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MARKET STRUCTURE AND CYCLICAL FLUCTUATIONS IN U.S. MANUFACTURING

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ABSTRACT

The relevance of imperfect competition for models of aggregate economic fluctuations has received increased attention from researchers in both macroeconomics and industrial organization. Measuring properly the size of industry markups of price over marginal cost is important both for assessing the role of market structure and for determining the extent to which excess capacity is a significant feature accompanying imperfect competition in American industry. Using a panel data set on four-digit Census manufacturing industries, this paper expands recent work by Robert Hall on the importance of market structure for understanding cyclical fluctuations.

We outline a methodology for estimating industry markups of price over cost and the influence of market structure on cyclical movements in total factor productivity. While we find evidence to support the proposition that price exceeds marginal cost in U.S. manufacturing, our results offer only limited support for the notion that markups are importantly related to differences in industry concentration, though the effect of unionization is important. Concentration effects are important only in industries producing durable goods or differentiated consumer goods. In addition, much of the estimated markup of price over marginal cost is accounted for by fixed costs related to overhead labor, advertising, and central office expenses; we do not find compelling evidence of substantial evidence of excess capacity in most industries.

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I. INTRODUCTION

The relevance of imperfect competition for models of aggregate economic fluctuations has received increased attention from researchers in both macroeconomics and industrial organization.[1] In particular, Hall has focused attention in a series of papers (1986a, 1986b, 1986c, 1986d) on the importance of market structure for understanding cyclical fluctuations. He shows (1986b) that price substantially exceeds marginal cost in many (two-digit-level) industries, evidence against the hypothesis of perfect competition, and that the gap between price and marginal cost explains the procyclical movements in total factor productivity long studied in empirical macroeconomics. The excess of price over marginal cost is reconciled with the observation of low average profit rates in most industries by asserting the importance of excess capacity.

Measuring properly the size of industry markups of price over marginal cost is important both for assessing the role of market structure and for determining the extent to which excess capacity is a significant feature accompanying imperfect competition in American industry. There is a long tradition in applied industrial organization of estimating the influence of market structure and industry characteristics on calculated (usually Census measures of) price-cost margins (see the reviews of studies in Domowitz, Hubbard, and Petersen, 1986a, 1986b). In this paper, we present a new method for estimating the gap between price and marginal cost for various groups of industries, and discuss its importance for explaining observed procyclical movements in total factor productivity. This new approach avoids many of the problems with inferring information about markups of price over marginal cost from Census price-cost margins, which are calculated with respect to average variable cost (see the discussion in Domowitz, Hubbard, and Petersen, 1986c).

Our departure from Hall's pioneering effort centers on two areas of empirical refinement. First, we focus on manufacturing, and make use of a more disaggregated panel data set of 284 four-digit S.I.C. industries to consider a richer description of potential market structure influences on cyclical fluctuations stemming from interindustry variation in concentration, import competition, and unionization. Second, we take into account the importance of intermediate inputs ("materials") in production. This addition turns out to be important for assessing the extent of realized industry market power (as measured by the markup of price over cost). We use these modifications to evaluate conclusions about the significance of imperfect competition for cyclical fluctuations.

The paper is organized as follows. Our methodology for estimating industry price-cost markups and the influence of market structure on cyclical movements in total factor productivity (the "Solow residual") is outlined in section II. We present econometric tests of alternative explanations of observed procyclical movements in the Solow residual in section III. In particular, we cast doubt on the "real business cycle" interpretation--i.e., that procyclical movements in the Solow residual are consistent with perfect competition in the presence of productivity disturbances common across industries. While we find evidence to support the proposition that price exceeds marginal cost in American manufacturing, our results offer only limited support for the notion that markups are importantly related to differences in industry concentration, though the effect of unionization is quantitatively important. Concentration effects are important only in industries producing durable goods or differentiated consumer goods. In section IV, we attempt to reconcile the price-cost margins calculated in section II with the low average profit rates observed in manufacturing. Much of the price-cost margin is accounted for by fixed costs related to overhead labor, advertising, and central office expenses; we do not find compelling evidence of substantial excess capacity in most industries. Conclusions and implications are reviewed in section V.

II. MARKET STRUCTURE AND CYCLICAL MOVEMENTS IN PRODUCTIVITY

Modeling Strategy

We approach the task of measur'ng the relevance of departures of price from marginal cost by modifying the framework suggested by Hall. Consider first a simrle production function in which, for the ith industry in period t, output Q is produced with constant returns to scale from capital K and labor L according to

$$(1) \qquad Q_{it} = A_{it}\, e^{\gamma_i} K_{it} f(L_{it}/K_{it}),$$

where A and γ represent a neutral shift in productivity and the rate of Hicks-neutral technical progress, respectively. Let $q = \ell n(Q/K)$, and let $\ell = \ell n(L/K)$. Then, as noted by Hall, differentiating with respect to time and approximating with discrete changes yields

$$(2) \qquad \Delta q_{it} = \gamma_i + \Delta a_{it} + \frac{A_{it} L_{it} e^{\gamma_i} f'(L_{it}/K_{it})}{Q_{it}} \Delta \ell_{it} ,$$

where $a = \ell n\ A$. Using the definition of marginal cost as the ratio of the wage to the marginal product of labor, we express the markup of price over marginal cost by $1/(1-\beta)$, where

$$(3) \qquad p_{it} = \frac{1}{1-\beta_{it}} \quad \frac{w_{it}}{A_{it} e^{\gamma i} f'(L_{it}/K_{it})} \quad .$$

That is. β has the interpretation of a price-cost margin (i.e., (P-MC)/P). Using this expression, we can rewrite (2) as

$$(4) \qquad \Delta q_{it} = \gamma_i + \Delta a_{it} + \frac{1}{1-\beta_{it}} \left(\frac{wL}{pQ}\right)_{it} \Delta \ell_{it}.$$

Denoting the labor share by α_L, we can reexpress (4) as

$$(5) \qquad \Delta q_{it} - \alpha_{Lit} \Delta \ell_{it} = \gamma_i (1-\beta_{it}) + \Delta a_{it}(1-\beta_{it}) + \beta_{it} \Delta q_{it} + u_{it},$$

where u is a random error term in productivity, which is assumed to be uncorrelated with aggregate fluctuations.[2] Given this assumption about the error term, it is the excess of price over marginal cost which gives rise to a positive estimate of β.

