Priorities in Coordinated Effects of Mergers

Working Paper

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Abstract

This study addresses two questions regarding coordinated effects of horizontal mergers. First, when should there be a major concern with coordinated effects of mergers? Through a numerical analysis of the profit increase from collusion in triopoly markets, we argue that markets in which the collusive profit increase is durable despite cost asymmetries deserve to be prioritized. The second question relates to why mergers increase outsiders' incentives to collude. We argue that the identity of exiting firms can inform the remaining firms in the market that they are eligible to engage in profitable collusion with tolerable cost asymmetries.

Keywords: Horizontal mergers; Coordinated effects; Collusion; Cost asymmetry

1. Introduction

Currently, competition agencies assess the potential competitive effects of horizontal mergers by referencing two theories of competitive harm: unilateral and coordinated effects. Horizontal mergers give rise to coordinated effects when both the merged entity and other competitors in the market are likely to reduce competition and increase their prices after a merger. Coordinated effects are easily confused with parallel price increases, but competition agencies must distinguish between them; Coordinated effects are profitable only when competitors follow suit, whereas parallel price increases can be the result of unilaterally profitable price increases due to industry-wide cost shocks.

From a competition policy perspective, coordinated effects theories of harm leave two fundamental questions unanswered. First, when should we focus on coordinated effects? The extant economic literature has examined how mergers change the minimum (critical) discount factor δ^* for collusion to be sustainable. One of the most supported propositions in the literature is that symmetry facilitates collusion (Compte et al. 2002; Kühn 2004; Vasconcelos 2005). However, near-perfect symmetries are rare in reality; both large and small firms exist. Thus, the practical question we face is as follows: how large are the asymmetries between firms consistent with coordinated effects of mergers? What market structures are more concerning? This issue entails the priority setting in the analysis of coordinated effects. Without knowledge of typical cases concerning coordinated effects, lawyers cannot provide adequate ex-ante advice. They are ineffective at their job if all they can say is that "Only the econometricians know the answer." Section 2 discusses this question and argues that we should prioritize markets in which the profit increase from collusion after a merger is both sufficient for each collusive member and durable with cost asymmetries between them. Specifically, we use triopoly models with different configurations (market shares) of firms and gain insights from numerical examinations on how the profit increase from collusion varies depending on cost asymmetries. We argue that in homogeneous goods quantity competition, markets where the top and second-largest firms have the most similar costs should be prioritized. In differentiated goods price competition, markets where the top large firm competes with two or more smaller firms should be prioritized.

The second fundamental question relates to why mergers increase outsiders' incentives to collude. We use the word "outsiders" to mean all firms other than the merging parties. Compared with unilateral theories, coordinated effects theories of harm are more encumbered and intricate theories. That is, it is enough for unilateral theories to explain why the merged entity's incentives to compete changes after the merger (for example, owing to enlarged capacity, a larger stock of brands, or the elimination of the runner-up). However, coordinated theories must explain why both the incentives of the merger entity and other competitors will change. Why do outsiders find it profitable to collude with other competitors, knowing that the merging parties will be larger? This question can be posed in a more legalistic way. Competition laws generally prohibit conduct that restrains competition and harms other trading parties that would otherwise benefit from competition in the market. As coordinated effects arise from the conduct of both the merged entity and outsiders, the merger not only restrains competition between the merging parties but also between the merged entity and outsiders. Without explaining how the merger reduces outsiders' incentives to compete, it cannot be properly called a coordinated theory of harm. Based on the insights gained in Section 2, we argue in Section 3 that the identity of the exiting firm can inform outsiders about the possibility of profitable collusion.

2. How large cost asymmetries are consistent with coordinated effects of mergers?

2.1 Practical guidance is still needed

Most pertinent to this study is the extant literature on the stability of collusion and asymmetry. Compte et al. (2002) examine how mergers affect firms' incentives to collude in the context of Bertrand-Edgeworth competition with different capacities but with equal marginal costs. As larger capacities increase firms' abilities to punish deviations and their incentives to deviate, capacity increases facilitate collusion when they enhance the retaliation power of small firms. This study is the most articulate about symmetry and collusion. They also criticize that the Herfindahl-Hirschman Index tells the opposite relationship between coordinated effects and symmetry. Kühn (2004) analyzes mergers under symmetrically differentiated Bertrand competition with equal marginal costs. He examines not only firms' incentives to deviate from the collusive price but also their incentives to deviate from the punishment price. Mergers increase the merged entity's varieties (brands) and reduce their incentives to compete because of externalities or cannibalization between brands. He argues that mergers that reduce asymmetries in varieties increase collusive prices. [1] Vasconceles (2005) analyzes firms' incentives to deviate from collusive output and their incentives to deviate from the punishment phase in Cournot competition with different quadratic costs. He argues that mergers increase the scope of collusion when they increase or decrease the size of the smallest or largest firms, respectively.

