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Market power amplifies the price effects of demand shocks*

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Abstract

In this paper, a model of competition in supply functions is used to analyse the relationship between market power and inflation. The model encompasses a range of market structures with Cournot and Bertand competition as polar cases. To the extent that inflation is driven by demand shocks, firms with market power are likely to respond by increasing margins, and thereby amplifying the inflationary impact of higher demand. This analysis is relevant to debates about the role of market power in recent US inflation.

1 Introduction

The recent upsurge in inflation has produced renewed debate about the relationship between imperfect competition and the dynamics of inflation. Biden Administration officials and other Democrats have suggested that monopolies and oligopolies have amplified the effects of inflationary shocks. [1]

Critics of this view have argued that the size of markups depends only on the extent of market power. Since there has been no evidence of a recent increase in market power, it is argued, there can be no connection between market power and recent inflation. For example, posting on Twitter, Summers asserts that:

> There is no basis in economics for expecting increases in demand to [cause] systematically larger price increases for monopolies or oligopolies than competitive industries.[2]

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[1] For example, see https://www.wsj.com/podcasts/google-news-update/lawmakers-question-powell-on-inflation-job-market/97b53925-9e8d-4cd7-9ade-60722d244160

[2] https://twitter.com/LHSummers/status/1475230229715161088

With a couple of exceptions, respondents to the FT-IGM survey of macroeconomists were similarly dismissive of the idea of a link between market power and inflationary shocks.

Little of this discussion has referred to the findings of the theoretical literature on response to cost and demand shocks in imperfectly competitive industries, including Cowan (2004), Menezes and Quiggin (2020) and Weyl and Fabinger (2013).

Insight into the problem may be gained through the use of the concept of the strategic equilibrium supply curve (Klemperer and Meyer (1989), Menezes and Quiggin (2020)). The strategic industry supply curve is a locus of market equilibria traced out by additive demand shocks. In the oligopoly case, the strategic supply curve lies in an envelope bounded by the Bertrand (marginal cost pricing) and Cournot cases, with the steepness of the curve depending inversely on the competitiveness of the market.

For many purposes, the strategic industry supply curve may be used to generalize the standard Marshallian supply-demand analysis of competitive markets to the general case of imperfect competition. In particular, demand-driven inflation can be represented by movements along the strategic industry supply curve.

Menezes and Quiggin (2020) show that the less competitive the market, the steeper the industry supply curve. Indeed, even under conditions of constant marginal cost, where the competitive supply curve is horizontal, the strategic industry supply curve under imperfect competition slopes upwards, indicating that markups increase with demand.

In this note we use the concept of the strategic industry supply curve to derive conditions under which demand shocks will lead firms with market power to raise prices. Our results suggest that, even in the absence of adjustment costs, inflationary shocks may generate price variation as a result of profit-maximising behavior by firms with market power.

2 Background

Suggestions that inflation may be caused or amplified by market power have elicited a mostly sceptical response from macroeconomists. The statement of Summers, quoted above, is similar to the views of most macroeconomists who have responded to this debate. Respondents to the FT-IGM survey of macroeconomists mostly rejected the proposition *'A significant factor behind today's higher US inflation is dominant corporations in uncompetitive markets taking advantage of their market power to raise prices in order to increase their profit margins'*. Few made any explicit reference to the issue of pass-through.

The most notable exceptions were Judith Chevalier who stated *'Pass-through of both cost shocks and demand shocks clearly differ in industries with vs without market power'* and provided a link to Weyl and Fabinger (2013), Eric Maskin, who pointed to evidence of partial cost pass-through, and Christopher Udry who said *'Market structure obviously interacts with shocks to affect inflation,* *but unlikely that this is first order now'.*[3]

With the exceptions noted above, most respondents to the FT-IGM survey did not draw on any explicit micro-economic foundations for their responses. In order to provide such foundations, it is necessary to consider formal models of pass-through, such as those of Weyl and Fabinger (2013) and Menezes and Quiggin (2020).

3 Comparative statics of demand shocks

The impact of demand shocks can be analyzed using the concept of the strategic industry supply curve (Klemperer and Meyer (1989), Menezes and Quiggin (2020)).[4] Competition in supply functions gives rise to a range of equilibrium concepts for oligopoly, including Cournot and Bertrand as special cases.

The comparative static effects of demand shocks are most simply represented for the case of firms with constant marginal cost, facing log-concave demand[5] and additive or multiplicative shocks.

3.1 Model

We follow the model of Menezes and Quiggin (2020), and consider a market in which $N > 1$ identical firms supply a homogeneous product[6] with demand given by

$$Q_d(P, \varepsilon, \lambda) = \max(\lambda(D_0(P) + \varepsilon), 0),$$

where $\varepsilon \in \mathbb{R}_{++}$ is an additive shock observed by firms before they make their strategic choices regarding output and prices, λ is a parameter which varies with multiplicative shocks to demand and $\lambda D_0(P) = Q_d(P, 0, \lambda)$, the value of demand when the additive shock is equal to zero The linear case

$$Q_d(P, \varepsilon, \lambda) = \max(\lambda(a + \varepsilon - bP), 0), \tag{1}$$

for $a, b > 0$ is of particular interest.

