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RESOLVING THE MERGER PARADOX[1]

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Abstract: *Horizontal mergers in a Cournot market are generally unprofitable for the merged entities and create a free-riding problem unless they involve more than 80% of market participants. This phenomenon is known as the merger paradox. This paper aims to explain the concept of the paradox and reasons for its emergence by modifying one assumption in the Cournot model while keeping the other assumptions constant in order to identify the primary contributor. The results suggest that the merger paradox can be partially addressed by modifying key assumptions of the Salant, Switzer and Reynolds (1983) model; however, the practical sustainability of these modifications remains uncertain.*

Key words: merger paradox, 80% rule, free-riding problem.

REŠAVANJE PARADOKSA SPAJANJA

Apstrakt: *Uopšteno govoreći, horizontalna spajanja u Kurnoovom modelu oligopola nisu profitabilna za preduzeća koja učestvuju u spajanju i stvaraju problem slepog putnika, osim ukoliko uključuju preko 80% učesnika na nekom tržištu. Ova pojava poznata je u literaturi kao Paradoks spajanja. Cilj ovog rada je da objasni ovaj paradoks i uzroke njegovog nastanka na osnovu modifikacije jedne pretpostavke u Kurnoovom modelu dok se ostale pretpostavke zadržavaju konstantnim, u cilju identifikovanja one koja najviše doprinosi nastajanju ovog paradoksa. Rezultati analize ukazuju da se paradoks spajanja može delimično rešiti promenom ključnih pretpostavki Salant, Switzer i Reynolds (1983) modela; međutim, postavlja se pitanje njihove održivosti u praksi.*

Ključne reči: Paradoks spajanja, pravilo 80%, problem slepog putnika.

JEL klasifikacija (classification): D43, L13, L41

1. Introduction

Merger control is a key pillar of competition policy, designed to prevent market distortions that may arise when companies combine their operations. Mergers, whether horizontal, vertical, or conglomerate, are often used by firms to expand their market presence, improve efficiency and reduce costs, potentially leading to higher-quality goods and services. However, they can also

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pose serious threats to competition, particularly horizontal mergers that increase market concentration. In highly concentrated markets, such mergers can create or strengthen dominant players, risking higher prices, reduced consumer choice, lower quality and diminished innovation. To safeguard competitive markets, competition authorities carry out *ex-ante* assessments of proposed mergers to evaluate their likely impact and determine whether to approve or reject them.

Although mergers have become more frequent, especially in the last decade, they have attracted the attention of many economists for a long time. One of the pioneering works on this subject is that of Salant, Switzer and Reynolds (1983) (hereafter referred to as "SSR"), who introduced the concept of the *merger paradox*. SSR demonstrated that a merger between m ($m < n$) Cournot competitors is privately unprofitable for companies participating in the merger (also referred to as *insiders*) unless it includes at least 80% of market participants. Conversely, a merger that includes more than 80% of the market participants or, in extreme cases, involves the entire market and leads to monopoly, is always profitable. This is commonly referred to in the literature as the *80% rule.* Furthermore, a merger leads to a *free-riding problem*, meaning that companies not participating in the merger (also referred to as *outsiders*) enjoy greater benefits from mergers due to free-riding on increased prices and increased output. Therefore, mergers can be viewed as a public good, as they enhance outsiders' profits at the expense of insiders.

Building on SSR's findings, many economists have sought to uncover the flaws in SSR's paper and resolve the merger paradox by modifying key assumptions in their original model. Perry and Porter (1985) demonstrated that when costs are sufficiently convex, a merger can be profitable for insiders. Deneckere and Davidson (1985) found similar results in a Bertrand model with differentiated goods. Fauli-Oller (2002) assumed demand concavity and demonstrated that a merger could be profitable if companies have sufficiently different costs. Heywood and McGinty (2008) integrated convex costs with timing leadership, allowing the merged entity to optimise production across various plants and reduce costs. Gelves (2010) combined timing leadership with cost asymmetries, enabling the merged entity to achieve greater efficiency through the transfer of cost technology. On the other hand, Faulí-Oller and Motta (1996) considered a model in which companies, run by professional managers focused on increasing market share rather than owners who are profit maximisers, are motivated to undergo mergers solely to increase market share, even if those mergers are unprofitable.

