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MARKET POWER AND INFLATION

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Abstract

Market power exercised by firms has become central to macroeconomics. Recent theoretical work highlights the importance of the relation between market power and inflation. We examine this relation for individual firms in eleven U.S. industries. Our econometric framework exploits restrictions from dynamic theory and information from financial markets to generate quantitative evidence on the responsiveness of market power to inflation. We find that inflation usually has a positive effect on market power. This relation is heterogeneous across the eleven industries, and statistically significant positive relations are concentrated in industries with little market power.

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I. Introduction

Market power exercised by firms has become central to macroeconomics. Hall (1986, 1988) demonstrates how substantial market power and declining or flat marginal costs attenuate firms' incentive to alter prices, thus contributing to aggregate fluctuations. In general equilibrium frameworks, market power heightens the sensitivity of output and employment to demand policies (Hart, 1982; Blanchard and Kiyotaki, 1987) and enhances the ability of calibrated models to mimic the data (Rotemberg and Woodford, 1996). Additional work (surveyed in Rotemberg and Woodford, 1991, 1999) emphasizes that cyclical variation in market power can attenuate or amplify the equilibrium impact of macro shocks.

Market power may be sensitive to inflation, thus creating an additional channel by which inflation directly affects the macroeconomy.[1] In a series of papers, Bénabou (1988, 1992a, 1992b) links the welfare costs of inflation to its impact on market power. When monopolistically competitive firms set prices with (S,s) rules, he shows that inflation increases the dispersion of prices within an industry. Consequently, buyers devote more resources to search and, for a given level of market power, inflation lowers welfare. However, additional search may reduce market power and lessen resource misallocation. On balance, the welfare effects of inflation are ambiguous, and depend critically on the sign of the relation between market power and inflation. In Ball and Romer (1996) and Tommasi (1994), inflation lowers welfare by increasing relative price variability, reducing the information about future prices contained in current prices, and thus allowing firms to raise markups on less informed and less price-elastic consumers.

With the exception of Bénabou (1992b), the market power/inflation relation has not been investigated empirically. This paper examines this relation for individual firms in eleven U.S. industries. Section II describes our analytic framework measuring market power with a

three-equation econometric model, and briefly discusses our firm-level data. Section III

presents our basic empirical findings: market power is positively related to inflation, this

relation is heterogeneous across the eleven industries, and statistically significant positive

relations are concentrated in industries with little market power. Several alternative

explanations are examined, and our empirical results prove robust. Section IV summarizes.

II. Econometric Framework

A. System Specification

We exploit restrictions from dynamic theory and information from financial markets to

generate quantitative evidence on the responsiveness of market power to inflation. The model

employed in this paper utilizes the substantial information in firm-level panel data, and is

developed in detail in Chirinko and Fazzari (1994). We provide only a sketch of the framework

here.

Firms choose variable inputs (labor plus materials) and capital to maximize net present

value. Output is determined by a homogeneous translog technology with non-constant returns

to scale and Hicks-neutral technical progress. Firms face convex costs of adjusting capital. In

general, firms have market power and face a downward sloping demand curve. The first-order

conditions for optimization and the transversality condition for the capital stock generate three

estimating equations (presented in the Appendix). The first equation equates short-run

marginal revenue and marginal cost. The second equation is the capital Euler equation

equating the marginal returns to the quasi-fixed stock of capital in adjacent time periods. The

third equation is based on the Q theory of investment. Because we allow for the possibility of

imperfect competition and non-constant returns to scale, the usual relation between investment

and Q contains an additional term involving the discounted sum of quasi-rents associated with

departures from constant returns or perfect competition. The Lerner index for firm j at time t,

Θ_{jt}, is the percentage differential between price and marginal cost. This index measures market power, enters the marginal revenue/marginal cost and Q equations, and equals zero for competitive firms,[2]

$$\Theta_{jt} \equiv \Theta_j/\omega_{jt} + \Theta_C\, y'_t + \Theta_\Pi\, \Pi_t. \tag{1}$$

The first term in (1) is the firm-specific percentage difference between price and marginal cost. It is divided by the firm's share of industry output (ω_{jt}) to facilitate the computation of the industry weighted average measure of market power. The second term captures cyclical variation in the Lerner index. The cyclical variable y'_t is the deviation between industry sales growth in period t and the industry's average sales growth over the full sample and, by construction, has a time mean of zero. The third term captures the effect of aggregate inflation (Π_t) on the Lerner index. The estimated parameter Θ_Π is the focus of this study, and measures the impact of inflation on market power. The Lerner index for each industry (Θ) is computed by weighting the Lerner index for each firm in the industry (Θ_{jt}) by the firm's market share (ω_{jt}), summing over all firms in the industry for each year in the sample, and averaging across time (with Π^μ is the time mean of inflation):

$$\Theta \equiv (1/T) \sum_{t=T}^{T} \sum_{j=I}^{J} \omega_{jt}\, \Theta_{jt} = \sum_{j=1}^{J} \Theta_j + \Theta_\Pi\, \Pi^\mu. \tag{2}$$

We estimate the three-equation system with non-linear three-stage least squares. Under the assumption of rational expectations, lagged values of the model variables are valid instruments (listed in the Appendix). In addition, we include the lagged level and change in the firm's employment, firm dummies, and a time trend as instruments.

