 (1.79)	.02	-.99 (.00)	.84 (.00)
25	-.06 (.05)§	-.10 (.04)**	3.46 (1.47)**	.19	-.98 (.00)	.76 (.00)
26	-.35 (.24)*	-.13 (.18)	-6.09 (3.76)*	.06	-.83 (.09)	.46 (.47)
27	.05 (.04)§	-.01 (.05)	.75 (.87) §	.58	-.91 (.00)	.68 (.02)
28	-.32 (.28)§	-.00 (.22)	-2.76 (3.47)	.17	.36 (.88)	-.56 (.75)
29	-1.77 (.34)**	.33 (.89)	-7.85 (5.93)‡	.26	.56 (.47)	-.61 (.26)
30	-.25 (.09)**	-.05 (.07)	1.48 (.89) *	.04	-.02 (.97)	-.30 (.63)
31	-.02 (.03)	-.19 (.08)**	.14 (1.15)	.06	-.99 (.00)	.83 (.00)
32	-.05 (.09)	-.16 (.20)	.65 (5.95)	.69	-.99 (.00)	.78 (.00)
33	-.19 (.12)‡	-.36 (.25)‡	-3.77 (2.38)‡	.07	-.93 (.00)	.62 (.00)
34	-.06 (.07)§	-.10 (.05)*	-.95 (1.74)	.21	-.98 (.00)	.69 (.00)
35	-.19 (.23)§	.12 (.19)	-6.87 (4.63)‡	.68	.85 (.02)	-.90 (.00)
36	.03 (.13)	-.04 (.06)	-.68 (1.87)	.89	-.92 (.00)	.87 (.00)
37	-.05 (.08)	-.05 (.14)	.41 (2.12)	.06	-.82 (.61)	.58 (.76)
38	-.18 (.08)*	-.09 (.11)§	.85 (.75) §	.32	-.89 (.00)	.68 (.07)
39	-.14 (.07)*	.00 (.17)	4.25 (2.32)*	.63	.36 (.87)	-.58 (.71)
			(b) Wholesale trade			
50	.00 (.15)	-.17 (.07)*	5.79 (2.24)**	.66	-.99 (.00)	.82 (.00)
51	-.25 (.11)*	-.05 (.17)	5.02 (2.87)*	.15	-.68 (.73)	.49 (.78)
			(c) Retail trade			
52	.00 (.09)	-.19 (.05)**	0.10 (1.00)	.18	-.99 (.00)	.84 (.00)
53	.69 (.09)**	-.13 (.06)*	1.93 (1.31)‡	.00	-.84 (.00)	.84 (.00)
54	-.14 (.06)**	.01 (.05)	-1.30 (.94) ‡	.20	.77 (.04)	-.50 (.20)
55	.07 (.04)‡	-.11 (.04)*	0.83 (.54) ‡	.11	-.96 (.00)	.86 (.00)
56	-.10 (.12)§	.01 (.14)	0.21 (2.78)	.17	-.80 (.71)	-.64 (.72)
57	-.01 (.08)	-.11 (.04)**	.84 (1.11)	.63	-.99 (.00)	.80 (.00)

Notes--Sample period is 1967:1-94:9. Monthly data are used for estimation.
Column (1): SIC codes.
Columns (2)-(4): parameter estimates; standard errors in parentheses.
Estimates of a_1 (and corresponding standard errors) are multiplied by 100.
**, *, ‡, §: parameter significant at 1%, 5%, 10% and 20% significance levels respectively (based on one-sided hypothesis tests).
Column (5): the probability value of Hansen's (1982) J test of overidentifying restrictions.
Columns (6)-(7): $\rho_{\mu,u}$ and $\rho_{\mu,IP}$ are the correlation between the mark up and the unemployment rate and the correlation between the mark up and U.S. industrial production, respectively. The figure reported in parentheses next to a given correlation coefficient is the p-values of a generalized Wald test of the hypothesis that that correlation equals zero.

APPENDIX A. SIC Codes for Two-Digit Industries

(1) Sic Code	(2) Industry	(3) Concentration Index
	(a) Manufacturing	
20	Food & kindred products	.345
21	Tobacco manufactures	.736
22	Textile mill products	.341
23	Apparel & other textile products	.197
24	Lumber & wood	.176
25	Furniture & fixtures	.216
26	Paper & allied products	.312
27	Printing & publishing	.189
28	Chemicals & allied products	.499
29	Petroleum refining & related industries	.329
30	Rubber & misc. plastics products	.691
31	Leather & leather products	.245
32	Stone, clay, glass, concrete products	.374
33	Primary metals industries	.429
34	Fabricated metals products	.291
35	Machinery, except electrical	.363
36	Electrical & electronic equipment	.450
37	Transportation equipment	.650
38	Instruments & related products	.478
39	Miscellaneous manufacturing industries	
	(b) Wholesale Trade	
50	Wholesale trade--durable goods	
51	Wholesale trade--nondurable goods	
	(c) Retail Trade	
52	Building materials, hardware, garden supply, and mobile home dealers	
53	General merchandise stores	
54	Food stores	
55	Automotive dealers & gasoline service stations	
56	Apparel & accessory stores	
57	Furniture, home furnishings & equipment stores	