This estimate of the markup of price over marginal cost is upward biased because of the exclusion of materials in the calculation of marginal cost. Only in the (unlikely) case wherein the change in materials use is uncorrelated with the change in output will estimates of the margin be unbiased. If, however, materials use changes in strict proportion to output, the formula governing the relationship between the ratio of price to marginal cost based on value added μ and the true markup μ^* can be expressed as

$$\mu^* = \frac{\mu}{1 + (\mu - 1)\,\omega},$$

where ω is the ratio of materials cost to the value of output (see also Hall, 1986b).[3] For average materials shares in manufacturing, the potential mismeasurement of the markup is quite large.

More generally, of course, production is a function of intermediate inputs as well--i.e., "materials." We let M denote materials, so that $m = \ell n(M/K)$ and α_M represents the materials share in the value of output. It is straightforward to show that

$$(6) \qquad \Delta q_{it} - \alpha_{Lit}\, \Delta \ell_{it} - \alpha_{Mit}\, \Delta m_{it} = \gamma_i\, (1-\beta_{it}) + \Delta a_{it}\, (1-\beta_{it}) + \beta_{it}\, \Delta q_{it} + u_{it}.$$

Using aggregate time-series data and individual time-series for two-digit industries, Hall emphasized that a positive estimate of β reflects the idea that the Solow (1957) residual measure of the growth rate of total factor productivity (the left-hand side of equation (6)) can be explained by the deviation of price from marginal cost (recall that $P/MC = (1-\beta)^{-1}$). If we assume for the moment that

$$(7) \qquad \Delta a_{it} = 0, \ \forall_i\, , \ \forall_t\, ,$$

and let β_{it} depend on a set of market structure characteristics X, so that

$$(8) \qquad \beta_{it} = \bar{\beta} + \beta' X_{it} ,$$

we can rewrite (6) as

$$(9) \qquad \Delta q_{it} - \alpha_{Lit} \Delta \ell_{it} - \alpha_{Mit} \Delta m_{it} = \gamma_i (1-\bar{\beta}-\beta' X_{it}) + (\bar{\beta} + \beta' X_{it}) \Delta q_{it} + u_{it}.$$

Empirical examination of the model in equation (9) involves tests of the hypotheses that $\bar{\beta}$ is nonzero and that β_{it} is a function of industry characteristics reflecting market structure.

<u>Estimating Cyclical Movements in Total Factor Productivity</u>

To address the obvious simultaneity problem with using Δq on the right-hand side of (9), we use an instrumental-variables procedure. Under the assumption of no common element to productivity disturbances across industries, we can use an aggregate demand variable as an instrument (so long as no individual industry is large relative to the economy). We use current and lagged real GNP growth as such instruments. As a test of robustness, we also use current and lagged values of the rate of growth of real military purchases and the rate of growth of the relative price of imports as (arguably) exogenous aggregate variables. The use of these instruments does not require assumptions incompatible with the real business cycle view.

The omission of individual industry effects not captured by our current information set can bias coefficient estimates obtained by OLS. The availability of longitudinal data, however, allows us to account for unobservable time-invariant industry differences. We estimate the model using the standard fixed-effects, within-group estimator. As in Hall (1986b,c), we set $\beta' = 0$, in order to allow direct comparison of results. Estimations over the period from 1958 to 1981 are carried out using the panel data base of 284 four-digit Census manufacturing industries described in Domowitz, Hubbard, and Petersen (1986a, 1986b). The results are in Table 1 for all industries and for decompositions by broad categories: (i) industries producing producer goods versus consumer goods, (ii) durable goods versus nondurable goods, and (iii) goods produced to order versus goods produced to stock.[4] The two columns report estimation results using the GNP growth instrument and the military and imports price instruments, respectively.

Three features of the results presented in Table 1 are particularly noteworthy. First, under our assumption about u_{it}, the estimated value of the Lerner index ((P-MC)/P) for all industries on average of about 0.36 indicates that price substantially exceeds marginal cost in U.S. manufacturing. Second, as expected from the inclusion of materials in variable cost, the estimated price-cost margins are significantly lower than the value-added markups studied by Hall. Third, there is little interindustry variation in cyclical movements in productivity (and implied markups of price over cost) according to the broad categories in Table 1—producer and consumer goods, durable and nondurable goods, and goods produced to order and stock. Results obtained under the two sets of instruments are qualitatively similar; in the work that follows, we report only those results using the real GNP growth instruments.

To provide information on a more disaggregated level, we pool the four-digit industry data into two-digit groups. Estimates of equation (9) maintaining $\beta' = 0$ for each two-digit industry group are reported in Table 2. We use these estimates in summary fashion in Table 3. The first two columns of Table 3 report the labor and materials shares in the value of output (tabulations are averages over the 1958-1981 period); there is considerable variation in the data, but in all cases the materials share is large relative to the labor share. The next two columns contrast Hall's (1986b) implied estimates of the price-cost margin[5] with estimates using the data described above which include materials in measuring costs. The last column is presented for purposes of comparison with calculations from the raw data, and shows the Census price-cost margin[6] exclusive of payments to non-production workers ("overhead labor").

Hall concluded that there was substantial market power in the paper, chemicals, primary metals, and transportation equipment industries. Each of these industries has substantial materials shares in output. Moreover, comparing the rankings in the third and fourth columns points up some important differences. For example, none of the industry groups noted by Hall has an estimated markup of price over marginal cost greater than that for all industries reported in Table 1.

