Economics Bulletin

Volume 41, Issue 4

On the social welfare effects of runner-up mergers in concentrated markets

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Abstract

This paper argues that it cannot be taken for granted that any merger that raises consumer surplus also increases social welfare. We assume a Cournot model with homogeneous goods, linear demand, and constant marginal costs, to show that a merger can raise consumer surplus while harming social welfare. Within this framework, we show that such an outcome depends on two conditions: the merger is between relatively small firms and it reduces concentration; that is, a constellation which can be characterized as a "runner-up" merger.

We thank Markus Dertwinkel-Kalt, Hans-Theo Normann and participants of the DICE-PhD workshop (summer 2021) for valuable comments. Christian Wey and Mengxi Zhang gratefully acknowledge financial support by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation)--grant 235577387/GRK1974.

Citation: Dragan Jovanovic and Christian Wey and Mengxi Zhang, (2021) "On the social welfare effects of runner-up mergers in concentrated markets", *Economics Bulletin*, Vol. 41 No. 4 pp. 2330-2337.

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Submitted: August 24, 2021. **Published:** December 29, 2021.

1 Introduction

This paper contributes to the merger literature by showing that it cannot be taken for granted that mergers that benefit consumers are necessarily beneficial from a social welfare perspective. If the negative external effect of the merger on outsider firms' profits outweighs both the merging firms' profit gain and the consumer surplus gain, then the overall social welfare effect of the merger is negative even though consumer surplus is increased. We assume a Cournot model with homogeneous goods, linear demand, and constant marginal costs to show that such an outcome arises even in a simple setting. The model accounts for merger efficiencies which have to be large enough to make the merger *consumer-surplus increasing* in the first place.

A closer examination of the assumed Cournot model reveals that there are two conditions potentially giving rise to this result: the merger is between small firms (i.e., relatively inefficient firms) and it reduces concentration (as measured by the Herfindahl-Hirschman index).

The intuition for this result follows from the general insight that small firms must have relatively high marginal production costs in an oligopolistic market equilibrium. Thus, the very existence of small firms is associated with a productive inefficiency as it would be desirable that more efficient firms take over smaller firms' market shares. If, therefore, a merger of relatively small firms leads to efficiencies, then this productive inefficiency can become even larger as the merged firm takes over market shares from its (still) more efficient rivals.

Our analysis complements the seminal work of Farrell and Shapiro (1990), which examines the social welfare effects of price-increasing (or, "anticompetitive") mergers. While consumers are always harmed by price increases, outsider firms' profits can go up or down depending on the merging firms' joint market share. The total external effect is unambiguously negative when the joint market share of the merging firms is sufficiently large (for instance, above 50% in a linear Cournot oligopoly model; see also Levin, 1990).

The Farrell-Shapiro analysis provides a useful argument for a market-share based screening of anticompetitive mergers. This insight is mirrored in merger control regulations all over the world, which take an increasingly hostile stance on larger mergers. Notably, the Farrell-Shapiro analysis applies to "anticompetitive" (i.e., consumer-surplus reducing) mergers, while it somehow appears to suggest that "procompetitive" (i.e., consumer-surplus increasing) mergers are always socially desirable.

This paper challenges this presumption by showing that there are certain types of mergers, namely *runner-up mergers*, which might result in negative social-welfare effects despite being procompetitive. Precisely, a social-welfare reducing runner-up merger that is procompetitive is defined by two properties. *First*, the merging firms must have a *below-average joint market share* (that is, we are dealing with a merger of relatively small firms). *Second*, the merger is *concentration decreasing*; that is, the Herfindahl-Hirschman index (HHI) is smaller after the merger than before. If a procompetitive merger does not meet either one of these properties, then the merger is social-welfare increasing.

We contribute to the merger literature that analyzes the relation between the merging firms' market shares and after-merger market outcomes (Farrell and Shapiro, 1990; Levin, 1990; McAfee and Williams, 1992; Nocke and Whinston, 2021). None of those works focused on the social welfare effects of consumer-surplus increasing mergers in an asymmetric oligopoly.