This paper aims to determine which assumption most significantly impacts the controversial results and to explore how modifying that assumption could potentially resolve the merger paradox completely, focusing on the following three assumptions: cost synergies, product differentiation and leadership. Modifying the assumption to include cost synergies is based on Farrell and Shapiro (1990), which focuses on identifying the necessary cost efficiencies that would result in a profitable merger for insiders, as well as the synergies that would positively affect consumers and total welfare. Analysing the combination of the merger paradox and product differentiation, Gelves (2014) demonstrates that a high level of product differentiation reduces the above-mentioned implications of the merger paradox. The shift in market participants' behaviour from Cournot to Stackelberg is based on Hamada and Takarada (2007), which indicates that mergers between leaders and followers are always profitable but socially harmful, while Huck et al. (2001) present a case of a merger between followers that behave as a leader following the merger.

2. Conceptual framework of the merger paradox

Mergers are not always profitable. A merger is considered profitable if the profit of the merged entity exceeds the combined individual pre-merger profits of the companies participating in a merger. Horizontal mergers reduce competition, which introduces a free-riding problem. Competition reduction acts as a public good that benefits all companies in the industry while only merging companies bear the associated costs. Consequently, companies not participating in a merger usually gain more from it than the participating companies themselves. This is due to the aggressive response of non-merging companies, which increase their output in reaction to the merging companies' output reduction. This phenomenon is known as the merger paradox and was first discussed within a clear economic model by SSR.

To illustrate the merger paradox, assume a homogeneous product market with $n = 24$ companies[3] jointly facing a linear demand curve $P = 1400 - 2Q$, where each has a constant marginal cost $c = 200$. The Cournot equilibrium implies that each company would produce $q_i = \frac{1.400-200}{2\cdot(24+1)} = 24$, and the total output would be $Q = 24 \cdot 24 = 576$. The price is, therefore, $P = 1400 - 2 \cdot 576 = 248$ and the profit of each company $\pi_i(n = 24) = (248 - 200) \cdot 24 = 1.152$. If two companies in the market merge, the total number of companies would be $n = 24 - 2 + 1 = 23$, with each producing

[3] The illustration with 24 companies in the market is purely illustrative and aims to demonstrate a gradual increase in the market share of insiders until it eventually exceeds 80%, which is the threshold for a profitable merger for insiders. While the literature typically illustrates the merger paradox within a three-company industry (which resembles an oligopolistic market), this illustration can only show scenarios involving a merger of two insiders (with 66.67% market share) or a merger to monopoly (all three companies). It is important to note that the presence of many companies in a Cournot equilibrium raises concerns about its stability. Additionally, coordination among companies is nearly impossible, creating conditions of perfect competition.

$q_i = 25$, and the total output would be $Q = 575$, resulting in a price of $P = 250$; therefore, the profit of each (including the merged) company $\pi_i(n = 23) = 1.250$. Prior to the merger, these two companies would earn twice the pre-merger profit, $2 \cdot \pi_i(n = 24) = 2.304$, which is lower than the post-merger profit of 1.250, meaning that the merger would be unprofitable for these two companies.

As mentioned, we can refer to the subset of companies that participate in the merger as insiders and those companies that continue to behave independently after the merger as outsiders. Table 1 below illustrates other scenarios with different numbers of insiders. The last column, depicting the merger of all 24 companies in the market, represents an extreme case leading to a monopoly.

Table 1. Merger paradox illustration

No. of insiders	3	5	7	9	11	13	15	17	19	21	22	23	24
No. of companies after the merger	22	20	18	16	14	12	10	8	6	4	3	2	1
Market share of insiders	13%	21%	29%	38%	46%	54%	63%	71%	79%	88%	92%	96%	100%
Individual output *(qi)*	26	29	32	35	40	46	55	67	86	120	150	200	300
Total output *(Q)*	574	571	568	565	560	554	545	533	514	480	450	400	300
Price *(P)*	252	257	263	271	280	292	309	333	371	440	500	600	800
Joint profit of colluding insiders (πc)	**1,361**	**1,633**	**1,994**	**2,491**	**3,200**	**4,260**	**5,950**	**8,889**	**14,694**	**28,800**	**45,000**	**80,000**	**180,000**
Joint profit of noncolluding insiders (π NC)	**3,456**	**5,760**	**8,064**	**10,368**	**12,672**	**14,976**	**17,280**	**19,584**	**21,888**	**24,192**	**25,344**	**26,496**	**27,648**

Source: Author's calculation

Based on Table 1, it can be observed that as the number of insiders increases, individual outputs rise, but total output declines, leading to price increases and subsequent increases in individual profits. However, is the merger profitable for insiders? Specifically, is the joint profit of colluding insiders (referring to the joint profit of insiders when they continue to operate as a single entity after the merger) greater than the joint profit of non-colluding insiders (combined/summed pre-merger profits of insiders)? It can be observed that, up to a specific number of insiders, colluding profit is lower than non-colluding profit, indicating that the merger is not profitable for insiders. However, beyond this point, the situation reverses, indicating that the merger is indeed profitable (as shown in Table 1, within the grey-shaded area).