For simplicity in the statement of results, we focus on the case of constant marginal costs, equal for all firms $c_n(q) = cq \ \forall n$.

3.2 The strategic industry supply curve

We assume that, after observing the shock ε, firms compete in linear supply schedules. That is, for each firm n, the strategy space is given by the set of

[3]See https://www.igmchicago.org/surveys/inflation-market-power-and-price-controls/

[4]For the monopoly case see Kripalani et al. (1990).

[5]As is known for the case of monopoly (Weyl and Fabinger 2013), if demand is not log-concave, an increase in demand may result in a reduction in margins. Conversely an increase in cost may increase margins resulting in more than 100 % pass through. Given the strong empirical evidence of partial cost pass-through, the assumption of log-concave demand appears plausible.

[6]Delbono and Lambertini (2018) extend the analysis to the case of differentiated products. See also Klemperer and Meyer (1989).

supply schedules of the form

$$q_n = \alpha_n + \beta P,$$

where α_n is the strategic variable for firm n and $\beta \in [0, \infty)$ is an exogenous parameter representing the competitiveness of the market, common to all firms. It is important to note that, in Nash equilibrium, the strategy of firm n represents the behavior imputed to n by other firms. In the case of competition in supply functions, each firm n evaluates possible deviations from equilibrium on the assumption that other firms $m \neq n$ will hold their strategic choices α_m constant. In considering its own choices, firm n may regard itself as choosing price, quantity or the intercept α_n, so long as the choice is profit-maximising.

Conditional on the choices α_{-n} of other firms and the values of ε and λ, the residual demand facing firm n is

$$D_n = \lambda\varepsilon + D_0(P) - \sum_{i \neq n} \alpha_i - (N-1)\,\beta P.$$

The strategic industry supply curve (Menezes and Quiggin) is the locus of market equilibria as ε varies over its range. This locus may be formally defined as follows:

Definition 1 *: The strategic supply curve is the set of all pairs (P,S(P)) such that for some* ε, $\exists(\alpha_i, i = 1...N)$ *such that*
(i) $\alpha_i, i = 1...N$ *is a Nash equilibrium for the game described above*
(ii) $S(P) = \sum \alpha_i + \beta P = D(P, \varepsilon)$ *is a market-clearing outcome*

It is straightforward to derive the strategic supply curve for the linear case. Conditional on the choices α_{-n} of other firms and the values of ε, a and b, the residual demand facing firm n is

$$D_n = \lambda(a + \varepsilon) - \sum_{i \neq n} \alpha_i - (\lambda b + (N-1)\,\beta)\,P.$$

The associated (positive) elasticity of residual demand is

$$\eta_n = (\lambda b + (N-1)\beta)\frac{P}{q_n}.$$

In equilibrium, firm n acts as a monopolist facing the residual demand D_n. It follows that the output-price pair (P, q_n) must satisfy the condition that the Lerner index should be equal to the inverse of the elasticity of residual demand.

$$\frac{1}{\eta_n} = \frac{P-c}{P}.$$

Rearranging the Lerner condition and multiplying by N yields the equilibrium firm industry supply curve:

$$Q \quad = \quad N\,(P-c)\,((N-1)\,\beta + \lambda b) \qquad (2)$$

More generally, Menezes and Quiggin show

Proposition 2 *Under the stated conditions, the strategic industry supply curve for firm i has the form*

$$
\begin{aligned}
S(P) &= \frac{N(P-c)}{-\left(D_i^{-1}\right)'\left(Q_i; \varepsilon(P), \alpha_{-i}\right)} && (3) \\
&= N\left((N-1)\beta - \lambda D_0'(P-\varepsilon)\right)(P-c) && (4)
\end{aligned}
$$

Additive demand shocks will result in higher prices if and only if the strategic industry supply curve is upward-sloping. This can be seen by inspection for the linear case. More generally, Menezes and Quiggin show:

Proposition 3 *The strategic industry supply curve is upward sloping if and only if* $0 < \frac{dP(\varepsilon)}{d\varepsilon} < 1$.

As shown by Weyl and Fabinger (2013), extending Seade (1985), this condition will be satisfied if and only if demand is log-concave. The same condition is necessary and sufficient for partial pass-through of cost shocks.

Figure 1 shows strategic supply curves under the assumptions of constant marginal cost and linear demand. The cases illustrated, going from most to least competitive, with N held constant, are Bertrand ($\beta \to \infty$) which corresponds to competitive pricing, oligopoly with $\beta = 1$ and Cournot oligopoly ($\beta = 0$). Demand curves are drawn for two values of the shock ε.