Related are also works which examine merger efficiencies (Röller, Stennek, and Verboven, 2001). Starting with Williamson (1968), this literature—by large—has assumed a monotone relation between merger efficiencies and after-merger social welfare (see Besanko and Spulber, 1993, and Neven and Röller, 2005, Fig. 2, p. 834). Our results show that such a monotone relation cannot be expected necessarily in case of runner-up mergers, so that the efficiency defence may turn into an "efficiency offense" (from a social welfare perspective) in those instances.

Our merger analysis is based on a 2-step "cost-change" analysis. In the first step, the less efficient firm (i.e., the "target firm") is taken out of the market and, in the second step, the more efficient firm (i.e., the "acquirer firm") realizes merger efficiencies (i.e., a marginal cost reduction). With this approach, we can relate our merger analysis to works which analyze how a firm's marginal cost affects equilibrium outcomes under Bertrand and Cournot oligopoly competition *within* a given market structure (Lahiri and Ono, 1988; Zhao, 2001; Février and Linnemer, 2004). This literature has shown that a reduction of a firm's marginal cost reduces social welfare when the firm's market share is sufficiently small.

We proceed as follows. In Section 2, we analyze mergers in a homogenous-goods Cournot model. In Section 3, we conjecture that our runner-up merger result can also hold under Bertrand and Cournot oligopoly competition when goods are differentiated. Finally, Section 4 concludes.

2 Cournot Oligopoly with Homogenous Goods

Assume a market with N firms indexed by $i = 1, ..., N$. All firms produce a homogenous good, incur constant marginal production costs, c_i, and compete à la Cournot. Inverse market demand is given by a linear function $p(Q) = A - Q$, with $Q := \sum_{i=1}^{N} q_i$, where q_i is firm i's output. We assume a parameter range such that all firms' equilibrium outputs are strictly positive in the Cournot-Nash equilibrium, which is ensured by assuming A to be sufficiently large.

The profit of firm i is given by $\pi_i = (p(Q) - c_i)\, q_i$. In the unique Cournot-Nash equilibrium, firm i's output level is given by

$$q_i = \frac{A - Nc_i + \sum_{j=1, j\neq i}^{N} c_j}{N+1} \text{ for all } i. \tag{1}$$

The equilibrium values for total output, consumer surplus, and firm i's profit are given by $Q = \frac{NA - \sum_{i=1}^{N} c_i}{N+1}$, $CS = \frac{1}{2}Q^2$, and $\pi_i = q_i^2$, respectively. In equilibrium, social welfare (i.e., the sum of firms' profits and consumer surplus) is given by

$$SW = \frac{1}{2}Q^2 + \sum_{i=1}^{N} q_i^2. \tag{2}$$

Firm i's market share is defined by $s_i := q_i/Q$ and the Herfindahl-Hirschman index by $HHI := \sum_{i=1}^{N} s_i^2$.

In the following, we analyze the social-welfare effect of a merger between two firms i and j, with $i, j \in \{1, ..., N\}$. Let $c_i \geq c_j$, with firm i being the *target* firm and firm j the *acquirer* firm.

We assume that the acquirer firm's marginal cost, c_j, is reduced after the merger by σ, which stands for the *merger efficiencies*. Thus, the merged entity (for which we keep the acquirer-firm index j) has after-merger marginal costs, c_j^a (the superscript a stands for "after-merger"), given by $c_j^a := c_j - \sigma$, for $\sigma \in [0, c_j]$.

The Cournot equilibrium formula (1) gives directly the before-merger equilibrium values, q_i^b, (we indicate "before-merger" equilibrium values by the superscript b). Noting that a merger between firms i and j takes firm i out of the market (and thereby reduces the number of firms from N to $N-1$) and that firm j's after-merger marginal costs change from c_j to $c_j - \sigma$, formula (1) can be easily re-written to get the after-merger equilibrium values, q_i^a.

A merger between two firms can be interpreted as changing the merging firms' marginal production costs in two steps. In step 1, the marginal costs of the target firm (which is relatively inefficient) are raised to infinity (i.e., it is taken out of the market). In step 2, the acquirer firm's (or: the *merged* firm's) marginal cost is reduced by the merger efficiency, σ.

Given this "cost-change" analysis of a merger, we can relate the merger analysis to comparative static results which examine how equilibrium values change due to a marginal change of a firm's marginal cost (Zhao, 2001, and Février and Linnemer, 2004).