Although the abovementioned studies use different models, they are strikingly similar in that symmetry facilitates collusion. Thus Fabra & Motta (2018) state that "there is a robust result that says that firms' asymmetries hinder collusion." That being said, line drawing between

[1] Davis (2006) reaches a similar conclusion regarding critical discount factors.

symmetric and asymmetric mergers is quite difficult in practice. Even the most specific guidance, given by Fabra & Motta (2018), is also ambiguous, stating "in general tacit collusion is unlikely to arise unless after the merger there will be two or three firms with a very important share of the market (say, more than 70 percent), and there will be considerable symmetry among them."

To clarify the range of "considerable symmetry," we fix the number of firms in the market to be three, and numerically analyze when the profit increase from collusion is sufficient and durable for each collusive member notwithstanding cost asymmetries

The literature most relevant to our analysis is Kovacic et al. (2007, 2009). They calculate payoffs from explicit collusion for all subsets of firms in the post-merger market and compare them with pre-merger non-cooperative profits. They prioritize merger enforcement when the increase in payoffs from collusion after the merger is largest.[2] Davis & Huse (2010) employ a similar approach but also analyze incentive compatibility constraints in a repeated game framework.[3] These works consider differentiated Bertrand models because unilateral effects analysis is straightforwardly applied to the context of coordinated effects; collusion after a merger is the same as another merger between the colluding members.[4] Our focus in this section is to identify markets where collusion is mutually profitable for collusive members despite cost asymmetries. In other words, we focus on the profitability of collusion after a merger, and not on the sustainability of collusion. We do not focus on the minimum discount factors because condensing various market configurations into a single index is contrary to the purpose of this study. We analyze collusions in both Cournot competition (Section 2.2) and differentiated Bertrand competition (Section 2.3).

2.2 Cournot Competition

We consider an industry comprising three firms (Firm1, 2 and 3) that produce homogeneous products. Firms make output decisions simultaneously.[5] The inverse demand curve is given by:

$$P = a - q_1 - q_2 - q_3,$$

where $0 < a$.

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[2] Kovacic et al. (2009) add calculations of the increase in profit by cheating and the decrease in profit from Nash reversion. They argue that comparing these figures "provides a measure of the stability of a post-merger cartel."

[3] See also Sabbatini (2006) for a different collusive equilibrium.

[4] Other models have been applied as well. Kovacic et al. (2007) analyze the increase in profit from collusion under the auction model. Igami & Sugaya (2019) estimate the net value of collusion, that is, the present value of collusion profits minus the defection profits and the present value of Nash equilibrium profits, in the dynamic Cournot model.

[5] We do not examine a leader-follower game, as it is hard to find the mutually profitable collusive output. We do not assume side payments either, because such an assumption is too speculative in the merger review context.

There are only two types of firms in the market: large (low cost) and small (high cost). The cost function of a large firm is given by

$$C_L = cq_L,$$

and the cost function of a small firm is given by

$$C_S = cq_S + \frac{d}{2}q_S^2,$$

where $0 < c < a$ and $0 < d$.

Here, d represents the inefficiency parameter. The simplified cost functions make calculations of market shares quite simple because the large firm's output in Nash equilibrium (NE) is $(1+d)$ times larger than that of the small firm: $q_L^{NE} = (1+d)q_S^{NE}$.

We calculate and compare Nash equilibrium profits and collusive profits of each firm. We assume that collusion is industry-wide and that all three firms participate. As our focus is to identify the markets where collusion is profitable despite cost asymmetries, we do not need to compare profits before and after a merger. In other words, we treat the triopoly market as the market structure after a merger. We compare two configurations of markets. One market comprises two large firms and one small firm (we call this an “LLS market”). The other market comprises one large firm and two small firms (an “LSS market”).

Before presenting the numerical results, we will explain some of the assumptions of our model. First, we do not assume quadratic cost functions with capital cost k_i, given by $C_i = cq_i + \frac{q_i^2}{2k_i}$, which was assumed by Vasconcelos (2005). The reason is, first, that such cost functions presume that mergers automatically decrease a merged entity's marginal cost. However, in the merger review practice of competition agencies, such efficiencies are not presumed, but they have to be proved by the merging parties. Second, the technical reason is that Cournot Nash equilibria in a triopoly does not always result in output proportional to capital (proportional-SPE), which is quite different from his analysis. Therefore, we selected different cost functions.

