A GENERALIZED MEASURE OF MARKET POWER

By

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Abstract

A generalized measure of market power is derived that accounts for both supply expansion by the competitive fringe and multi-market participation by the dominant firm. Traditional market power measures are shown to be biased-upward (downward) in the case of complements (substitutes). Numerical simulations suggest that this bias can be pronounced. These findings have potentially important implications for antitrust in the *new economy* as there may be a natural tendency for certain markets to "tip" in favor of a dominant provider.

1. Introduction

A firm possesses market power when it has "the ability profitably to maintain prices above competitive levels for a significant period of time."[1] In a classic article, Landes and Posner (1981) construct a measure of market power for the dominant firm that depends upon the dominant firm's market share, *s*, the market price elasticity of demand, ε_D, and the competitive fringe supply elasticity, ε_S. Specifically, they show that:

$$(1)\quad L^{L-P} = \frac{P - c_d}{P} = \frac{1}{\varepsilon_d} = \frac{s}{\varepsilon_D + (1-s)\varepsilon_S},$$

where $L^{L\text{-}P}$ denotes the Lerner index for the Landes-Posner (L-P) measure of market power,[2] P is price, c_d is the dominant firm's marginal cost and ε_d is the price elasticity of demand facing the dominant firm. Equation (1) indicates that the dominant firm's market power is increasing with its market share and decreasing with the market elasticity of demand and the competitive fringe supply elasticity, *ceteris paribus*. The L-P measure of market power is frequently used to review proposed mergers because it accounts for both demand-side and supply-side effects.

The primary objective of this analysis is to generalize the L-P market power measure to a multi-market setting. Dominant firms typically operate in multiple markets and

[1] Department of Justice Horizontal Merger Guidelines, 1992, Section 0.1.

[2] Lerner (1934, p. 171) observes that "the primary unit to which our measure of monopoly applies is the firm in the very shortest period."

demand interdependence is common (Bulow et al., 1985), particularly in network industries such as telecommunications and transportation. In addition, recent trends toward greater concentration in certain sectors of the *new economy* may reflect a natural tendency for certain markets to "tip" in favor of a dominant provider (Klein, 1998; Posner, 2001; Dreazen et. al., 2002).[3, 4] These tendencies may be particularly pronounced in markets that exhibit demand complementarities.[5]

The primary findings of this analysis are two-fold. First, traditional market power measures tend to overstate market power in the case of complements and understate market power in the case of substitutes. In the special case of identical markets, the degree of bias in the measurement of market power is directly related to the number of markets in which the dominant firm operates. Numerical simulations suggest that the measurement bias may range upwards of 80 percent. Second, the market power of the dominant firm is increasing in the absolute value of the cross-elasticity of supply for the competitive fringe when the goods are substitutes in production. This occurs because reduced supply by the competitive fringe in a market necessarily implies higher demand for the dominant firm in that market, *ceteris paribus*.

The format for the remainder of this paper is as follows. A generalized measure of market power is derived in section 2. The main findings and numerical simulations are presented in Section 3. Section 4 discusses the policy significance of these findings and concludes.

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[3] White (2002) finds no evidence of a wholesale increase in aggregate market concentration in the U.S. economy despite significant merger activity in selected industries.

[4] A case in point is the common practice among telecommunications providers of charging lower prices for on-net calls, presumably because intra-network calls are less costly than inter-network calls. This practice would naturally encourage consumers to subscribe to the largest network, *ceteris paribus*.

[5] Complementary demands are typical of network industries because increased traffic flows from one node to another node on a telecommunications or transportation network tend to propagate traffic flows in the reverse direction and also to other nodes on the network.