Both the findings we present and those of Hall attribute the procyclical movements in total factor productivity to a significant gap between industry price and marginal cost. Strictly speaking, however, the empirical results could be explained in a competitive setting given specification errors. Hall (1986d) goes through a careful review of potential biases--most notably through cyclical variation in work effort, measurement errors in hours, the possibility of increasing returns to scale, and the possibility of sticky prices--and shows them to be very small, and often in a direction amplifying our results. We do not repeat such an analysis here.

III. EXPLANATIONS FOR PROCYCLICAL BEHAVIOR OF THE SOLOW RESIDUAL

Procyclical Solow Residuals and Perfect Competition

The discussion in the previous section indicates some testable hypotheses regarding links between the markup of price over marginal cost and the Solow residual. Before proceeding to econometric work, however, we consider a possible alternative explanation for the observed procyclical movements in total factor productivity -- the existence of aggregate real business cycles.[7] A key identifying assumption in our model and that of Hall is that productivity disturbances across broad industry groups are uncorrelated.[8] An alternative interpretation of the procyclical movement of the Solow residual is that industries are characterized by perfect competition (in the sense that price equals marginal cost), but that productivity disturbances are correlated across industry groups; that is, there is an aggregate real business cycle in the economy. Hall dismisses this possibility by assumption. We provide some evidence on this point below.

Our approach is a simple one; we consider the correlations in innovations in the Solow residual across industries. High positive correlations would indicate that our identifying assumption about u_{it} is a poor one; that is, "real business cycles" would be important.[9] Operationally, we estimate equation (9) for all industries, setting $\beta \equiv 0$, and calculate the simple correlations of the innovations across four-digit classifications. We then average the correlations across two-digit classifications, in order to provide useful summary statistics.[10] The results of this procedure for some selected two-digit industries are reported[11] in Tabl 4A.

Although the averaging of correlations makes a formal test difficult, it is clear that the estimated correlations are quite small, and sometimes negative. There is only limited support for the notion of real business cycle effects; correlations over the post-1973 period are generally larger than those estimated for the 1958-1973 period, reflecting the oil shocks during the 1970s.

Negative correlation is evidence against the productivity-shock explanation of the cycle, however. Imposing the extremely strong prior that negative correlations across four-digit classifications must be spurious leads to the results reported[12] in Table 5A. Even there, correlations are "large" only for the post-1973 period. We note that our model accounts only for disembodied tech ical change. The residuals used to obtain these correlations still may contain a cyclical component which should be positively correlated across industries, due the embodiment of technological change not accounted for in the model; i.e., vintage effects could be important, but we still find the correlations to be small. In summary the assumption in Hall (1986c) and in the empirical work below--that movements in productivity growth are not causal factors explaining the business cycle--is consistent with the data.

The correlations reported in Tables 4A and 4B may be biased downward if, indeed, the real business cycle is reflected in GNP, given that aggregate output is used as an instrumentable variable in the regressions. The same sets of correlations are reported in Tables 4B and 5B, based on residuals produced from equation (9) based on the use of the exogenous military spending and import price variables as instruments. Although the reported correlations increase slightly over those reported in Tables 4A and 4B, the increases are very small, and our qualitative conclusions remain unchanged.

Imperfect Competition and the Price-Cost Margin: Market-Structure Effects

As noted in section II, the explanation for the observed procyclical movements in the Solow residual on which we focus our attention is that price exceeds marginal cost in most industries; that is, information about price-cost markups can be inferred from estimating models of the form of equation (9). It is possible to test, then, whether variation in such estimated markups across groups of industries reflects differences in market structure. While such differences in market structure are difficult to define operationally, we consider three measures--industry concentration (as measured by the four-firm concentration ratio),[13] import competition, and unionization. Each is discussed in turn below.

Theory gives some guidance here as to the expected magnitudes of the Lerner index of market power as a function of market structure and industry behavior. For a given industry, a firm's price-cost margin can be expressed as

$$\frac{P-MC_i}{P} = \frac{s_i(1+\psi_i)}{\eta} \quad ,$$

where s_i is the firm's market share, ψ_i is its conjectural variation (the ith firm's guess about the output response of all other firms), and η is the industry demand elasticity. Some reference points of interest include the monopoly outcome, PCM = $1/\eta$, and the Cournot outcome, PCM = s_i/η.

We use industry data, and we can derive industry expressions by aggregating across firms. For example, if marginal cost were equal to average variable cost for each firm, the monopoly and Cournot outcomes become PCM = $1/\eta$ and PCM = H/η, respectively where H is the Herfindahl index of concentration.[14] Using reasonable assumptions about demand elasticities and Herfindahl indices, Domowitz, Hubbard, and Petersen (1986c) concluded using Census data that price-cost margins (the relative markup of price over cost inclusive of the cost of materials) were much closer to the Cournot predictions than the monopoly predictions. This finding is consistent with the results in recent cross-sectional studies by Alberts (1984) and Salinger (1984).

Employing the same panel data used here, we found in Domowitz, Hubbard, and Petersen (1986a, 1986b) evidence of only a weak positive association between concentration and Census price-cost margins. Our basic data for four-firm concentration ratios (C4) across industries and over time are taken from the Census of Manufactures. For some industries, however the concentration measurements reported by the Census are significantly biased because of inappropriate specification of product boundaries by the SIC classifications, or for those industries for which markets are regional instead of national because of low value-to-weight ratios. We make use of a met culous study by Weiss and Pascoe (1981), which adjusts concentration ratios for inappropriate product groupings and geographic fragmentation.

We report in Table 6 results for estimating the basic model in (9) for various concentration groupings. The first two rows report margin estimates according to[15] $C4 < 50$ or $C4 > 50$. The lack of difference in the two estimates is striking. In the next two rows, we decompose concentrated industries into producer-goods and consumer-goods categories. The estimated margin is higher in consumer-goods industries.[16] It is clear from the estimates in Table 6 that procyclical movements in the Solow residual do not depend importantly on domestic industry concentration.