Notes--Column (3) provides four-firm concentration indexes for SIC 20-38 (Source is Rotemberg and Saloner (1986, Table 2), with the exception of the index for SIC 37, which is taken from Galeotti and Schiantarelli (1994, Table 1).

APPENDIX B. The Data

i. Manufacturing

The data on manufacturing **shipments** and **inventories** used in this study were obtained from the Bureau of Economic Analysis (BEA), a division of the U.S. Commerce Department. These data are in constant dollars and they are seasonally adjusted. The inventories are stocks of final goods inventories (measured at the end of each month).

The manufacturing **price indexes** used in this study were constructed from different datasets provided by the BEA and by the U.S. Census Bureau. The BEA computes deflators for shipment made by industries defined at the two-digit SIC level. These deflators are available for the period 1977:1-1994:9. They are seasonally adjusted. These deflators were used as a measure of sales prices for this period. To obtain manufacturing price indexes for the period prior to 1977, data on current dollar shipments (seasonally adjusted) made by two-digit manufacturing industries during the period 1967:1-1977:1 were used (the source of these data is the Census Bureau). Price indexes for shipments during 1967:1-1977:1 were constructed by dividing the current dollar shipment series (provided by the Census Bureau) by the constant dollar shipment series provided by the BEA. This price index was multiplicatively spliced together with the BEA shipments deflators in order to obtain price series for the period 1967:1-1994:9.

ii. Wholesale Trade

Data on **sales** and **inventories** (end-of-month) of merchant wholesalers during the period 1967:1-1994:9 as well as **price indexes** for sales made by wholesaler during the period 1977:1-1994:9 were obtained from the BEA. These series are seasonally adjusted and they are expressed in constant dollars. These data were obtained from the BEA at the 3-digit SIC level. The sales and inventories series were aggregated (by summation across subsets of 3-digit groups) to yield sales and inventories series at the 2-digit level.

Paasche price indexes (with baseline 1987) were constructed for two-digit SIC groups using the price and shipments indexes available at the three-digit SIC level for the period 1977:1-1994:9. To obtain price indexes for the period prior to 1977, monthly time series on current dollar sales (seasonally adjusted) made by merchant wholesaler (measured at the two-digit SIC level) during the period 1967:1-1977:1 were used. That data is available from the Census Bureau. Price indexes for the period 1967:1-1977:1 were obtained by dividing the current dollar sales series by the constant dollar sales series constructed from BEA data. These price indexes were spliced together with the price deflators constructed for the period 1977:1-1994:9.

iii. Retail Trade

Data on retail trade **sales** and **inventories** (end-of-month) as well as **price indexes** for retail sales covering the period 1967:1-1994:9 were obtained from the BEA. These data are available from the BEA at the two-digit SIC level (in seasonally adjusted form).

APPENDIX C. Estimation Results--Annual Data

Estimation results based on annual time series are presented in the Table below. The annual time series are generated as follows: the annual series on prices, inventories and the unemployment rate are annual averages of the corresponding monthly series which are used for Table 1. Annual series on industry sales, aggregate industrial production are obtained by computing annual sums of the corresponding monthly series. Likewise, the annual interest rate used below is the sum of the monthly interest rates used for Table 1.

The econometric set up is the same as for Table 1 (i.e. the data are detrended using the same method, the same moment conditions are used for GMM etc.), with one exception: $\hat{S}_t^2$, $\hat{u}_t^2$, $\hat{IP}_t^2$, $\hat{S}_t \cdot \hat{u}_t$, $\hat{S}_t \cdot \hat{IP}_t$ and $\hat{u}_t \cdot \hat{IP}_t$ are assumed to be MA(2) processes (compared to Table 1, the assumed order of the MA process was reduced, because the number of periods usable for the estimation would otherwise be too small).