Lemma 1 (Cournot equilibrium properties). *Suppose an interior equilibrium of an N-firms Cournot oligopoly with firm-specific constant marginal costs, c_i, and a linear inverse demand function. An exogenous marginal change of firm i's marginal cost, c_i, then affects the equilibrium values as follows:*

i) Firm i's output, q_i, profits, π_i, and market share, s_i, decrease in c_i.

ii) Firm j's ($j \neq i$) output, q_j, profit, π_j, and market share, s_j, increase in c_i.

iii) The market price, p, increases in c_i, and total output, Q, as well as consumer surplus, CS, decrease in c_i.

iv) Social welfare, SW, strictly increases (strictly decreases) in c_i if and only if $s_i < \frac{1}{2(N+1)}$ ($s_i > \frac{1}{2(N+1)}$) (with $\frac{\partial SW}{\partial c_i} = 0$ for $s_i = \frac{1}{2(N+1)}$), while it is strictly convex in c_i.

Proof. For parts *i)-iii)* see Zhao (2001). Part *iv)* follows from $\frac{\partial SW}{\partial c_i} = Q \cdot \frac{\partial Q}{\partial c_i} + 2 \cdot \sum_{j=1}^{N} \left[q_j \cdot \frac{\partial q_j}{\partial c_i} \right]$, which can be re-written as $\frac{\partial SW}{\partial c_i} = \left(\frac{1}{N+1} - 2s_i \right) Q$ (see Zhao, 2001, p. 466), from which we get the conditions stated in the proposition. Finally, $\frac{\partial^2 SW}{\partial c_i^2} = \left(\frac{\partial Q}{\partial c_i} \right)^2 + 2 \cdot \sum_{j=1}^{N} \left(\frac{\partial q_j}{\partial c_i} \right)^2 > 0$, so that social welfare is strictly convex in c_i. □

We next perform the 2-step cost-change analysis of a merger between firms i and j, where firm j (the acquirer) has (weakly) lower marginal costs than firm i (the target).

Step 1 (increasing the marginal costs of the target firm i). A merger of two firms i and j with different technologies (such that $c_i \geq c_j$) induces the abandonment of the less efficient technology used by firm i. In other words, the target firm i is shut down, while the acquiring firm j remains active in the market. Taking firm i out of the market is equivalent to increasing the marginal costs of the target firm to infinity. The next result then follows immediately from Lemma 1.

Corollary 1 (Social welfare effect of a no-efficiency merger). *A no-efficiency merger (with $\sigma = 0$) in an N-firms Cournot oligopoly increases social welfare if the target firm's market* *share is sufficiently small; i.e.,* $s_i^b < \frac{1}{2(N+1)}$ *holds. Otherwise, a no-efficiency merger reduces social welfare. Finally, a no-efficiency merger always reduces consumer surplus.*

Corollary 1 mirrors the view that a horizontal merger appears less harmful to competition the smaller the target firm is. Conversely, if the target firm's market share (and, with that, the concentration associated with the merger) becomes large enough, then the merger is likely to harm competition significantly, in which case merger-regulations' approval conditions become increasingly restrictive. At the same time, efficiency considerations become increasingly important to counter the anticompetitive effects of the merger. The rationale behind the "efficiency defence" in merger control is that efficiencies have a positive *monotone* impact on market outcomes (Besanko and Spulber, 1983). While this reasoning is valid from a consumer-welfare view (see part *iii)* of Lemma 1), it may fail with regard to social welfare (see part *iv)* of Lemma 1). The social-welfare problem of a merger is further examined in the next step.

Step 2 (lowering the marginal cost of the acquirer firm j): The second step of the cost-change analysis of a merger between firms i and j relates to the merger efficiency, σ, realized by the acquirer firm j after the merger. To derive the social welfare effects of the merger in terms of the (observable) before-merger market shares, we focus on efficiency levels that surpass the *price-fixing* efficiency level, which we denote by $\widehat{\sigma}$. That is, we focus on consumer-surplus increasing (or, procompetitive) mergers, which should be approved by an antitrust authority following a consumer-surplus standard.