An obvious qualification to these results is that the measure of concentration used ignores the role of entry by **foreign** firms, an important phenomenon in recent years. Recent studies have isolated important effects of import competition on price-cost margins (see for example Domowitz, Hubbard, and Petersen, 1986a; and the review of studies in Caves, 1985). We account for the role of import competition by multiplying the concentration ratio by one minus the imports-to-sales ratio (I/S). From equation (8), we allow β_{it} to be a function of this adjusted concentration ratio, so that

$$(8') \qquad \beta_{it} = \bar{\beta} + \beta \; C4_{it}(1-(I/S)_{it}).$$

Coefficient estimates corresponding to the model in equation (9) are reported in Table 7 for the broad categories enumerated in Table 1. Concentration differences do not appear to be important for all industries on average or for producer-goods industries. Concentration effects are important, though, in consumer-goods industries and in durable-goods industries. The relative importance of industry concentration for explaining margins in consumer-goods industries as opposed to producer-goods industries is consistent with the evidence for Census price-cost margins in Domowitz, Hubbard and Petersen (1986a). The strong results for durable-goods industries are of interest, since these industries comprise the most cyclical portion of U.S. manufacturing.

We also consider the proposition that imperfect competition in the labor market is important. Several recent studies have found a negative relationship between unionization and measures of industry profitability.[17] Specifically, we analyze jointly the effects of concentration and unionization on the implied margin. That is, we express the margin in equation (8) as

$$(8'') \qquad \beta_{it} = \beta_i + \beta_1 \, C4_{it}(1-(I/S)_{it}) + \beta_2 \% \, UNION_i ,$$

where $\% \, UNION_i$ refers to the percentage of workers unionized in the ith industry. To quantify the role of unionism, we use data on the percentage of total workers covered by union bargaining agreements reported for three-digit S.I.C. industries in Freeman and Medoff (1979).[18] Freeman and Medoff point out that no consistent longitudinal data on unionization exist; we treat the Freeman-Medoff series as a fixed effect. Results for the categories of industries considered in Table 7 are presented in Table 8. While there is evidence for a slight positive effect of concentration on the estimated margin for all industries in general, that effect is again most economically important for consumer-goods industries and durable-goods industries as in Table 7. It is clear from the coefficient estimates that while concentration is not generally important in explaining the interindustry variation in β, unionization is. There are two features of these results. The results for all industries imply that the estimate of β is reduced by about one-third when union coverage equals 100 percent relative to when it is zero.[19] That is, unions are obtaining part of the rents implied by the positive markup of price over marginal cost. The most substantial effect of unions on the estimated margin is found in durable-goods industries. Second, with respect to cyclical movements in the Solow residual, these results suggest that "labor hoarding" is less important in unionized industries (i.e., that layoffs in bad times are more common).

The estimates reported in Tables 7 and 8 ignore the interactive effect of the industry-specific rate of Hicks-neutral technological progress on the concentration, import competition, and unionization measures. In effect, the coefficients on those variables may be interpreted as embodying the average rate of technical progress in a random-coefficients model of such a process. An alternative approach is to assume that the rate of technological change varies among the two-digit industrial categories, but is identical within two-digit classifications. As results based on this assumption differed little from those in Tables 7 and 8, we do not present them here.

The clear conclusion of the previous section is that price substantially exceeds marginal cost in U.S. manufacturing industries, though markups and the implied procyclical movements in the Solow residual are not significantly related to differences in industry concentration.

IV. IMPLICATIONS OF "HIGH" INDUSTRY MARKUPS

It is of course, important to reconcile the notion of relatively high price-cost markups with low average observed profit rates. The explanation must be the existence of relatively large fixed costs of production. The identity of these fixed costs is of interest for policy considerations. If fixed costs are traceable primarily to capital, considerable "excess capacity" may exist in U.S. manufacturing, and output can be expanded without greatly elevating marginal cost. If the source of fixed cost is not primarily capital, adding more labor to the production process will probably reduce the marginal product of labor. In this case, high price-cost margins may exist in equilibrium together with a rapidly rising marginal cost schedule should firms expand output much beyond average levels of production.

To provide a connection between the markups of price over marginal cost estimated in section III and observed rates of profit (relative to sales), we note that

$$(10) \qquad pQ = wL + p_M M + F + F' + \pi,$$

where p_M represents the unit cost of materials, F and F' represent fixed costs of capital and other fixed costs, respectively, and π represents pure profit.

Table 9 reports two categories of non-capital fixed costs of production--plant overhead labor (payments to non-production workers) and central office expenditures. Central office expenditures consist of both central office workers and advertising. Defining managerial labor to be a fixed input and production workers to be a variable input is likely to lead to an underestimate of the true degree of the fixed labor cost if there is any labor hoarding. The estimates in the second column in Table 9 then are probably underestimates of the true degree of fixed labor costs.

Comparing the first column of Table 3 with the second column of Table 9 reveals that for many industries, the managerial component of labor expenditures is nearly as great as that for production workers. That is, overhead labor is likely to be a very important component of fixed cost. Good examples are industry groups 25 (printing and publishing) and 38 (instruments and related products), which also have the highest estimated price-cost margins. It is also apparent that some industries have significant levels of central office expenditures--for example, 21 (tobacco products) and 28 (chemicals and allied products). Average industry capital-output ratios are reported in the fourth column of Table 9. Given any reasonable assumption about rates of depreciation and the cost of capital (see for example the estimates in Jorgenson and Sullivan, 1981), the fixed costs attributable to the sum of plant overhead labor and central office expenditures are as large as those attributable to capital for most industry groups.

An "adjusted margin" is computed in the fifth column by subtracting the two categories of fixed costs from the price-cost margin estimated previously. The adjusted margin in most industries is below 0.30, with the exceptions being industry groups 21 (tobacco products), 27 (printing and publishing), 32 (stone, clay, and glass products), and 38 (instruments and related products). It is clear from the last two columns in the table that average profit rates will be low for most industries, as expected; exceptions include industry groups 21 (tobacco products), 27 (printing and publishing), and 38 (instruments and related products).