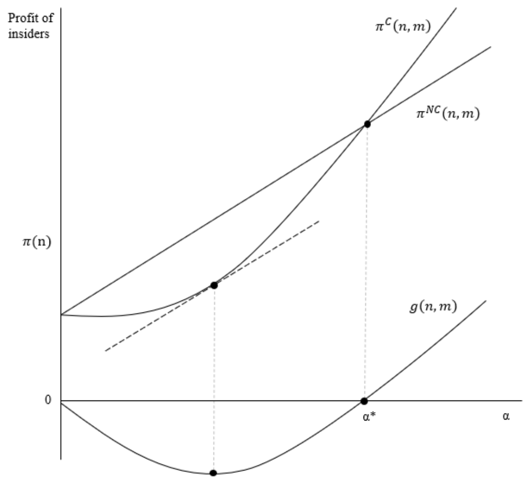
What explains this turnaround in the profitability for insiders? In order to answer this question, this matter will be illustrated in a more generalised approach, reflecting the merger paradox as initially observed by SSR.

Consider a market of *n* companies behaving as Cournot competitors, offering a homogeneous product, with constant unit costs and a linear market demand function. Assuming *m* companies opt to merge, where $m < n$ to prevent a monopoly, the post-merger market would have $n - m + 1$ companies.

For a merger to be profitable, the joint profit of colluding insiders (π^C) must exceed the joint profit of non-colluding insiders (π^{NC}). In other words, for a merger to produce gains, the difference between these profits, $g(n,m)$, should be greater than 0.

The joint profit of colluding and non-colluding insiders, as well as gains (losses) from a merger for a changing market share of m insiders ($\alpha = \frac{m}{n}$), are shown in Figure 1 below. Without a merger, there are no gains or losses, while a merger to monopoly is always profitable. As insiders' market share increases, losses rise until a certain threshold is reached, after which losses decline and gains begin.

Figure 1. Profits of a merger



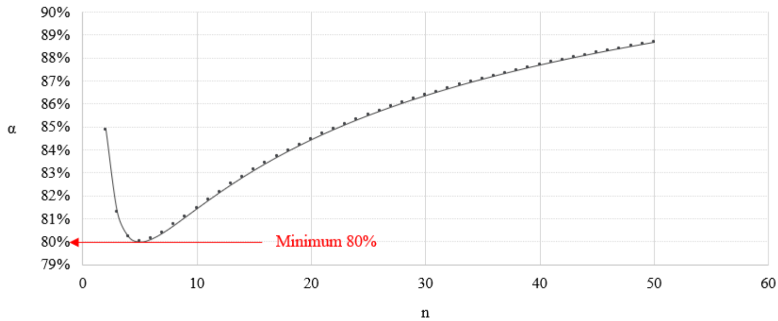
Source: Salant et al. (1983)

To determine the value of α at which $g(n,m)$ has positive values, we find α^* such that $g(n,m) = 0$. It equals zero when:

$$\alpha^* = \frac{(2n+3) - \sqrt{4n+5}}{2n} \tag{1}$$

See Appendix 1 for details on calculating α^*. For each $\alpha > \alpha^*$, a merger is profitable for insiders. Figure 2 shows that for any value of n, the α needed for a profitable merger never falls below 80%. As mentioned, this is known in the literature as the 80% rule.