At $\sigma = \widehat{\sigma}$, the merging firms' after-merger market share is just equal to their joint market share before the merger; i.e., $s_i^b + s_j^b = s_j^a(\widehat{\sigma})$.[1] For larger efficiency levels, $\sigma > \widehat{\sigma}$, the merged firm's equilibrium market share is strictly larger than the joint before-merger market share; i.e., $s_j^a(\sigma) > s_i^b + s_j^b$.

At the price-fixing efficiency, $\widehat{\sigma}$, all firms' output levels, the equilibrium price, and consumer welfare are the same before and after the merger, whereas social welfare is strictly larger after the merger. The latter observation follows from noticing that at $\widehat{\sigma}$ the merged entity produces the same output as before but with lower marginal costs. The merging firms' profit gain is equal to the social welfare gain at $\sigma = \widehat{\sigma}$, because consumer surplus and all outsider firms' profits do not change at this point.

Given part *iv)* of Lemma 1, we can directly infer how a change of the merged firm's efficiency level affects social welfare for $\sigma \geq \widehat{\sigma}$; i.e., for merger efficiencies that reach beyond the merely price-fixing level. Noticing that the number of firms is reduced to $N-1$ after the merger, the marginal effect of firm j's after-merger marginal cost on social welfare is given by

$$\frac{\partial SW^a}{\partial c_j^a} = \left(\frac{1}{N} - 2s_j^a\right) Q^a. \tag{3}$$

Using the fact that $s_i^b + s_j^b = s_j^a(\widehat{\sigma})$ and $Q^b = Q^a(\widehat{\sigma})$ must hold at the price-fixing efficiency level $\widehat{\sigma}$, we can express (3) in terms of the joint market share of the merging firms:

$$\left.\frac{\partial SW^a}{\partial c_j}\right|_{\sigma=\widehat{\sigma}} = \left(\frac{1}{N} - 2(s_i^b + s_j^b)\right) Q^a. \tag{4}$$

[1] The existence of a unique $\widehat{\sigma}$ follows from the monotonicity of a firm's output in its marginal costs (see part *i)*, Lemma 1).

Note that $\frac{\partial SW^a}{\partial c_j} = -\frac{\partial SW^a}{\partial \sigma}$. From (4) we see that a change of the merger efficiency impacts negatively on social welfare (evaluated at the price-fixing efficiency level) if and only if $s_i^b + s_j^b < \frac{1}{2N}$ holds, while social welfare increases otherwise. We, therefore, have derived a necessary (sufficient) condition for a social-welfare reducing (increasing) merger, which makes consumer better off by reducing the market price.

Proposition 1 (Social welfare effect of a price-reducing merger). *Suppose that a merger reduces the equilibrium market price, and hence, increases consumer surplus; i.e., $\sigma \geq \widehat{\sigma}$ holds. Social welfare unambiguously increases after the merger if $s_i^b + s_j^b \geq \frac{1}{2N}$ holds. Otherwise, social welfare can increase or decrease with the merger depending on the efficiency level σ. If social welfare is lower after the merger than before, then the following properties of a "runner-up merger" hold:*

i) The merger occurs between relatively small firms, where the sum of the market shares of the merging firms fulfills $s_i^b + s_j^b < \frac{1}{2N}$.

ii) Concentration is reduced after the merger; i.e., $HHI^a < HHI^b$ holds.

Proof. Part *i)* When $s_i^b + s_j^b < \frac{1}{2N}$ holds, then a no-efficiency merger must increase social welfare according to Corollary 1, because $s_i^b \leq s_j^b$, together with $s_i^b + s_j^b < \frac{1}{2N}$, implies that $s_i^b < \frac{1}{2(N+1)}$ holds. Condition $s_i^b + s_j^b < \frac{1}{2N}$ (which is implied by (4)) also ensures that SW^a decreases monotonically until the price-fixing efficiency level, $\widehat{\sigma}$, is reached. At that point, after-merger social welfare is strictly larger than the before-merger level. Thus, increasing the efficiency level beyond the price-fixing level is a necessary condition for a consumer-surplus increasing and social welfare-reducing merger. If, on the other hand, $s_i^b + s_j^b \geq \frac{1}{2N}$, then $SW^a > SW^b$, for all $\sigma \geq \widehat{\sigma}$, follows from the strict convexity of $SW(c_j)$ (see part *iv*), Lemma 1).