Hall (1986a, 1986b) argues that the joint occurrence of high margins and low average profit rates is explained by "chronic excess capacity" in manufacturing industries. Such a situation could be consistent with equilibrium in an industry where minimum optimal scale is a large fraction of total industry output.[20] However, minimum efficient scales relative to industry output in U.S. manufacturing are typically quite small (see for example Scherer, et al., 1975; and Scherer, 1980), so that it is difficult to imagine an industry equilibrium with substantial excess capacity for this reason alone. Moreover, engineering and economic studies have largely concluded that long-run cost curves at the plant level are much less steep at suboptimal plant scales than is suggested by many textbook diagrams (Scherer et al., 1975; Weiss, 1975). Scherer, et al. (1975) calculate the percentage increase in unit costs in the long run as a consequence of operating at only one-third of the size of the minimum efficient scale, and find them generally to be not very significant.

While excess capacity in capital does not seem to be of primary importance here, it would be interesting to consider the possibility of "excess labor" based on, say, specific-human-capital considerations in manufacturing industries. If labor were perceived incorrectly in the data as being entirely variable cost, then measured average variable cost would exceed marginal cost, providing a partial explanation for the gap between price-cost markups and observed profit rates noted by Hall and for the procyclical movements of Census price-cost margins (which are defined with respect to average variable cost) noted by Domowitz, Hubbard, and Petersen (1986a,1986b).

V. CONCLUSIONS AND IMPLICATIONS

Links between the industrial organization of markets and macroeconomic outcomes are receiving increasing theoretical and empirical attention. We begin by exploiting the connection researched by Hall that procyclical movements in productivity are reflective of imperfect competition in industrial product markets. By using highly disaggregated data on U.S. manufacturing industries, we are able to test explicitly for the influences on markups of price over marginal cost and total factor productivity movements over the cycle of such market-structure variables as industry concentration and the extent of unionization and foreign competition. Our principal findings were stated in the introduction.

Our findings indicate two promising extensions for future research. First, the relative importance of union effects over measures of concentration in explaining markups in homogeneous-goods manufacturing industries points firmly in the direction of an explicit consideration of cyclical movements in costs in industries characterized by imperfect competition in both labor and product markets. Second, to the extent that price exceeds marginal cost in many industries, firms are demand-constrained, so long as marginal cost is constant or not too steeply sloped over the relevant range. Further research on the shape of marginal cost schedules may thus have important implications for macroeconomics as well as for industrial economics.

Notes

1 See for example the papers by Hart (1982), Mankiw (1985), Akerlof and Yellen (1985), Blanchard and Kiyotaki (1985), Hubbard and Weiner (1985), and Rotemberg and Saloner (1986a).

2 That is, the phenomenon of "real business cycles," in which industry productivity movements are highly correlated (because of common rea shocks) is ruled out. We return to this point later.

3 The magnitude of the overstatement clearly depends on the magnitude of ω. We find (see Table 1) that ω is approximately 0.5 on average, and that there is substantial variation across industries) at the 4-digit level of disaggregation.

4 The producer-goods/consumer-goods classification is taken from Ornstein (1975). Ornstein's classification is based on the percentage of shipments of output for final demand in four categories; consumption, investment, materials, and government. If fifty percent or more of an industry's output went to consumption, it was classified as a consumer goods industry; if fifty percent of more went to investment plus materials, it was classified as a producer-goods industry. Information for the classification of industries according to "produce-to-order" versus "produce-to-stock" was taken from Belsley (1969). Durable-goods and nondurable-goods industries were defined as follows. Durable goods are assumed to be capital goods--for use either by households or firms. With few exceptions, the set of durable-goods industries includes the fo lowing two-digit categories: 25 (Furniture), 35 (Machinery Except Electrical Machinery), 36 (Electronic Equipment), 37 (Transportation Equipment), and 38 (Instruments and Related Products). Exceptions include the following four-digit industries: 3562 (Ball Bearings), 3565 (Industry Patterns), 3625 (Carbon and Graphite Products), 3691 (Storage Batteries), 3692 (Primary Batteries-Dry and Wet), and 3694 (Engine Electrical Equipment).

5 Hall estimated the price-cost ratio (P/MC), which is converted to a price-cost margin ((P-MC)/P) in Table 1.

6 This version of the Census price-cost margin is defined as

$$\frac{\text{Value Added-Production Worker Payroll}}{\text{Value Added + Cost of Materials}}.$$

7 Another possibility which we do not consider in much detail is that important cyclical movements in the labor share exist in the data as a result of overtime and that the marginal cost of labor exceeds the straight-time wage (see for example Bils, 1985). Overtime hours relative to total hours are nontrivial in many manufacturing industries (see the summary information below), but the labor share is sufficiently small that distortions in the margin are not very significant.

Two-Digit-Industry	Overtime Hours/Total Hours
20	0.093
21	0.041
22	0.086
23	0.035
24	0.085
25	0.066
26	0.110
27	0.075
28	0.072
29	0.076
30	0.083
31	0.045
32	0.099
33	0.077
34	0.080
35	0.086
36	0.059
37	0.087
38	0.059

Data on overtime hours are taken from Employment and Earnings, United States, 1909–1985; U.S. Department of Labor, Bureau of Labor Statistics, 1986.

[8] It is, of course, likely that within a two-digit category, productivity innovations are correlated across constituent four-digit industries.

[9] The model of Kydland and Prescott (1982) depends on an aggregate productivity disturbance as the driving variable for the cycle. Some models employed in the literature on real business cycles (in particular that of Long and Plosser, 1983) do, however, produce cyclical fluctuations with shocks uncorrelated across sectors.