Graph 2. Market share for a profitable merger

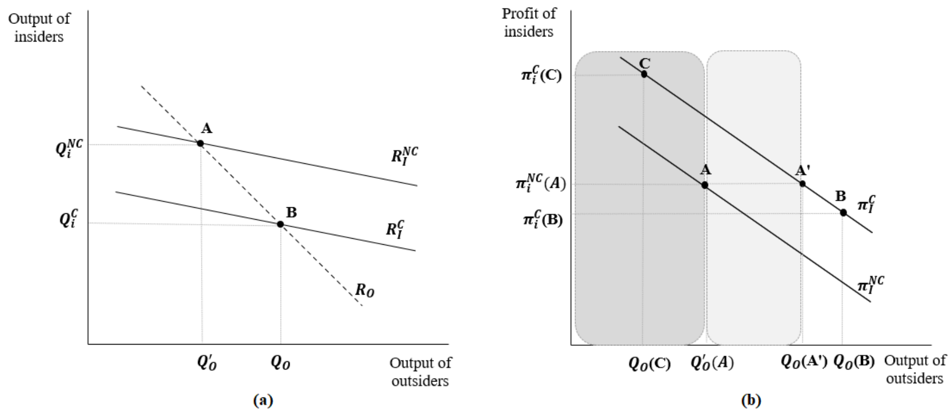


Source: Hamada and Takarada (2007*)*

The insights on joint profits of colluding and non-colluding insiders presented above are depicted in Figures 3a and 3b below. In Figure 3a, R_o is the best-response function of outsiders for any aggregate output produced by insiders, R_I^{NC} is the best-response production function of non-colluding insiders and R_I^C the best-response function of colluding insiders. Nash equilibrium prior to the merger occurs at A. If insiders decide to collude, the best-response function for insiders shifts from R_I^{NC} to R_I^C, leading to a new equilibrium at B. This shift results in a contraction in the insiders' equilibrium output and an expansion in the outsiders' output due to the merger.

For any given production level by outsiders, the aggregate profit of insiders can only increase, which is shown in Figure 3b, with the joint profit function of insiders shifting from π_I^{NC} to π_I^C. As the outsiders' output rises following a merger, the insiders' profits decline. Figure 3b illustrates three situations: i) left of point A, the merger paradox is fully eliminated, as the number of insiders is large enough ($\alpha > 80\%$) and results in reduced outsiders' aggregate output while increasing the profits of insiders (contrary to the results of the merger paradox). This is illustrated by point C in the figure; ii) between points A and A', the merger paradox exists to a certain extent as the aggregate output of outsiders is higher, but the profitability for insiders is larger, which partially resembles the merger paradox; and iii) right of point A', the aggregate output of outsiders is greater and the profitability for insiders is lower, which fully describes the implications of the merger paradox. This situation is illustrated by point B.

Graph 3. Joint profits of colluding and non-colluding insiders



Source: Salant et al. (1983)

Under the Cournot model, a reduction in the number of companies leads to a decline in industry output and a subsequent increase in prices. These effects are evident and shared with all companies in the market, even outsiders. Therefore, a merger creates a free-riding problem, with outsiders benefiting more from the higher market share and higher prices that follow the merger.

Based on the analysis by SSR, we can conclude that mergers, besides being individually unprofitable for insiders, also have a negative impact on total welfare. In this model, aggregate output serves as a proxy for welfare, as total production costs are solely dependent on aggregate output, rather than the distribution of output among companies.

SSR also found that mergers can still result in losses even when creating efficiency gains through economies of scale. Prior to the merger, each company had fixed costs and constant marginal costs. Post-merger, the merged company maintains the same marginal cost while consolidating production to the company with the lowest fixed costs, resulting in savings by shutting down the higher-cost production plants. If the savings in fixed costs are lower than the losses from merging *m* companies, the merger is unprofitable for insiders. However, while unprofitable for insiders, such mergers can be socially beneficial. Mergers increase prices, reducing consumer surplus; however, due to the free-riding problem, outsiders may benefit more than consumers lose, resulting in a positive impact on welfare.

3. Theoretical solutions to the merger paradox

The intriguing results of the merger paradox, as observed by SSR, have sparked a number of studies attempting to understand the reasons behind the paradox and to resolve it by modifying either one or multiple assumptions in the model. This section will focus on changing just one assumption in the SSR model.

3.1 The merger paradox and cost synergies

Farrell and Shapiro (1990) demonstrated that in Cournot equilibrium, larger companies tend to have lower marginal costs. By rationalising production and capital, mergers can result in cost savings significant enough to solve the implications of the merger paradox. Farrell and Shapiro (1990) emphasised the importance of outsiders' reaction to the exogenous changes in insiders' output due to the merger and, in that context, focused on examining the effect of a merger on consumer surplus and outsiders' profitability (hereinafter jointly: *net external welfare effect*), which influences the overall effect on total welfare.