Part *ii)* We can re-write (2) as $SW = Q^2\left(\frac{1}{2} + HHI\right)$. We then get that $SW^a < SW^b$ can only hold if $HHI^a < HHI^b$, because $Q^a \geq Q^b$ for all $\sigma \geq \widehat{\sigma}$. □

Notably, Proposition 1 refers to the before-merger market shares, a metric easily available given the relevant antitrust market is well-defined. It clearly singles out runner-up mergers as the only candidates for social-welfare reducing mergers, *given* that the merger is consumer surplus increasing. Such a procompetitive but social welfare reducing runner-up merger is characterized by two defining features. *First*, it is a merger of relatively small firms (according to part *i)* of Proposition 1, the combined market share is below one-half of the average market share in the respective market). *Second*, the merger induces some—but limited—merger efficiencies, so that concentration (as measured by the Herfindahl-Hirschman index) is reduced after the merger.

Figure 1 illustrates our result. Panel A refers to a social-welfare reducing and panel B to a social-welfare increasing merger. In both panels, the x-axis measures the merger efficiency, σ, and the y-axis stands for social and consumer welfare, respectively. The point $\widehat{\sigma}$ indicates the price-fixing merger efficiency, where consumer surplus is the same before and after the merger. At this point, after-merger social welfare, SW^a, must be larger than social welfare before, SW^b. Moreover, at $\sigma = \widehat{\sigma}$, the difference between SW^a and SW^b is equal to the merging firms' profit gain from the merger.

Panel A depicts the case of a "small-firms" merger (i.e., condition $s_i^b + s_j^b < \frac{1}{2N}$ of part *i)* of Proposition 1 holds). In this case, after-merger social welfare is decreasing in the efficiency level

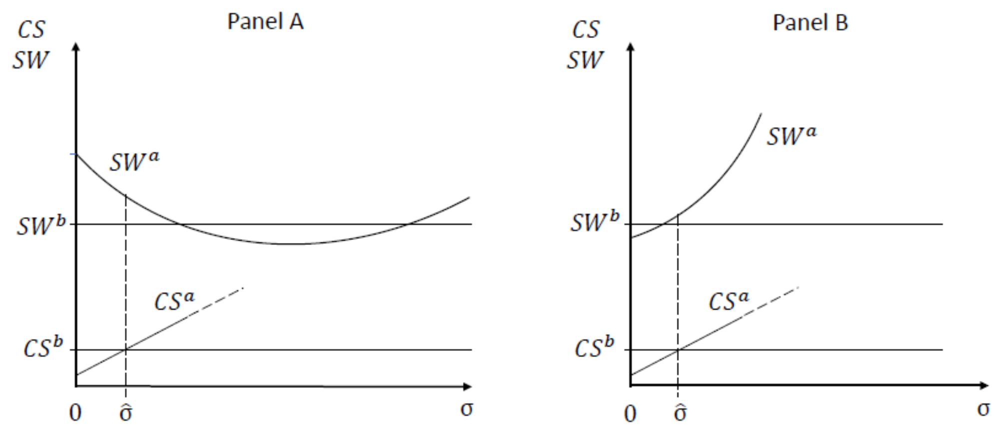

Figure 1: Social Welfare Effects of a Merger with Efficiencies

at $\sigma = \widehat{\sigma}$, which implies that a no-efficiency merger must raise social welfare (i.e., $SW^a(\sigma = 0) > SW^b$).

Panel A highlights the case, where there exist merger-efficiency levels, $\sigma > \widehat{\sigma}$, such that social welfare is lower after the merger than before; notably, even though consumer surplus is increased after the merger. For such an outcome to occur, the merger efficiency level must be larger than the price-fixing level but not too large, so that the HHI decreases after the merger.

Panel B shows a situation, where the merging firms are large enough (i.e., $s_i^b + s_j^b \geq \frac{1}{2N}$ holds). In this case, after-merger social welfare is increasing in the efficiency level at $\sigma = \widehat{\sigma}$, which implies that after-merger social welfare remains larger than before-merger social welfare for all efficiency levels beyond the price-fixing level.