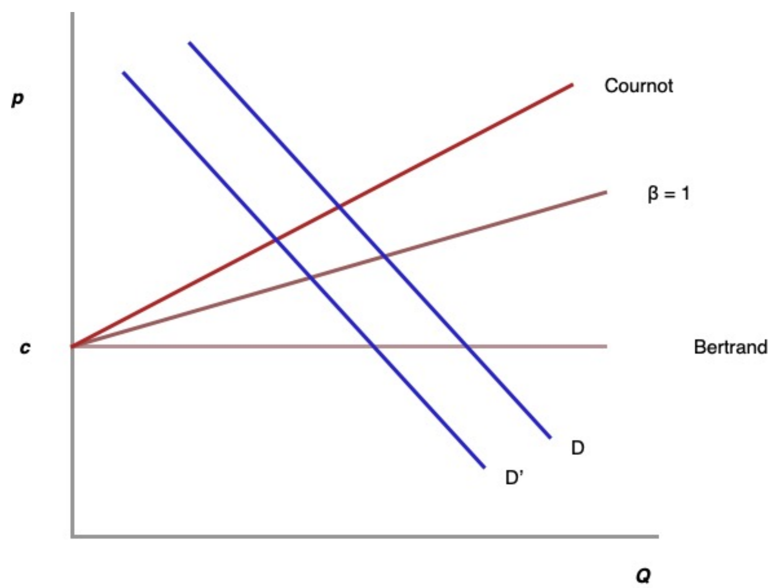

Figure 1 Interaction of demand shocks and strategic industry supply

As can be seen in Figure 1, in the competitive/Bertrand case an increase in demand leads to an increase in quantity but no change in price. This follows directly from the assumption that marginal cost is constant, and the requirement that price equals marginal cost in a competitive market.

The less competitive is the market, the steeper the industry supply curve and the greater the increase in price associated with a given increase in demand. As discussed by Menezes and Quiggin, the competitiveness of the market will depend both on the number of firms N and the aggressiveness of competition, measured by β.

3.3 Multiplicative shocks

We now turn to multiplicative shocks. Rearrange (3) to yield

$$P - c = \frac{Q}{N\left((N-1)\,\beta - \lambda D_0'(P)\right)}. \tag{5}$$

Substituting from the demand equation

$$P - c = \frac{\lambda(\varepsilon + D_0(P))}{N\left((N-1)\,\beta - \lambda D_0'(P)\right)}. \tag{6}$$

Rewriting (6) we obtain

$$\frac{P-c}{\varepsilon + D_0(P)} = \frac{1}{N(N-1)\beta/\lambda - ND_0'(P)}. \tag{7}$$

This is increasing in λ whenever $\beta > 0$. That is, a multiplicative increase in demand allows firms to increase their profit margins. Conversely, Q grows less than proportionally with λ.

This result holds true for any finite positive value of β. However, for the Cournot case β =0, we have

$$\frac{P-c}{\varepsilon + D_0(P)} = \frac{1}{ND_0'(P)}, \tag{8}$$

so that the margin is independent of λ. On the other hand as $\beta \to \infty$, $(P-c) \to 0, \forall\lambda$. This yields:

Proposition 4 *The equilibrium price will increase in response to a multiplicative increase in demand if and only if β is finite and positive.*

This result is noteworthy in showing that the model of competition in supply functions can yield results which are not merely intermediates between the polar cases of Cournot and Bertrand.

4 Economy wide implications

The analysis above deals with shocks to a single market. We now consider implications for the economy as a whole.

4.1 Relative price distortions

Concern about the possibility that inflation will generate or exacerbate price distortions is long-standing, going back to Mills (1927). There is a large empirical literature supporting this view. Theoretical analysis (Sheshinski and Weiss 1977, Fischer 1981, Ball and Mankiw 1994) has focused on various forms of price stickiness such as menu costs and staggered wage setting, under which prices are changed irregularly. Typically, these models involve monopolistic competition, rather than a distinction between more and less competitive sectors of the economy. This implies that relative price variation in response to demand shocks is stochastic rather than systematic. Relative prices for different firms rise and fall as adjustments take place.

The analysis here suggests a different cause for concern. The response of prices to inflationary shock will depend on the competitiveness of the market, which in turn depends both on the number of firms and the aggressiveness of competition, measured here by β. Demand driven inflation will generate, or amplify, the relative price distortions associated with market power.

4.2 Macroeconomic transmission mechanisms[7]

In standard macroeconomic models (Dixit and Stiglitz 1977), expansionary demand shocks generate inflation through the labor market. Firms hold margins constant, but increase output, leading to upward pressure on wages. With constant margins, increases in wages are passed through to prices.

The mechanism proposed here is more direct: firms competing in supply schedules raise prices directly. In a general equilibrium setting, direct price increase dampens down the output increase and thus reduces the effect of the demand shock on wage costs and thus on prices. The direct inflationary effect derived above is offset by less of the indirect inflation effect coming through extra output and employment. However, it seems likely that the direct effect will dominate.

5 Conclusion

Contrary to the predominant view among macroeconomists, the presence or absence of market power at the micro level is an important determinant of responses to inflationary demand shocks. Using the concept of the strategic industry supply curve, we have shown that, when firms have market power, the price effects of additive and multiplicative demand shocks will, in general, be multiplied. The magnitude of this effect will depend on the competitiveness of the market which may be represented by the slope of the supply functions available to firms as strategies.

[7]We thank an anonymous referee for the observations in this subsection

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