Mergers can be distinguished by the extent to which productive assets can be effectively reallocated and the degree to which output decisions can be coordinated, either in a procompetitive or anticompetitive manner. Two extremes can be identified: one where all pre-merger companies have equal marginal costs and the merged entity retains the same costs, indicating anti-competitive behaviour; the other involves differing marginal costs, allowing for production rationalisation by shifting output to the facility with lower costs without changing total output. Mergers may also create synergies, enabling insiders to produce more efficiently than they could individually.

Unlike SSR, Farrell and Shapiro (1990) argued that privately unprofitable mergers would not be proposed. From an antitrust perspective, the acceptability of such a merger depends solely on whether the negative external effects outweigh the private profitability for insiders. However, to determine whether mergers are indeed always privately profitable for insiders, let us revisit the example from Section 2. In this example[4], companies are facing the same linear demand curve, $P = 1400 - 2Q$. However, in this case, instead of assuming identical marginal costs among all 24 companies, we will assume that $c_{i\ (i=1,2,\ldots,23)} = 200$, while $c_{24} = 200b$, where $b > 1$, and measures the cost disadvantage of company 24. In Cournot equilibrium, by solving a system of 24 equations, the outputs produced by these companies can be expressed as follows: $q_{i\ (i=1,2,\ldots,23)} = 20 + 4b$ and $q_{24} = 120 - 96b$[5]. Total output is $Q = 580 - 4b$, and price is $P = 240 + 8b$. The profit of these companies is given as $\pi_{i\ (i=1,2,\ldots,23)} = 2 \cdot (20 + 4b)^2$ and $\pi_{24} = 2 \cdot (120 - 96b)^2$.

[4] The illustration follows the same logic as in Pepall et al. (2014), p. 392.
[5] For company 24 to be in the market, b should be lower than 1.25.

Assume that companies 23 and 24 decide to merge. Since company 24 has a marginal cost of $c_{24} = 200b$, with $b > 1$, it would be more profitable to shift the entire production to company 23, which is more efficient. After the merger and the shift in production, the newly formed company would have a marginal cost of 200, with a colluding output of 25, resulting in a colluding profit of 1,250. For the merger to be beneficial for insiders when cost synergies are realised, it must be the case that the joint profit of the colluding insiders exceeds the sum of the insiders' profits prior to the merger:

$$1{,}250 - (2 \cdot (20 + 4b)^2 + 2 \cdot (120 - 96b)^2) > 0 \quad (2)$$

Simplifying (2):

$$9{,}232 \cdot \left(\frac{1{,}442}{1{,}154} - b\right) \cdot \left(b - \frac{2{,}835}{2{,}308}\right) > 0\ . \quad (3)$$

Based on the conditions for b outlined in (3) and the condition in footnote 3, b must be approximately 1.25.[6] In other words, company 23 must be 25% more cost-efficient for the merger to be profitable for the insiders.

Assessing the impact of a merger on price and, consequently, on consumer surplus is part of analysing a merger's effect on total welfare. Generally speaking, for the price to decrease after a merger, the merged entity must have substantially lower marginal costs than insiders prior to the merger. The required reduction in marginal costs is greater, the higher the pre-merger markups of the insiders. If we define the cost functions as $c_i = l_i \cdot VC(x_i, k_i)$, where *VC* represents the short-run variable cost function, x_i is output produced by company i, k_i is the amount of capital employed and l_i is an inverse measure of knowledge at company i, we can identify three types of cost savings resulting from a merger. Farrell and Shapiro (1990) analysed each of these three types of cost savings and established the necessary conditions for them to contribute to a post-merger price decrease effectively.

a. *Production rationalisation* occurs when insiders can optimise their production allocation among themselves, leading to lower total costs for the merged entity due to pre-merger differences in marginal costs. By reallocating production, only x_i in the cost function changes, while other parameters remain constant. However, without synergies, production rationalisation does not affect total output or price; it solely impacts the total costs of the merged company.

b. *Capital reallocation* occurs when insiders shift and re-combine capital among themselves, allowing them to change the distribution of k_i without affecting the total available capital. This is beneficial in the case of

[6] More precisely, the intersection of the intervals from condition (3) and footnote 4 results in $b \in (1.228, 1.25)$. For clarity and simplicity in the interpretation of results and given the narrow interval, b is considered to be approximately 1.25.