2. A Generalized Measure of Market Power

Suppose that there are $N \geq 1$ distinct markets, where N is a positive integer. The profits for the (multi-market) dominant firm are given by:

$$(2)\ \Pi_d = [P^i - c_d^i][D^i(\hat{P}) - S^i(\hat{P})] + \sum_{j \neq i}^{N} [P^j - c_d^j][D^j(\hat{P}) - S^j(\hat{P})] - F,$$

where c_d^i is the dominant firm's marginal cost, which is assumed to be constant and separable across markets,[6] F represents the fixed costs of production, D^i is aggregate demand, $\hat{P} = \langle P^1, \ldots, P^N \rangle$ is a price vector, S^i is competitive fringe supply, R^i denotes dominant firm revenues and ε_d^{ji} is the cross-elasticity of demand for the dominant firm. The superscripts indicate the specific market $i, j = 1, \ldots, N$, $i \neq j$. Let L^G denote the Lerner index for the generalized measure of market power.

Proposition 1. The generalized measure of market power is given by:

$$(3)\ L^G = \frac{P^i - c_d^i}{P^i} = \left[\frac{s^i}{\varepsilon_D^i + \varepsilon_S^i (1 - s^i)} \right] \times \left[1 + \sum_{j \neq i}^{N} \frac{(P^j - c_d^j)}{P^j} \frac{R^j}{R^i} \varepsilon_d^{ji} \right] = \left[\frac{s^i}{\varepsilon_D^i + \varepsilon_S^i (1 - s^i)} \right] \times [1 + k],$$

where $k = \sum_{j \neq i}^{N} \frac{(P^j - c_d^j)}{P^j} \frac{R^j}{R^i} \varepsilon_d^{ji}$.[7]

Proof: Differentiating (2) with respect to P^i, setting the resulting expression equal to zero and simplifying yields:

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[6] Relaxing this assumption would require substituting net marginal cost measures for marginal cost measures to allow for the possibility that output changes in market i affect costs in market j, $i \ldots j$. This would increase the complexity of the analysis without fundamentally changing the economic insights.

[7] It is straightforward to show that Tirole's (1988, p. 70) mark-up rule for a multi-product monopolist with interdependent demands is identical to (3) when $s^i = 1$ and notational differences in the cross-elasticities are properly accounted for. See also Weisman (2003) for a generalized pricing rule for multi-market Cournot oligopoly.

$$(4)\ \frac{P^i - c_d^i}{P^i} = -\frac{1}{P^i} \times \left[\frac{D^i(\hat{P}) - S^i(\hat{P})}{\partial D^i(\hat{P})/\partial P^i - \partial S^i(\hat{P})/\partial P^i} + \sum_{j \neq i}^{N} [P^j - c_d^j] \left[\frac{\partial D^j(\hat{P})/\partial P^i - \partial S^j(\hat{P})/\partial P^i}{\partial D^i(\hat{P})/\partial P^i - \partial S^i(\hat{P})/\partial P^i} \right] \right].$$

Let $Q_d^i = D^i(\hat{P}) - S^i(\hat{P})$ and $Q_d^j = D^j(\hat{P}) - S^j(\hat{P})$. Substitution yields:

$$(5)\ \frac{P^i - c_d^i}{P^i} = -\frac{1}{P^i} \times \left[\frac{Q_d^i}{\partial Q_d^i/\partial P^i} + \sum_{i \neq j}^{N} [P^j - c_d^j] \times \frac{\partial Q_d^j/\partial P^i}{\partial Q_d^i/\partial P^i} \right].$$

Finally, let $\varepsilon_d^i = -(\partial Q_d^i/\partial P^i) \times (P^i/Q_d^i)$,[8] $\varepsilon_d^{ji} = (\partial Q_d^j/\partial P^i) \times (P^i/Q_d^j)$, $R^i = P^i \times Q_d^i$, $R^j = P^j \times Q_d^j$ and $s^i = Q_d^i/D^i(\hat{P})$. The result in (3) follows from algebraic manipulation of (5) and appeal to (1) and the above definitions. □

In the statement of Proposition 1, k is a correction factor to account for multi-market participation and demand interdependence. When demands are independent, $\varepsilon_d^{ji} = 0$, $k = 0$ and the generalized market power measure in (3) reduces to the L-P market power measure in (1).