A cross-sectional regression of the correlations $\rho_{\mu,u}$ and $\rho_{\mu,IP}$ reported in the Table below for manufacturing sectors SIC 20-38 on the concentration indexes for these sectors yields:

$$\hat{\rho}^i_{\mu,u} = \underset{(0.28)}{-1.28} + \underset{(0.68)}{2.32} \cdot C^i + \varepsilon^i; \qquad R^2 = .40.$$

$$\hat{\rho}^i_{\mu,IP} = \underset{(0.27)}{0.93} - \underset{(0.64)}{1.93} \cdot C^i + \eta^i; \qquad R^2 = .34.$$

GMM Estimation Results for Annual Time Series

(1) Sector	(2) b_1	(3) b_2	(4) a_1	(5) p-value of J test	(6) $\rho_{\mu,u}$	(7) $\rho_{\mu,IP}$
			(a) Manufacturing			
20	-2.81 (.80)**	-.23 (.09)**	.29 (.39)	.44	-.70 (.00)	.40 (.09)
21	.12 (.15)	.03 (.03)§	.09 (.06)‡	.32	.85 (.00)	-.66 (.01)
22	-.30 (.18)‡	-.23 (.03)**	.62 (.12)**	.49	-.90 (.00)	.67 (.00)
23	-.18 (.15)§	-.06 (.04)‡	.25 (.08)**	.31	-.76 (.01)	.44 (.24)
24	-.34 (.23)‡	-.46 (.08)**	.27 (.24)§	.16	-.95 (.00)	.81 (.00)
25	-.38 (.17)*	-.21 (.05)**	.84 (.17)**	.15	-.64 (.09)	.27 (.52)
26	-1.50 (.93)‡	-.29 (.18)*	-.17 (.51)	.18	-.56 (.05)	.18 (.56)
27	-.06 (.38)	-.11 (.07)‡	.26 (.14)*	.14	-.99 (.00)	.90 (.00)
28	-2.66 (.50)**	-.61 (.16)**	.66 (.35)*	.84	-.00 (.98)	-.25 (.08)
29	-1.66(1.25)‡	.11 (.25)	-1.41 (.55)**	.43	.36 (.33)	-.36 (.29)
30	-.71 (.20)**	-.31 (.09)**	.51 (.09)**	.71	-.39 (.06)	.04 (.83)
31	-.05 (.24)	-.19 (.05)**	-.13 (.17)	.17	-.99 (.00)	.86 (.00)
32	-1.84 (.51)**	-.44 (.18)**	-1.46 (.53)**	.20	.14 (.53)	-.33 (.10)
33	-1.10 (.84)‡	-.50 (.32)‡	-.39 (.26)‡	.95	-.29 (.20)	-.04 (.82)
34	-.71 (.47)‡	-.27 (.20)‡	-.35 (.33)§	.16	-.51 (.12)	.07 (.84)
35	-1.36 (.66)*	-.35 (.24)‡	-1.02 (.53)*	.43	.00 (.97)	-.31 (.11)
36	-.00 (.19)	-.01 (.09)	-.40 (.17)*	.20	-.97 (.35)	.80 (.70)
37	-.20 (.06)**	.06 (.04)§	-.47 (.11)**	.25	.88 (.00)	-.84 (.00)
38	.04 (.39)	-.05 (.10)	.12 (.11)§	.16	-.99 (.00)	.87 (.00)
39	-.65 (.15)**	-.14 (.05)**	.88 (.15)**	.66	-.16 (.53)	-.17 (.48)
50	.18 (.34)	-.07 (.04)*	.15 (.18)	.17	-.92 (.00)	.92 (.00)
51	-1.17 (.47)**	-.13 (.06)*	-.25 (.28)§	.40	.32 (.29)	-.09 (.74)
52	.17 (.27)	-.05 (.09)	.55 (.18)**	.10	-.89 (.00)	.91 (.00)
53	.18 (.34)	-.07 (.04)*	.15 (.18)	.17	-.92 (.00)	.92 (.00)
54	-1.17 (.47)**	-.13 (.06)*	-.25 (.28)§	.40	.32 (.29)	-.09 (.74)
55	.17 (.05)**	-.04 (.02)*	.32 (.03)**	.16	-.79 (.00)	.74 (.00)
56	-2.94(1.96)‡	-.06 (.13)	-.65 (.50)‡	.78	.28 (.20)	-.20 (.38)
57	-1.13 (.59)*	-.31 (.14)*	-.04 (.42)	.40	-.22 (.43)	-.03 (.91)

Notes--Sample period is 1967-93. Annual data are used for estimation.
Column (1): SIC codes.
Columns (2)-(4): parameter estimates; standard errors in parentheses. **, *, ‡, §: parameter significant at 1%, 5%, 10% and 20% significance levels respectively (based on one-sided hypothesis tests).
Column (5): the probability value of Hansen's (1982) J test of overidentifying restrictions.
Columns (6)-(7): $\rho_{\mu,u}$ and $\rho_{\mu,IP}$ are the correlation between the mark up and the unemployment rate and the correlation between the mark up and U.S. industrial production, respectively. The figure reported in parentheses next to a given correlation coefficient is the p-values of a generalized Wald test of the hypothesis that that correlation equals zero.

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