B. Data

We present estimates with firm-level data (drawn from Value Line) for eleven manufacturing industries listed in Table I by SIC code. The selected industries represent all

four-digit manufacturing industries from Value Line that had enough firms for estimation. These industries can be perfectly competitive, monopolistically competitive, or characterized by some other form of rivalrous behavior and, under any of these interpretations, Θ measures market power. After the variables are transformed and the instruments lagged, the sample period is 1975 to 1985. See Chirinko and Fazzari (1994, Section 5 and their Data Appendix) for a detailed description of the data. Inflation is measured as the percentage change in the implicit deflator for Gross Domestic Product, except in Table II, column 7, where we measure inflation with the PPI for Finished Goods Excluding Foods and Energy.

III. Empirical Results

<u>A. Basic Findings</u>

Table II contains the estimated parameters representing the industry Lerner index (Θ) and its responsiveness to inflation (Θ_Π) for eleven industries.[3] (The industries are arranged from the least to the most competitive, where competitiveness is determined by the value of the Lerner index evaluated at zero inflation in column 2.) In nine of the eleven industries, inflation has a positive effect on market power, and Θ_Π is statistically different from zero (at the 10% level) in six cases. The signif-icant Θ_Π's tend to be in relatively competitive industries. The estimates in Table II reveal a noticeable amount of heterogeneity in the Θ_Π's. This diversity suggests the sensitivity of Θ_Π to product market structure and hence the importance of examining market power at fine levels of disaggregation.

Heterogeneity is also evident when we examine the economic impact of inflation on market power. The entries in columns 3 and 4 evaluate Θ at different inflation rates: the average rate for the sample period (6.1 percent) and the difference between the maximum (9.9 percent) and minimum (3.5 percent) values of inflation. In three industries, market power varies substantially; the change in Θ when inflation is at its maximum and minimum rate exceeds 9 percentage points. For five other industries, the changes are much smaller, and are less than 3 percentage points.

Bénabou examines one industry (the retail trade sector, SIC codes 52-59) for the period 1948-1985 that, to the best of our knowledge, is the only other empirical study of market power and inflation. He finds that market power is negatively related to inflation. The most relevant comparison is with our results from industry 2082 that also has a significantly negative Θ_Π and shares three striking similarities with Bénabou's retail trade sector. First, estimates of market power at zero inflation are nearly identical: 0.403 in Bénabou (1992b, p. 570) and 0.416 in Table I, column 2. Second, market power is countercyclical in both industries.[4] Third, search costs

are low in the retail trade sector and, among the eleven industries studied here, industry 2082 (Malt Beverages, a relatively homogenous product) is likely to have one of the lowest search costs.

B. Alternative Interpretations

These findings are open to alternative interpretations, and four are explored here. The computer revolution and other major technological developments could reflect biased technical progress (see Blanchard (1997) for further discussion). In this case, definitions of marginal cost and the marginal rate of substitution in the econometric equations are incomplete, and parameter estimates are adversely affected. In particular, estimates of Θ_Π may be seriously affected insofar as inflation has a secular component correlated with the technology index and technical progress has been biased. Our model based on a translog technology provides a natural way for accounting for biased technical change. We augment the translog technology with interaction terms between technology (proxied by a time trend) and the output and capital variables that determine variable factor requirements (see the Appendix for specific additions). Estimates of Θ_Π based on this expanded model are presented in Table II, column 5. Allowing for biased-technical change leads to a uniformly positive increase in the relation between market power and inflation. In several cases, changes in Θ_Π are substantial, and an additional industry (2300) now emerges with a positive and statistically significant Θ_Π. Biased technical change, rather than undermining the prior results, actually strengthens our finding of a positive relation between market power and inflation.

A second alternative interpretation is that the effects of inflation are masked by the cyclical component of the Lerner index. Insofar as inflation is partly cyclical, interactions between inflation and the included cyclical variable may bias estimates of Θ_Π. To explore this possibility, we constrain Θ_C to zero, and report results for this restricted model in column 6 of Table II. (Note that $\Theta_C = 0$ is rejected in eight industries.) The results prove robust with the exception of industries 2834 (Pharmaceuticals), 3011 (Tires) and 3714 (Motor Vehicle Parts). These latter two industries are associated with the cyclically-sensitive production of

automobiles, and hence the elimination of the cyclical effect is particularly important. While this restricted model is rejected by the data, it nonetheless highlights the robustness of our results.