Second, when choosing the collusive output that maximizes joint profits, we assume it to be the monopoly output when the most efficient firm (the low-cost firm) monopolizes the market. The allocation of collusive output is assumed to reflect the cost of each firm. For example, in a market with one large firm and two small firms (an LSS market), the collusive output is allocated at a ratio of $(1+d):1:1$. More specifically, $q_1^c = \frac{(a-c)(1+d)}{6+2d}$, $q_2^c = q_3^c = \frac{a-c}{6+2d}$. In our model, a merger is assumed to reduce costs only when a small firm and a large firm merge and shut down high-cost plants (rationalization). Therefore, if two small firms merge, their costs remain the same after the merger and their allocated collusive share in duopoly is $\frac{1}{2+d}$. One of the reasons for selecting such an allocation rule is its simplicity. Another possible allocation rule is that the merged entity is allocated a share based on the sum of the merging parties' pre-merger market share. However, such an allocation is not mutually profitable and we have excluded such a rule.[6] The assumption about the allocation of collusive output suggests that if a merger increases efficiency, outsiders do not know the merged entity's new costs, which frustrates the formation of collusion. Therefore, a merger between small firms with increased efficiency is procompetitive not pro-collusive. This implication is contrary to that found in the extant literature.

In Table 1, we show the calculated profit increases for the LLS and LSS markets according to the specific parameter values of *d*. Profit increases are collusive profits minus Nash equilibrium profits. For simplicity, we assume $(a-c)^2 = 1$, which does not affect our analysis.

Table 1. Profit increase from collusion compared to Cournot NE

LLS		LSS	
$d = 1/8$	0.0204(L)	$d = 1/8$	0.0200(L)
(35,35,30)	0.0199(S)	(36,32,32)	0.0196(S)
$d = 1$	0.0184(L)	$d = 1$	0.0139(L)
(40,40,20)	0.0144(S)	(50,25,25)	0.0130(S)
$d = 2$	0.0171(L)	$d = 2$	0.0094(L)
(43,43,14)	0.0106(S)	(60,20,20)	0.0088(S)

The profit increases for each value of *d* are calculated for large firms (first row with (L)) and small firms (second row with (S)). The numbers in parenthesis under the values of *d* indicate the market shares of the three firms.

There are three insights evident from Table 1. First, in both LLS and LSS markets, an increase in *d* reduces the profitability of collusion for both large and small firms.[7] In other words, greater symmetry makes collusion profitable mutually. Second, by comparing the increase in profits between the two markets for the same value of *d*, we observe that the increase in profits is larger in the LLS market than in the LSS market for each collusive member. This is one reason for prioritizing the LLS market over the LSS market. Aggregating all collusive members' profits does not seem to be the right criterion for priority setting because the sum of collusive profits is larger with a large number of firms. Third, in the LLS market, profitability of collusion is less immune to an increase in *d*. In the LSS market, in contrast, the small firm's collusive profits shrink more

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[6] It is easily shown that the outsider's collusive profit is lower than its Nash equilibrium profit after the merger.

[7] A similar result was obtained in Schmalensee (1987), where one low-cost firm faces competition from N identical high-cost firms.

quickly as cost asymmetries widen. When $d = 2$, the profit increase of a small firm decreases to 0.0088. In this respect, the collusion in the LLS market is more durable despite cost asymmetries.[8] The profitability of collusion, even with a large d, signifies that collusion is profitable with wider margins of error in estimating competitors' costs. All these observations allow us to conclude that the priority target markets for coordinated effects in quantity competition are those markets where the costs of the top firm and the second largest firm are the closest. Caveat is that we do not mean to say that the LSS market is not subject to coordinated effects. When the cost differences are small, both the LSS and LLS markets are equally concerning with respect to coordinated effects. Caution should be taken not to dismiss coordinated effects theory of harm in LLS markets when there are sufficient cost asymmetries.[9]

2.3 Bertrand Competition

Next, we consider a symmetrically differentiated triopoly. The inverse demand curves are given by, $p_1 = a - q_1 - dq_2 - dq_3$, $p_2 = a - q_2 - dq_3 - dq_1$, $p_3 = a - q_3 - dq_1 - dq_2$, where $0 < a$, $0 < d < 1$. The parameter d stands for differentiation. A lower d means that the goods of the three firms are more differentiated and a higher d means that they are more homogeneous. We assume that marginal costs are constant. As in the Cournot competition model, we assume that there are only two types of firms: large (low cost) firms with marginal cost c_1, and small (high cost) firms with marginal cost c_2, where $0 \leq c_1 < c_2$.