[10] Let the 4-digit indices i and j run over two-digit industries I and J, and suppose that there are N four-digit industries in I and M four-digit industries in I and M four-digit industries in J. Let e_{kt} denote a residual from equation (9) for a four-digit industry k. The estimated covariance between industries i and j is

$$s_{ij} = (1/T) \sum_{t=1}^{T} e_{it}\, e_{jt}.$$

The covariance between I and J is then

estimated as $(1/MN) \sum_{j=1}^{m} \sum_{i=1}^{n} s_{ij}$.

[11] The industries are textiles (22), lumber (24), chemicals (28), petroleum (29), rubber (30), primary metals (33), machinery (35), and motor vehicles (37). This list includes basic industries for which productivity shocks may be important, and excludes "secondary industries;" e.g., lumber and wood (24) is included, but furniture

and paper are not. Chemicals, petroleum, and rubber require consideration given the importance of oil shocks.

[12]Negative correlations are simply set to zero in the averaging process. Otherwise, the calculations are the same as for Table 5.

[13]We do not have data on Herfindahl indices, but they are highly positively correlated with the four-firm concentration ratio.

[14]That is, $H = \sum_i s_i^2$. Time-series data on Herfindahl indices are not available. However, all available evidence at the four-digit level of disaggregation, including the thorough (though somewhat dated) study by Nelson (1963), indicate that H values above 0.35 are very rare.

[15]The results were not particularly sensitive to the choice of dividing point.

[16]The concentrated producer-goods industries correspond to the trigger-pricing industries examined by Green and Porter (1984) and Rotemberg and Saloner (1986b). See the more detailed discussion in Domowitz, Hubbard, and Petersen (1986c).

[17]Several recent studies have found that unions reduce industry price-cost margins; see for example Freeman (1983), Salinger (1984), Karier (1985), and Domowitz, Hubbard, and Petersen (1986b).

[18]The data are averages from information gathered in 1966, 1970, and 1972 by the Bureau of Labor Statistics Expenditures on Employee Compensation Surveys.

[19]This compares with estimated reductions in Census price-cost margins of 17-23 percent in Freeman (1983) and 25 percent in Domowitz, Hubbard, and Petersen (1986b).

[20]Hall's assertion of Chamberlin an competition may well be accurate for industries engaged in the production of consumer goods, where product differentiation is important. One can imagine that advertising and investment in building "brand loyalty" are the important fixed costs. It is harder to make such arguments for industries manufacturing homogeneous producer goods.

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TABLE 1

ESTIMATES OF CYCLICAL EFFECT ON PRODUCTIVITY*
(For Major Categories of Manufacturing Industries)

Set of Industries	GNP Instrument		Military and Import Price Instruments	
	$\hat{\Delta q}$	$\bar{R}^2$	$\hat{\Delta q}$	$\bar{R}^2$
All Industries	0.363 (0.004)	0.877	0.376 (0.004)	0.878
Producer Goods	0.365 (0.004)	0.882	0.373 (0.004)	0.883
Consumer Goods	0.353 (0.010)	0.861	0.368 (0.008)	0.864
Durable Goods	0.377 (0.007)	0.912	0.397 (0.006)	0.919
Nondurable Goods	0.356 (0.005)	0.865	0.362 (0.004)	0.866
Produce to Order	0.366 (0.004)	0.883	0.377 (0.004)	0.886
Produce to Stock	0.336 (0.011)	0.855	0.354 (0.007)	0.858

*The equations were estimated using fixed effects and instrumental variables, as described in the text. Corrected standard errors are in parentheses. The estimation interval was 1958 to 1981.

TABLE 2

ESTIMATES OF CYCLICAL EFFECT ON PRODUCTIVITY*

(For Two-Digit Categories of Manufacturing Industries)

	Industry Group	$\hat{\Delta q}$	$\bar{R}^2$
20:	Food and Kindred Products	0.307 (0.021)	0.830
21:	Tobacco Products	0.481 (0.087)	0.966
22:	Textile Mill Products	0.258 (0.021)	0.801
23:	Apparel	0.324 (0.022)	0.857
24:	Lumber and Wood Products	0.287 (0.082)	0.872
25:	Furniture and Fixtures	0.391 (0.014)	0.941
26:	Paper and Allied Products	0.322 (0.023)	0.869
27:	Printing and Publishing	0.547 (0.023)	0.926
28:	Chemicals and Allied Products	0.349 (0.022)	0.895
29:	Petroleum and Coal Products	0.320 (0.020)	0.931
30:	Rubber and Miscellaneous Plastic Products	0.357 (0.040)	0.933
31:	Leather and Leather Products	0.238 (0.045)	0.871

TABLE 2
(continued)

Industry Group	$\hat{\Delta q}$	$\bar{R}^2$
32: Stone, Clay, and Glass Products	0.432 (0.011)	0.930
33: Primary Metals	0.266 (0.009)	0.891
34: Fabricated Metals	0.394 (0.010)	0.908
35: Machinery, Except Electrical	0.378 (0.012)	0.926
36: Electric Machinery, Electronic Equipment	0.399 (0.011)	0.922
37: Transportation Equipment	0.259 (0.019)	0.856
38: Instruments and Related Products	0.516 (0.023)	0.952

*The equations were estimated using fixed effects and instrumental variables, as described in the text. The estimation interval was 1958 to 1981. Corrected standard errors are in parentheses.