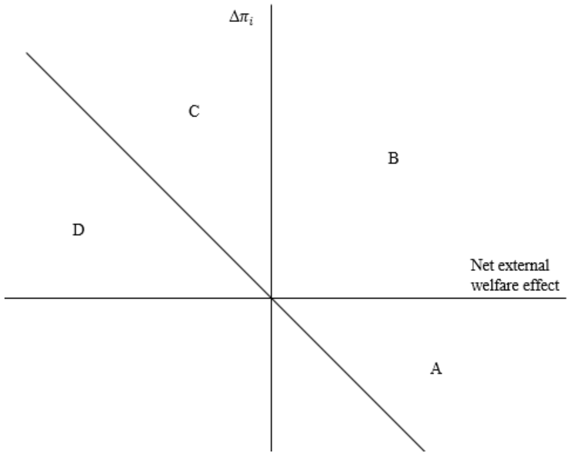
economies of scale and applies only in the short run when external capital is unavailable. However, capital immobility across facilities may limit cost efficiency and increase prices. Assuming these cost efficiencies are achievable, for a merger to lower prices, the combined input (twice the capital) must produce at least 2.4 times the output.[7]

c. *Learning* allows insiders to benefit from one another by sharing techniques, patents and management skills, under the assumption that capital cannot be reallocated across companies and marginal costs are nondecreasing. This leads to a change in l_i in the cost function. For the price to decrease, at least one of the insiders must achieve a reduction of at least 25% in l_i.[8]

From an antitrust policy perspective, a merger's approval depends on its net external welfare effect, assuming no privately unprofitable mergers will be proposed. Figure 4 shows various combinations of private profitability for insiders and net external welfare effects from a merger. The diagonal line represents mergers with a neutral total welfare effect, i.e. the sum of the net external welfare effect and the change in insiders' profitability equals zero. Mergers to the right of this line have a positive total welfare effect, while those to the left have a negative effect. In this context, only mergers in areas A, B and C could be considered by antitrust authorities for approval. Ideally, only mergers located in area B in Figure 4 will be approved by antitrust authorities. However, such a policy would be overly conservative and restrictive, overlooking socially beneficial mergers. For mergers in area A to occur, some form of compulsion or subsidy is necessary. Conversely, mergers in area D would not be allowed, as they are profitable but socially undesirable. Area C includes profitable mergers for insiders that negatively affect net external welfare, raising concerns for antitrust authorities. Yet, some of these may create significant synergies that enhance consumer surplus, potentially offsetting negative impacts on outsiders and leading to a slightly negative net external welfare effect. If these mergers also positively impact insiders' profitability, they could yield an overall positive total welfare effect, justifying antitrust approval. Thus, strong synergistic effects are crucial for approving mergers in area C.

[7] The calculated value of 2.4 applies in case of a merger between two companies, each holding 20% market share and facing a unitary elastic demand curve. However, it can vary for different market shares and demand elasticity.
[8] A reduction in l_i of 25% applies under the same conditions as described in footnote 6.

Figure 4. Implications for antitrust policy



Source: Farrell & Shapiro (1990)

3.2 The merger paradox and product differentiation

Do the results of the merger paradox change when products are differentiated? Gelves (2014) demonstrated in his study that product differentiation can lead to privately profitable mergers without requiring an 80% market share of insiders. He showed that the level of product differentiation (d) influences the response of outsiders. Product differentiation creates segmented markets. In this context, a merger does not necessitate closing a merging company's production plant and transferring all production to another insider (as seen with cost synergies), as this would mean losing one market segment entirely. Instead, insiders would retain their own production facilities.

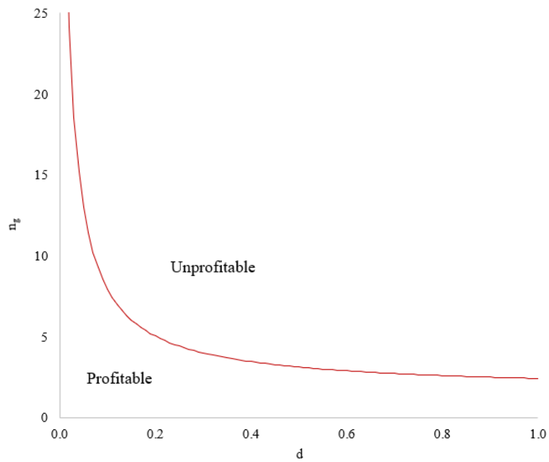
In contrast to the merger paradox, where reduced competition leads to increased output of outsiders, negatively affecting insiders' profitability, a free-riding problem is not present in the case of product differentiation. Based on the reaction functions (A2.2) in Appendix 2, it can be seen that as product differentiation increases, the free-riding problem is diminished, and the likelihood of a profitable merger increases. In the extreme case where goods are perfectly differentiated (although, by definition, horizontal mergers are not typical in markets of differentiated goods), there is no negative externality from outsiders, and the merger is at least as favourable for insiders' profitability as having no merger at all.