There are two points to note regarding this model: Firstly, we confine our model to a symmetrically differentiated market because competition is fiercer compared to one which is asymmetrically differentiated. When firms are highly differentiated, they benefit from high prices even with Nash equilibrium, and the profit increase from collusion is minimal.[10] Secondly, we assume that each firm sells only one product. In other words, we analyze a triopoly as a market after a merger and do not incorporate the unilateral effects of a merger that brings two or more brands together into the merged entity. Nevertheless, our simple model is justified if we consider the case in which, after a merger, a remote competitor becomes a closer competitor to top firms by obtaining a new brand.

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[8] In duopoly, cost asymmetries have a larger effect of destroying the profitability of collusion. For example, in a market with one large firm and one small firm, the profit increase from collusion for a large firm decreases to 0.0067 when $d = 1$. This finding admonishes us that duopoly might not always be a pro-collusive market structure.

[9] We report the minimum discount factors for collusion to be sustainable with grim strategies (Nash reversion) here (when $d = 1/8$). For the LLS market, it is $\delta^* = \delta_L = 0.5669$. For the LSS market, it is $\delta^* = \delta_L = 0.5623$. The large firm's incentive constraint is binding.

[10] It is easily shown numerically that collusion is barely profitable when products are more differentiated. For example, when $a = 1$, $d = 0.1$, $c_1 = 0.1$, $c_2 = 0.5$, profit increase for a large firm is 0.0021.

As in the previous section, we compare collusive profits to Nash equilibrium profits across the LLS and LSS markets and examine how the profit increase from collusion changes depending on the cost asymmetries of the three firms. Collusive profits are obtained by maximizing the joint profits of all three firms. The collusive price is $p_L^c = \frac{a+c_1}{2}$, for large firms and $p_S^c = \frac{a+c_2}{2}$, for small firms.

Table 2 shows the calculated profit increase for specific parameter values, where $a = 1$, $d = 0.9$, $c_1 = 0.1$.

Table 2. Profit increase from collusion compared to Bertrand NE

LSS	$c_2 \leq 0.19$	LLS	$c_2 \leq 0.1473$
$c_2 = 0.11$	0.0707(L)	$c_2 = 0.11$	0.0647(L)
(36,32,32)	0.0512(S)	(35,35,30)	0.0451(S)
$c_2 = 0.14$	0.1061(L)	$c_2 = 0.14$	0.0827(L)
(43,28,28)	0.0297(S)	(38,38,23)	0.0053(S)

For small firms to supply a positive output in the LSS and LLS markets, they must satisfy the upper limits on c_2, which are described in the first row of the table. As the LLS market has a lower limit for small firms' costs, it is more difficult for them to survive in the LLS market than the LSS market.

If we apply the same approach as in the previous section, the LSS market should be a priority market we are more concerned with. First, when comparing the increase in profits between the two markets for the same parameter of c_2, we observe that the increase in profits is larger in the LSS market than the LLS market for each collusive member. Second, in the LSS market, profitability of collusion is less immune to an increase in c_2. In the LLS market, in contrast, the small firm's collusive profits shrink more quickly as cost asymmetries widen. The same caveat applies to this model as well. This is not indicative of a lack of concern for the LLS market, but more caution should be taken to consider coordinated effects theory of harm in the LSS market when there are sufficient cost asymmetries.

Based on the above analysis, we conclude that we should be more concerned with coordinated effects in differentiated Bertrand markets when the products are less differentiated and when the cost asymmetries between the second largest and the lower ranked firms are the smallest.[11]

3. why do mergers increase outsiders' incentives to collude?

[11] We report the minimum discount factors for collusion to be sustainable in both markets here (when $a = 1$, $d = 0.9$, $c_1 = 0.1$, $c_2 = 0.11$). For the LSS market, it is $\delta^* = \delta_S = 0.8562$. For the LLS market, it is $\delta^* = \delta_S = 0.8724$.

The analysis in Section 2 assumes that, after a merger, firms in the market have incentives to collude. This section examines the reasons justifying this assumption. The simplest answer is that horizontal mergers reduce the numbers of competitors (at least one). Although this is an important reason, it does not specify the most concerning cases of coordinated effects nor does it draw a line between competitively benign and harmful mergers. Another possible explanation is that a merger with a maverick firm provides outsiders incentives to collude. As Baker (2002, 2019) exposits, a maverick is "any firm that is nearly indifferent between coordination and cheating" and that prevents "coordination from becoming more effective." Although the maverick theory is the most compelling explanation of why mergers facilitate collusion, it does not identify who among the outsiders would have incentives to collude after a merger. Strictly speaking, the maverick theory sidesteps specifying the would-be collusive members and is unbale to provide an answer to the second question.