TABLE 3

PRICE-COST MARGINS UNDER ALTERNATIVE DEFINITIONS

Two-Digit Industry	Labor Share in Output[a]	Materials Share in Output[a]	Hall's Price-Cost Margin[b]	Alternative Estimated Price-Cost Margin (Including Materials Cost)	Alternative Price-Cost Margin (Excluding Overhead Cost)
20: Food and Kindred Products	5.7%	46.6%	0.676	0.307	0.296
21: Tobacco Products	8.6	56.6	0.219	0.481	0.348
22: Textile Mill Products	16.9	58.2	0.048	0.258	0.249
23: Apparel	18.3	51.0	0.231	0.324	0.279
24: Lumber and Wood Products	17.4	58.2	0.000	0.287	0.244
25: Furniture and Fixtures	16.3	41.1	0.275	0.391	0.338
26: Paper and Allied Products	16.5	52.2	0.627	0.322	0.313
27: Printing and Publishing	20.7	31.4	0.379	0.547	0.480
28: Chemicals and Allied Products	10.0	45.5	0.705	0.349	0.445
29: Petroleum and Coal Products	6.9	67.1	N.A.	0.320	0.260
30: Rubber and Miscellaneous Plastic Products	20.6	46.2	0.291	0.357	0.332
31: Leather and Leather Products	19.7	51.9	0.371	0.238	0.284
32: Stone, Clay, and Glass Products	20.1	38.8	0.448	0.432	0.382
33: Primary Metals	15.3	59.6	0.545	0.266	0.244
34: Fabricated Metals	17.0	45.1	0.281	0.394	0.345
35: Machinery, Except Electric Machinery	17.0	40.1	0.281	0.378	0.385
36: Electronic Equipment	15.4	42.7	0.301	0.399	0.396
37: Transportation Equipment	17.5	54.4	0.517	0.259	0.278
38: Instruments and Related Products	17.1	35.7	0.225	0.516	0.472

Note: [a] Calculations are based on the four-digit industry data over the 1958-1981 period described in Domowitz, Hubbard, and Petersen (1986a, 1986b).

[b] Estimates are taken from Hall (1986b).

TABLE 4A

RESIDUAL CORRELATIONS FOR SELECTED TWO-DIGIT INDUSTRIES*

1958 - 1981

SIC							
22	---						
24	.220	---					
28	-.029	-.035	---				
29	.099	.098	.084	---			
30	.025	-.041	.118	.035	---		
33	.185	.280	.051	.201	.074	---	
35	-.068	-.013	-.021	-.050	-.085	-.071	
37	.193	.294	-.025	.182	.030	.213	-.051

1958 - 1973

SIC							
22	---						
24	.120	---					
28	-.055	-.084	---				
29	-.071	.019	.061	---			
30	.135	.049	.184	.016	---		
33	.156	.167	.041	.118	.255	---	
35	-.045	.004	-.058	-.001	-.189	.369	---
37	.170	.272	-.057	.099	.111	.209	.036

1974 - 1981

SIC							
22	---						
24	.405	---					
28	-.024	.008	---				
29	.080	.172	.051	---			
30	-.087	-.125	-.022	-.055	---		
33	.270	.412	.041	.211	-.116	---	
35	-.050	-.121	.017	-.146	.049	-.095	---
37	.290	.418	-.019	.313	-.064	.275	-.120

*Based on 92 four-digit industries. Residuals are taken from equation (9) in the text, with $\beta \equiv 0$.

TABLE 4B

RESIDUAL CORRELATIONS FOR SELECTED

TWO-DIGIT INDUSTRIES*

1958 - 1981

SIC								
22	---							
24	.231	----						
28	-.021	-.009	---					
29	.108	.119	.093	---				
30	.036	.011	.120	.043	---			
33	.202	.306	.064	.219	.102	---		
35	-.054	-.022	-.025	-.040	-.091	-.067	---	
37	.202	-.059	-.012	.193	.053	-.104	-.036	---

1958 - 1973

22	---							
24	.089	---						
28	-.060	-.148	---					
29	.072	-.016	.049	---				
30	.116	-.100	.178	.178	---			
33	.136	.106	.015	.114	.185	---		
35	-.067	.011	-.048	-.017	-.200	-.095	---	
37	.141	.257	-.074	.086	.051	.167	-.056	

1974 - 1981

22	---							
24	.421	---						
28	.057	.111	---					
29	.162	.266	.109	---				
30	-.016	-.010	-.029	-.035	---			
33	.360	.525	.124	.332	-.071	---		
35	.006	-.040	-.009	-.082	.021	-.040	---	
37	.307	.450	.080	.364	.002	.377	-.048	---

*Based on 92 four-digit industries. Residuals are taken from equation (9) in the text, with $\beta \equiv 0$.

TABLE 5A

RESIDUAL CORRELATIONS FOR SELECTED TWO-DIGIT INDUSTRIES*

1958 - 1981

SIC							
22	---						
24	.254	---					
28	.088	.083	---				
29	.136	.139	.164	---			
30	.127	.093	.195	.124	---		
33	.223	.292	.138	.221	.137	---	
35	.080	.087	.112	.078	.089	.085	---
37	.224	.311	.096	.214	.138	.259	.099

1958 - 1973

SIC							
22	---						
24	.188	---					
28	.094	.058	---				
29	.148	.125	.171	---			
30	.222	.113	.302	.139	---		
33	.216	.214	.150	.186	.285	---	
35	.110	.111	.125	.146	.098	.109	---
37	.228	.297	.099	.189	.220	.268	.138

1974 - 1981

SIC							
22	---						
24	.451	---					
28	.165	.204	---				
29	.178	.223	.209	---			
30	.139	.099	.126	.179	---		
33	.347	.442	.218	.296	.106	---	
35	.152	.131	.195	.093	.204	.146	---
37	.371	.460	.190	.342	.236	.350	.137

---

*Based on 92 four-digit industries. Residuals are taken from equation (9) in the text with $\beta \equiv 0$. Negative four-digit correlations are truncated at zero.

TABLE 5B

RESIDUAL CORRELATIONS FOR SELECTED TWO-DIGIT INDUSTRIES*

1958 - 1981

SIC								
22	---							
24	.263	---						
28	.092	.099	---					
29	.143	.150	.173	---				
30	.135	.113	.197	.131	---			
33	.235	.315	.148	.237	.150	---		
35	.086	.094	.109	.086	.086	.090	---	
37	.231	.317	.103	.224	.151	.274	.106	---

1958 - 1973

SIC								
22	---							
24	.167	---						
28	.093	.047	---					
29	.143	.113	.161	---				
30	.210	.045	.309	.140	---			
33	.201	.178	.137	.175	.240	---		
35	.102	.117	.132	.140	.094	.101	---	
37	.215	.282	.098	.182	.197	.239	.127	---

1974 - 1981

SIC								
22	---							
24	.460	---						
28	.225	.292	---					
29	.227	.288	.254	---				
30	.160	.153	.137	.209	---			
33	.414	.534	.282	.381	.127	---		
35	.185	.196	.188	.127	.206	.183	---	
37	.378	.487	.268	.388	.269	.422	.184	---

---

*Based on 92 four-digit industries. Residuals are taken from equation (9) in the text with $\beta \equiv 0$. Negative four-digit correlations are truncated at zero.