What level of product differentiation is needed for a merger to be profitable? Comparing pre- and post-merger variables, for a merger to generate gains, the difference between the profit of the merged entity and the individual profits of insiders before the merger (defined by [A2.1] and [A2.5] in Appendix

2) must be greater than zero. By calculating this, we find that for a merger to be profitable, the number of companies should be less than the threshold value on the right-hand side of inequality (4):

$$n < \frac{5d - 2 - d^2 + 2\sqrt{(d+1)(2-d)^2}}{d(3-d)} \tag{4}$$

Figure 5. The inverse relationship between product differentiation and n



Source: Gelves (2014)

Figure 5 illustrates an inverse relationship between the number of companies and the level of product differentiation required for a profitable merger. Mergers consistently benefit outsiders, as shown by a comparison of pre- and post-merger profits in Appendix 2, reinforcing the merger paradox. Therefore, one issue related to the merger paradox remains unresolved, even when product differentiation is considered. However, as product differentiation increases (and the value of *d* decreases), outsiders react less to insiders' changes in output, resulting in reduced benefits from the merger.

Outsiders always benefit from mergers, while the benefits for insiders depend on the level of product differentiation. However, mergers consistently lead to an increase in prices, which negatively affects consumers, as their surplus decreases after the merger by an amount greater than the benefits to insiders and outsiders. Ultimately, this has a negative impact on total welfare, confirming another implication of the merger paradox.

In summary, when product differentiation is integrated into the SSR model: 1) mergers may be profitable for insiders, particularly with a high level of product differentiation; 2) outsiders always benefit from mergers, regardless of product differentiation; and 3) mergers negatively impact total welfare.

3.3 The merger paradox and Stackelberg leadership

This section analyses how market structure and the strategic power of insiders affect their private profitability and total welfare. Specifically, this part changes the assumption in the merger paradox that companies in the market act as Cournot competitors, and instead, the market is characterised by a Stackelberg model with n_l leaders and $n_f = n - n_l$ followers. Other assumptions remain the same. We will consider three scenarios: 1) a merger between companies with the same output choice timing (two leaders or two followers) that do not change their strategic power following a merger, 2) a merger between a leader and a follower, and 3) a merger between two followers that changes their strategic power.

A merger between two leaders (or followers) fully mirrors the merger paradox and is privately unprofitable for insiders who face the free-rider problem. This merger results in a decrease in consumer surplus, ultimately affecting total welfare. In the Stackelberg model, as well as in the Cournot model, mergers are unprofitable unless they involve at least 80% of the firms with the same output choice and timing in the industry[9]. It is important to note that this threshold falls below 80% when considering the total number of companies – both leaders and followers – in the industry. Please refer to Appendix 3 for further details.

Unlike a merger between two market participants with the exact output choice timing, a merger between a leader and a follower is always profitable[10]. This merger changes the number of followers to $n_f = n - n_l - 1$, while leaving the number of leaders unchanged. Subtracting the combined pre-merger profits of a leader and a follower (the sum of [A4.1] equations in Appendix 4) from the post-merger profit of a leader (A4.2), the resulting difference (g) can be used to draw a conclusion about the profitability of this type of merger:

$$g > \frac{1}{(n_l + 1)^2 (n - n_l)(n - n_l + 1)^2} \tag{5}$$

The calculated value of g is greater than zero for any $n_l < n$, indicating that mergers between a leader and a follower are always profitable. The quantity produced by the merged entity matches the pre-merger output of the leader, but the price increase is significant enough to offset the reduction in quantity, resulting in an overall increase in profit.

Aside from the private profitability of the merger, does a change of this assumption address any other negative implications of the merger paradox?

[9] Hamada and Takarada (2007), p. 2.
[10] Huck et al. (2001), p. 215.

Unfortunately, no; total output decreases, and the price increase following the merger reduces total welfare. Consequently, antitrust authorities may have valid concerns if two companies with different strategic powers intend to merge.