The third alternative interpretation is that the positive Θ_Π reflects the upsurge of oil prices during our sample period, rather than a general relation between market power and inflation. In a dynamic general equilibrium model, Rotemberg and Woodford (1996) present simulations that yield a positive relation between market power and oil price inflation. To remove the effect of oil prices, we replace the GDP inflation measure with one calculated with the PPI For Finished Goods Excluding Foods and Energy. The results are presented in column 7 of Table II. In ten of the eleven industries, the estimate of Θ_Π is lower, thus confirming the positive effect indicated by the Rotemberg and Woodford simulations. Even with this oil price effect removed, however, inflation continues to exert a significantly positive effect on market power in five industries. These results support both Rotemberg and Woodford's oil price effect and our conclusion that inflation usually has a positive impact on market power.

Finally, all of the results could be affected by specification error from a variety of sources. Of particular concern for the current study is that the Lerner index (1) may be subject to measurement error because it is not derived from a specific optimization problem (cf. note 2). We examine the impact of this and other forms of specification error on the key coefficient, Θ_Π, in two ways. First, to attenuate possible correlation between the instruments and specification error, the instruments are lagged an additional period. The point estimates of Θ_Π are very similar to those in column 1 of Table II. Second, we use a Hausman test that compares estimates from 2SLS and 3SLS and that allows us to focus on Θ_Π.[5] For ten of the eleven industries, the p-values from this Hausman test exceed 10%. For the exceptional industry (#2621), the difference in the Θ_Π's is small. Thus, the positive relation between market power

and inflation reported in this paper does not appear to be sensitive to specification error in the Lerner index or other parts of the equation system.

IV. Summary

This paper explores the relation between market power and inflation in an econometric framework that exploits restrictions from dynamic theory and information from financial markets. Firm-level data from eleven industries are analyzed, and the following "stylized facts" emerge:

1) Inflation usually has a positive effect on market power.

2) The market power/inflation relation is heterogeneous across the eleven industries.

3) Statistically significant positive relations are concentrated in industries with little market power.

These results prove robust to the introduction of biased technical change, the removal of the cyclical effect, and the exclusion of energy prices.

These findings, combined with recent theoretical work, suggest an important channel for understanding the welfare costs of inflation. Additional work investigating the market power/inflation relation would begin by expanding the dataset to obtain a broader representation of the economy and by examining the robustness of our findings to alternative technologies (e.g., non-convex adjustment costs and irreversibilities).[6] The endogenous search model of Bénabou (1992a) provides an excellent vehicle for relating market power to inflation and product market structure, and his optimizing model could provide the basis for a more detailed specification of market power. Lastly, recent theoretical models and the heterogeneity of the empirical results presented in this paper suggest that the market power/inflation relation is sensitive to product market structure and thus requires further exploration with a broader set of industries and measures of market characteristics.

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Endnotes

1. Other channels are described in Romer (1996, Chapter 9.8) and Lucas (1997).

2. This specification is not derived explicitly from an optimization problem set in a (potentially) noncompetitive strategic environment. Rather, following Schmalensee (1988, p. 650), we interpret equatior (1) as "conjectural variations that are best interpreted as reduced form parameters that summarize the intensity of rivalry that emerges from what may be complex patterns of behaviour." Pesaran and Smith (19 suggest a similar modeling strategy when optimization problems do not deliver estimable econometric equations.

3. Table II does not report estimates of the technology parameters. The estimates are similar to those in Chirinko and Fazzari (1994, table 1, pp. 58-59). The results are reasonable: returns to scale vary from approximately constant to modestly increasing, the translog technology satisfies standard regularity conditions at nearly every data point, and the convex adjustment cost parameter is positive in most cases a often statistically different from zero.

4. For eight of our eleven industries, market power is significantly procyclical ($\Theta_C > 0$).

5. Under the null of no misspecification, the 2SLS and 3SLS estimates are asymptotically equivalent, but the latter is more efficient. Under the alternative of, for example, misspecification in the Lerner index, only a subset of parameters would be inconsistently estimated under 2SLS, but all 3SLS parameter estimates wou be inconsistent because misspecification in one equation is transmitted to all equations via the estimated residual covariance matrix (Hausman, 1978, pp. 1264-1266). The test statistic for ($\Theta_\Pi \sim X^2(1)$.

6. Barnett and Sakellaris (1998) develop a useful regime-switching approach incorporating the effects of no convex adjustment costs into an econometric Q investment model. Also, see the models and results discus

in Dixit and Pindyck (1994).