In Section 2, we have concluded that merger enforcement should prioritize markets where collusion is mutually profitable despite tolerable cost asymmetries. If we accept this criterion, we can answer the second question by relating mergers to outsiders' costs and profitability. A merger can send two messages; that the market is not worthwhile for the exiting firm to keep investing, or that the exiting firm has high costs and cannot survive in the market. Outsiders with equal to or higher than the exiting firm's costs will know that their prospective businesses are also unprofitable in spite of their competitive efforts. Such outsiders can reasonably be presumed to have incentives to collude with, or at least to follow price increases. When the exiting firm is efficient, especially when the top firm exits,[12] such a message is the strongest. As even the top firm does not see high stakes in investing in the market, a merger incentivizes outsiders to live and let live. Conversely, if the top firm keeps investing substantially in the market, coordinated effects are highly unlikely. When an inefficient firm exits through merger, it means that it cannot survive in the market. The remaining competitors that are more efficient than the exiting firm understand that they can engage in profitable collusion, similar to a small firm in the LSS market in the differentiated Bertrand model. As the number of significant competitors or relatively close competitors decreases, outsiders are more likely to know that they are within tolerable cost asymmetries for profitable collusion.

4. Conclusion

This study has addressed two questions regarding coordinated effects of mergers from a novel perspective than that endorsed in the extant economic literature First, we have identified

[12] The famous example of this type is Nestlé/Perrier merger. See Compte et al. (2002).

the markets in which mutually profitable collusion with cost asymmetries is predicted. These are the primary targets about which we should be more concerned with. We have also found that the relationship between the number of firms and collusion may not be monotonic (see footnote 8). Second, based on the analysis in Section 2, we obtained an answer to why mergers incentivize outsiders to collude. Mergers can inform competitors that they are within the boundary of profitable collusion.

The questions discussed in this study may resonate more with lawyers than economists. The method used in this study is quite simple. However, showing changes in indices without incorporating the various aspects of individual markets is not a practical guide for lawyers. We hope to see more research that is nuanced and compelling for lawyers in the near future. We have not analyzed all possibilities of collusive output (price) or all possible allocations of collusive profits. There may be more subtle and effective ways of collusion, but we submit these explorations for future studies.

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References

Baker, J. (2002), "Mavericks, Mergers, and Exclusion: Proving Coordinated Competitive Effects under the Antitrust Laws." New York University Law Review, Vol.77(1), 135-203.

Baker, J. (2019), The Antitrust Paradigm: Restoring a Competitive Economy. Cambridge, MA: Harvard University Press.

Compte, O., F. Jenny, and P. Rey (2002), "Capacity constraints, mergers and collusion." European Economic Review, Vol. 46, 1-29.

Davis, P. (2006), "Coordinated effects merger simulation with linear demands"

Davis, P. and C. Huse (2010), "Estimating the 'coordinated effects' of mergers."

Fabra, N. and M. Motta (2018), "Assessing coordinated effects in merger cases." In Corchón L. and Marini M. (Eds.), Handbook of Game Theory and Industrial Organization, Vol. 2, 91-122. Cheltenham, UK: Edward Elgar Publishing.

Igami, M. and T. Sugaya (2019), "Measuring the Incentive to Collude: The Vitamin Cartels, 1990-1999."

Kovacic, W., R. Marshall, L. Marx, and S. Schulenberg (2007), "Coordinated effects in merger review: quantifying the payoffs from collusion." In Hawk B. (Ed.), International Antitrust Law and Policy: Fordham Law 2006, 271-285.

Kovacic, W., R. Marshall, L. Marx, and S. Schulenberg (2009), "Quantitative analysis of coordinated effects." Antitrust Law Journal, Vol. 76, 397-430.

Kühn, K.-U. (2004), "The Coordinated Effects of Mergers in Differentiated Products Markets."

Sabbatini, P. (2006), "How to simulate the coordinated effect of a merger."

Schmalensee, R. (1987), "Competitive Advantage and collusive optima." International Journal of Industrial Organization, Vol. 5, 351-367.

Vasconcelos, H. (2005), "Tacit collusion, cost asymmetries, and mergers." RAND Journal of Economics, Vol. 36(1), 39-62.