Next we provide two examples of runner-up mergers, which reduce social welfare even though they meet the price-test. We are particularly interested in the largest possible market shares of the merging firms under which such an outcome is possible within a linear Cournot oligopoly. Consider a market with a single or several (symmetric) "large" firms (with index d) and two smaller firms i (the target) and j (the acquirer), which are the merger candidates. Consider the following parameter values: $A = 1$ and $c_d = 0$, while the merging firms have strictly positive marginal costs with $c_i \geq c_j > 0$. Thus, the merging firms have strictly smaller market shares than the $N - 2$ outsider firms.

Example 1 (merger between asymmetric firms). Consider the extreme asymmetric constellation, where the target firm's output is close to zero and the acquirer firm's output is strictly larger. That is, let $c_i \rightarrow \frac{1+c_j}{N}$, which implies $q_i^b \rightarrow 0$. It is then straightforward to show that for all $c_j > \frac{N+1}{2N(N-1)-1}$ there exists merger-efficiency levels $0 < \sigma < c_j - \frac{N+1}{2N(N-1)-1}$, such that social welfare is smaller after the merger than before; notably, even though consumer surplus increases for all $\sigma > 0$.

At $c_j \rightarrow \frac{N+1}{2N(N-1)-1}$, we get the largest possible market share of firm j (and hence, of the merging firms together) such that a small merger efficiency reduces social welfare. If $N = 3$, then the upper bound of the market share of the acquirer firm is $\overline{s}_j^b = \frac{1}{6} \approx 16.7\%$, so that for all $s_j^b < \overline{s}_j^b$ exists a range of merger efficiencies such that social welfare is reduced after the merger even though the merger raises consumer surplus.

Example 2 (merger between symmetric firms). We turn to symmetric constellations, where the merging firms have the same marginal costs, $c_i = c_j := c_n$, while the $N-2$ outsider firms have marginal costs of zero. If $N = 3$, then the maximal possible joint market share of the merging firms must not be larger than 10.8%, so that there are merger efficiency levels such that the merger reduces social welfare and increases consumer surplus. If $N = 4$, then the upper bound on the joint market share is 7.8%.

3 Differentiated-Goods Oligopolies

Our previous analysis has shown that the non-monotone relation between a firm's marginal cost and social welfare (see Lemma 1) is a building block of our runner-up merger result (Proposition 1). We conjecture that our main result also applies to differentiated-goods oligopoly models that exhibits the same comparative statics results as described in Lemma 1. In this regard, the analysis of Wang and Zhao (2007) is reassuring. They consider a Bertrand-Shubik demand system for differentiated goods and they analyze equilibrium outcomes under Cournot and Bertrand competition. Their key result is that both oligopoly models react qualitatively in the same way to a small change of firm i's marginal cost as described in Lemma 1. In particular, equilibrium social welfare is non-monotone (and strictly convex) in firm i's marginal cost in both oligopoly models (see Propositions 1 and 2 in Wang and Zhao, 2007). Consequently, we obtain a similar situation as depicted in panel A of Figure 1 with respect to the after-merger social welfare curve. While a global comparison of social and consumer welfare before and after the merger is out of reach at a general level because of space constraints, those (local) results are nevertheless reassuring that market-share increasing mergers of small firms remain candidates for socially undesirable runner-up mergers in differentiated-goods Bertrand and Cournot oligopolies.

4 Conclusion

We showed within a standard Cournot model that small-firms merger, which give rise to some—but limited—efficiencies may increase consumer welfare while they reduce social welfare. If such a constellation occurs, then concentration must decrease. Our result becomes practically relevant when antitrust regulations would switch from a consumer-welfare standard to a social-welfare standard (see Heyer, 2006, for such a proposal). Under a social-welfare standard the harm imposed by the merger on competitors has to be considered in the overall evaluation of a merger. If this harm exceeds the sum of the profit gain of the merging firms and the consumer welfare gain, then the merger had to be blocked. As the harm imposed on competitors increases with the merger-generated efficiencies, the merging firms may want to conceal any such possible merger gains. Thus, the antitrust agency would have to deliver the facts by claiming an "efficiency offense" of the merger proposal. According to our analysis, such a claim is most likely to be critical when the merging firms have a below-average joint market share, while efficiencies ensure that the merger is market-share increasing and tends to reduce market concentration—i.e., when a runner-up merger is at stake.

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