TABLE 6

MEASURING EFFECTS OF CONCENTRATION AND STRATEGIC BEHAVIOR ON MARGINS*

Industries (Concentration Grouping)	$\hat{\Delta q}$	$\bar{R}^2$
C4 < 50	0.363 (0.005)	0.877
C4 > 50	0.365 (0.007)	0.885
C4 > 50 (Producer Goods)	0.360 (0.008)	0.875
C4 > 50 (Consumer Goods)	0.393 (0.005)	0.891

*The equations were estimated using fixed effects and instrumental variables, as described in the text. Corrected standard errors are in parentheses. The estimation interval was 1958 to 1981.

TABLE 7

CONCENTRATION, IMPORT COMPETITION, AND MARGINS*

Industries	C4(1-I/S)	$\Delta\hat{q}$	C4(1-I/S) $\Delta\hat{q}$	$\bar{R}^2$
All Industries	0.009 (0.007)	0.351 (0.013)	0.021 (0.028)	0.880
Producer Goods	0.017 (0.009)	0.362 (0.014)	-0.003 (0.029)	0.883
Consumer Goods	-0.005 (0.012)	0.263 (0.038)	0.235 (0.093)	0.877
Durable Goods	-0.029 (0.015)	0.294 (0.030)	0.209 (0.060)	0.914
Nondurable Goods	0.018 (0.008)	0.365 (0.015)	-0.032 (0.031)	0.873
Produce to Order	0.010 (0.009)	0.347 (0.015)	0.036 (0.031)	0.878
Produce to Stock	0.006 (0.012)	0.370 (0.040)	-0.059 (0.075)	0.881

*The equations were estimated using fixed effects and instrumental variables, as described in the text. Corrected standard errors are in parentheses. The estimation interval was 1958 to 1981.

TABLE 8

CONCENTRATION, UNIONIZATION, AND MARGINS*

Industries	C4(1-I/S)	$\Delta\hat{q}$	C4(1-I/S) $\Delta\hat{q}$	% UNION ($\Delta\hat{q}$)	$\bar{R}^2$
All Industries	0.009 (0.007)	0.431 (0.018)	0.054 (0.029)	-0.140 (0.020)	0.875
Producer Goods	0.019 (0.009)	0.457 (0.020)	0.030 (0.029)	-0.158 (0.020)	0.880
Consumer Goods	-0.005 (0.012)	0.304 (0.051)	0.269 (0.102)	-0.090 (0.070)	0.866
Durable Goods	-0.030 (0.014)	0.478 (0.049)	0.163 (0.059)	-0.242 (0.050)	0.915
Nondurable Goods	0.020 (0.008)	0.423 (0.020)	-0.002 (0.033)	-0.104 (0.030)	0.868
Produce to Order	0.014 (0.009)	0.430 (0.020)	0.066 (0.032)	-0.143 (0.020)	0.874
Produce to Stock	-0.004 (0.012)	0.409 (0.058)	-0.064 (0.096)	-0.005 (0.009)	0.875

*The equations were estimated using fixed effects and instrumental variables, as described in the text. Corrected standard errors are in parentheses. The estimation interval was 1958 to 1981.

ACCOUNTING FOR INDUSTRY PRICE-COST MARKUPS

Two-Digit Industry Group	Estimated Price-Cost Margin[a]	Plant Overhead Labor[b]	Central Office Expenditures[c]	Capital-Output Ratio[d]	Adjusted Margin[e]
20: Food and Kindred Products	0.307	0.057	0.034	0.398	0.216
21: Tobacco Products	0.481	0.026	0.083	0.252	0.372
22: Textile Mill Products	0.258	0.051	0.021	0.528	0.186
23: Apparel	0.324	0.062	0.017	0.165	0.245
24: Lumber and Wood Products	0.287	0.040	0.008	0.579	0.239
25: Furniture and Fixtures	0.391	0.084	0.016	0.302	0.291
26: Paper and Allied Products	0.322	0.068	0.022	0.925	0.232
27: Printing and Publishing	0.547	0.137	0.028	0.365	0.382
28: Chemicals and Allied Products	0.349	0.071	0.112	0.934	0.166
29: Petroleum and Coal Products	0.320	0.043	0.042	0.495	0.235
30: Rubber and Miscellaneous Plastic Products	0.357	0.023	0.054	0.857	0.270
31: Leather and Leather Products	0.238	0.070	0.031	0.169	0.137
32: Stone, Clay, and Glass Products	0.432	0.075	0.034	0.777	0.323
33: Primary Metals	0.266	0.051	0.016	0.603	0.199
34: Fabricated Metals	0.394	0.080	0.023	0.442	0.291
35: Machinery, Except Electric Machinery	0.378	0.114	0.028	0.402	0.236
36: Electronic Equipment	0.399	0.089	0.054	0.404	0.256
37: Transportation Equipment	0.259	0.085	0.027	0.387	0.147
38: Instruments and Related Products	0.516	0.123	0.046	0.327	0.347

[a] See Table 3.
[b] Calculations use the data described in Domowitz, Hubbard, and Petersen (1986a, 1986b).
[c] Information was used from the data base described in Domowitz, Hubbard, and Petersen (1986a, 1986b).
[d] The ratio of the real net capital stock to real output (average over the 1958-1981 period).
[e] The adjusted margin is just the estimated price-cost margin less the adjustments noted above.