Let ε_D^{ji} denote the market cross-elasticity of demand and ε_S^{ji} denote the cross-elasticity of supply for the competitive fringe. The next proposition shows that the generalized measure of market power can be expressed in terms of the own and cross market demand and competitive fringe supply elasticities.

Proposition 2. The generalized measure of market power can be expressed alternatively by:

$$(6)\ L^G = \frac{P^i - c_d^i}{P^i} = \left[\frac{s^i}{\varepsilon_D^i + \varepsilon_S^i(1-s^i)} \right] \times \left[1 + \sum_{j \neq i}^{N} \frac{(P^j - c_d^j)}{P^j} \frac{R^j}{R^i} \left[\frac{\varepsilon_D^{ji} - \varepsilon_S^{ji}(1-s^j)}{s^j} \right] \right].$$

[8] It is straightforward to show that $\varepsilon_d^i = [\varepsilon_D^i + \varepsilon_S^i(1-s^i)]/s^i$.

Proof: The dominant firm's demand is the residual of market demand and the supply of the competitive fringe, or

(7) $Q_d^j = D^j(\hat{P}) - S^j(\hat{P})$.

Differentiating (7) with respect to P^i, multiplying the resulting expression through by P^i / Q_d^j and simplifying yields:

(8) $\varepsilon_d^{ji} = \left[\dfrac{\varepsilon_D^{ji} - (1-s^j)\varepsilon_S^{ji}}{s^j} \right]$,

where $\varepsilon_D^{ji} = (\partial D^j(\hat{P}) / \partial P^i) \times (P^i / D^j(\hat{P}))$ and $\varepsilon_S^{ji} = (\partial S^j(\hat{P}) / \partial P^i) \times (P^i / S^j(\hat{P}))$.

Substituting (8) into (3) yields the result in (6). □

Proposition 3. In the special case of *N* identical markets,[9] the generalized measure of market power is given by:

(9) $L^G = \dfrac{P^i - c_d^i}{P^i} = \dfrac{s^i}{[\varepsilon_D^i + (1-s^i)\varepsilon_S^i - (N-1)(\varepsilon_D^{ji} - (1-s^i)\varepsilon_S^{ji})]}$.[10]

Proof: In the case of *N* identical markets, $P^i = P^j$, $c_d^i = c_d^j$, $s^i = s^j$ and $R^i = R^j$. Also, $\sum_{j \neq i}^{N} \dfrac{(P^j - c_d^j)}{P^j} = (N-1)\left[\dfrac{P^i - c_d^i}{P^i} \right]$. Substituting into (6), collecting terms and simplifying yields the expression in (9). □

3. Main Findings

This section builds on the formal analysis of the previous section to investigate the conditions that facilitate (respectively, temper) the exercise of market power as well as the bias associated with the use of traditional market power measures.

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[9] Whereas no two markets are likely identical in all respects, two or more markets may be of approximately equal size and share other common characteristics.

[10] In standard fashion, own price effects are assumed to dominate cross price effects. This ensures that the denominator on the right-hand side of (9) is strictly positive.

Finding 1. Relative to the generalized measure of market power in (3), the L-P measure of market power in (1) overstates (understates) market power in the case of complements (substitutes), *ceteris paribus*.

As Proposition 1 indicates, in the case of complements (substitutes), $\varepsilon_d^{ji} < (>) 0$, and $k < (>) 0$ in (3). In the case of complements (substitutes), the dominant firm's incentive to raise price in market *i* is diminished (enhanced) because doing so decreases (increases) demand in market *j*. It follows that the dominant firm's market power is tempered by its participation in complementary markets and augmented by its participation in substitutable markets. To see this directly, rewrite *k* in (3) as $k = \sum_{j \neq i}^{N} \frac{(P^j - c_d^j)}{R^i} s^j D^j(\hat{P}) \varepsilon_d^{ji}$, which is decreasing (increasing) in s^j for $\varepsilon_d^{ji} < (>) 0$ and $P^j > c_d^j$, *ceteris paribus*.

Finding 2. The market power of the dominant firm in market *i* is increasing (decreasing) with the absolute value of the cross-elasticity of supply for the competitive fringe, $\left|\varepsilon_S^{ji}\right|$, when the goods *i* and *j* are substitutes (complements) in production *ceteris paribus*.

Proposition 2 indicates that when goods *i* and *j* are substitutes in production, $\varepsilon_S^{ji} < 0$, an increase in P^i induces the competitive fringe to redirect supply from market *j* to market *i*.[11, 12] This, in turn, increases the dominant firm's demand in market *j* since $Q_d^j = D^j(\hat{P}) - S^j(\hat{P})$. A similar argument explains why the effect is reversed when goods *i* and *j* are complements in production, $\varepsilon_S^{ji} > 0$.

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[11] Alternatively, observe from (8) that ε_d^{ji} is increasing in $\left|\varepsilon_S^{ji}\right|$ under these conditions, compounding the effect of substitutes ($\varepsilon_d^{ji} > 0$) and dampening the effect of complements ($\varepsilon_d^{ji} < 0$).

[12] Consider, for example, the case of a commercial airline that is able to, in part, redeploy its fleet from market *j* to market *i* in response to a price increase in market *i*. This redeployment would enable the airline to reduce the number of flights in market *j* and increase the number of flights in market *i*.

In evaluating proposed mergers, the Department of Justice considers the likely supply response should the merging firms attempt to raise prices, *post-merger*.[13] To this end, observe from (6) that market power is decreasing in the competitive fringe supply elasticity, but increasing in the absolute value of the competitive fringe cross-supply elasticity when $\varepsilon_S^{ji} < 0$. In this case, the cross-supply elasticity is a countervailing influence on the supply response by the competitive fringe in mitigating market power.

Finding 3. Suppose that all elasticity measures are independent of the number of markets, *N*. The market power for the dominant firm is decreasing (increasing) in *N* when $\varepsilon_d^{ji} < (>) 0$, *ceteris paribus*.

This finding follows directly from Proposition 3. Differentiating (9) with respect to *N* yields:

$$(10)\ \frac{\partial}{\partial N}\left\{\frac{P^i - c_d^i}{P^i}\right\} = \frac{s^i[\varepsilon_D^{ji} - (1-s^i)\varepsilon_S^{ji}]}{\left[\varepsilon_D^i + (1-s^i)\varepsilon_S^i - (N-1)(\varepsilon_D^{ji} - (1-s^i)\varepsilon_S^{ji})\right]^2} = \frac{(s^i)^2\varepsilon_d^{ji}}{\Omega^2}$$

upon appeal to (8), where $\Omega = \left[\varepsilon_D^i + (1-s^i)\varepsilon_S^i - (N-1)(\varepsilon_D^{ji} - (1-s^i)\varepsilon_S^{ji})\right]$. Hence, the sign of (10) is equal to the $sgn\{\varepsilon_d^{ji}\}$.

Using (1) and (9), the bias in the L-P market power measure, denoted here by β, is given by:

$$(11)\ \beta = -\left[\frac{L^G - L^{L-P}}{L^G}\right] = -\frac{[N-1][\varepsilon_D^{ji} - \varepsilon_S^{ji}(1-s^i)]}{[\varepsilon_D^i + \varepsilon_S^i(1-s^i)]},$$

or simply the negative of the ratio of cross effects and own effects.

[13] Department of Justice Horizontal Merger Guidelines, 1992, Section 3.

Finding 4. The absolute value of the bias ($|\beta|$) in the L-P market power measure is symmetric and increasing in N and $\left|\varepsilon_D^{ji}\right|$, *ceteris paribus*.

Table 1 provides the L^G, $L^{L\text{-}P}$ and β measures for a hypothetical parameter set and selected values of ε_D^{ji} and N. The table reveals that the bias in the use of L-P market power measures is potentially, at least, quite large. For example, when $\varepsilon_D^{ji} = -1.0$ and $N = 2$, $L^G = 1$, $L^{L\text{-}P} = 0.2$ and $\beta = 0.40$, indicating that the L-P market power measure overstates actual market power by 40 percent. The upward bias doubles to 80 percent when $N = 3$. A symmetric pattern emerges for substitutes, although in this case the bias is downward rather than upward. Finally, note that the bias is directly proportional to the absolute value of the cross elasticity and vanishes as the cross-elasticity approaches zero.

[Table 1 About Here]

4. Conclusions

The primary objective of this analysis is to generalize the L-P measure of market power to take into account the effects of both supply expansion by the competitive fringe and multi-market participation by the dominant firm. A key finding is that L-P market power measures are biased upward in the case of complements and biased downward in the case of substitutes. These findings have potentially important implications for antitrust in the *new economy* given the natural tendency for certain markets—notably those that exhibit demand complementarities—to "tip" in favor of a dominant provider. The obvious concern is that a reliance on traditional market power measures could lead antitrust authorities to block mergers that are welfare-enhancing and *vice versa*.

References

Bulow, Jeremy, John D. Geanakoplos and Paul D. Klemperer, "Multimarket Oligopoly: Strategic Substitutes and Complements," *The Journal of Political Economy*, Volume 93, Number 3, June 1985, pp. 488-511.

Dreazen, Yochi J., Greg Ip and Nicholas Kulish, "Oligopolies Are on the Rise As the Urge to Merge Grows." *The Wall Street Journal*, February 25, 2002, p. A1.

Klein, Joel I., "The Importance of Antitrust Enforcement In The New Economy," Before the New York State Bar Association, Antitrust Law Section Program, New York, NY, January 29, 1998.

Landes, William W. and Richard A. Posner, "Market Power in Antitrust Cases." *Harvard Law Review*, Volume 94, Number 5, March 1981, pp. 937-996.

Lerner, Abba P., "The Concept of Monopoly and the Measurement of Monopoly Power," *The Review of Economic Studies*, Volume 1, Number 3, June 1934, pp. 157-175.

Posner, Richard A., "Antitrust in the New Economy," *Antitrust Law Journal*, Volume 68, 2001, pp. 925-943.

Tirole, Jean, *The Theory of Industrial Organization*, Cambridge MA: MIT Press, 1988.

U.S. Department of Justice and the Federal Trade Commission. *Horizontal Merger Guidelines*, 1992 [Inclusive of April 8, 1997 Revisions].

Weisman, Dennis L., "A Generalized Pricing Rule For Multi-Market Cournot Oligopoly," *Economics Letters*, Volume 81(1), October 2003, pp. 95-99.

White, Lawrence J., "Trends in Aggregate Concentration in the United States," *Journal of Economic Perspectives*, Volume 16, Number 4, Fall 2002, pp. 137-160.

ε_D^{ji} \ N	1			2			3		
	L^G	L^{L-P}	β	L^G	L^{L-P}	β	L^G	L^{L-P}	β
-1.00	0.20	0.20	0.00	0.143	0.20	0.40	0.111	0.20	0.80
-0.75	0.20	0.20	0.00	0.154	0.20	0.30	0.125	0.20	0.60
-0.50	0.20	0.20	0.00	0.167	0.20	0.20	0.143	0.20	0.40
-0.25	0.20	0.20	0.00	0.182	0.20	0.10	0.160	0.20	0.20
0.00	0.20	0.20	0.00	0.200	0.20	0.00	0.200	0.20	0.00
0.25	0.20	0.20	0.00	0.222	0.20	-0.10	0.250	0.20	-0.20
0.50	0.20	0.20	0.00	0.250	0.20	-0.20	0.333	0.20	-0.40
0.75	0.20	0.20	0.00	0.286	0.20	-0.30	0.500	0.20	-0.60
1.00	0.20	0.20	0.00	0.333	0.20	-0.40	1.000	0.20	-0.80

Table 1.

Bias in $L^{L\text{-}P}$ Market Power Measures

Parameter Set: $s^i = 0.5, \varepsilon_D^i = 2, \varepsilon_S^i = 1,$ and $\varepsilon_S^{ji} = 0$