However, what if two leaders merge, adjust their strategic power and continue operating as market leaders? This scenario demonstrates that mergers can be both privately profitable and beneficial for total welfare in markets that are very close to symmetric and have a low number of leaders[11].

In a Stackelberg model, a merger between two followers that creates a new leader reduces the total number of companies to $n-1$, while increasing the number of leaders to n_l+1. A merger is considered profitable for insiders if the difference (g) as calculated in Appendix 5 satisfies:

$$(n-n_l+1)^2(n_l+1)^2-2\cdot(n-n_l-1)(n_l+2)^2>0 \qquad (6)$$

This holds true for any $n_l<n$. However, what are the effects on total output and, consequently, on price and consumers? Simplifying (A5.3) in Appendix 5, a merger is socially desirable when:

$$n_l<\frac{n}{3}-1 \qquad (7)$$

Based on (7), a merger is socially desirable when the number of leaders is less than approximately one-third of the total number of companies in the market, which is also a sufficient condition for a merger to be both privately profitable and socially desirable, given that condition (5) always holds.

4. Conclusion

M&A transactions lead to market concentration. Horizontal mergers, in particular, involve the consolidation of companies that operate as competitors within the same industry. Considering that these mergers bring together previously rival companies, they inherently raise significant antitrust concerns. An increase in concentration within a market already characterised by high concentration may indicate that a merger has the potential to substantially reduce competition and adversely affect consumers. In fact, horizontal mergers can be viewed as a mechanism for establishing a legal cartel.

Salant et al. (1983) were pioneers in addressing this subject from a theoretical perspective. Their findings indicated that mergers, besides being detrimental to consumers and society as a whole, also negatively impact the merged companies. Specifically, they observed a decline in profitability for merging companies post-merger unless the transaction involves more than 80% of market participants. These intriguing results prompted a series of theoretical analyses aimed at unpacking the merger paradox.

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[11] Daughety (1990), p. 1236.

One approach to addressing the merger paradox is the introduction of cost efficiencies, which has been shown to mitigate the paradox, especially when there is a substantial disparity in cost efficiencies among the merging companies. Moreover, it can be concluded that the merger paradox is unlikely to arise in markets with differentiated products, where such differentiation often suffices to ensure the profitability of merging companies. Another strategy entails permitting the merged entity to take on the role of a Stackelberg leader.

However, while these approaches provide partial or complete re-solutions to the merger paradox, the conditions for achieving a profitable mer-ger remain quite demanding. Specifically: 1) in the first approach, the merging companies must have significant cost differences, leading to the question of whether an efficient company would be willing to merge with a highly inefficient counterpart; 2) in the second scenario involving perfectly diffe-rentiated goods, the paradox appears to be resolved; yet this raises concerns whether a merger between companies offering perfectly differentiated products is advantageous and beneficial for the acquirer; 3) shifts in strategy following a merger raise a question whether merging two followers – typically firms with lower market power – would genuinely enhance their competitive strength post-merger. Moreover, it is worth noting that these three approaches modify one assumption in isolation while holding the other assumptions constant. This is particularly relevant since the concept of the merger paradox is based on the SSR model, which relies on assumptions that often diverge from real market conditions. Changing these assumptions simultaneously and aligning them more closely with real market conditions might yield different results.

5. Appendices

Appendix 1. The merger paradox

In a market comprising of n identical Cournot competitors, where each company faces a linear demand curve $P(Q) = a - bQ$ and has identical (linear) total costs as $C(q_i) = c \cdot q_i$, pre-merger equilibrium variables are:

$$q_i = \frac{(a-c)}{b(n+1)}; \pi_i = \frac{(a-c)^2}{b(n+1)^2} \qquad \text{(A1.1)}$$

When m companies decide to merge ($m < n$), the post-merger market has $n - m + 1$ companies. The joint profit of non-colluding insiders is equal to $\pi^{NC}(n,m) = m \cdot \pi(n)$, while the joint profit of colluding insiders is equal to $\pi^{C}(n,m) = \pi(n-m+1)$. For a merger to be profitable, $g(n,m) > 0$, the joint profit of colluding insiders must exceed the joint profit of not colluding insiders:

$$g(n,m) = \pi^{C}(n,m) - \pi^{NC}(n,m) = \frac{(a-c)^2}{b(n-m+2)^2} - m \cdot \frac{(a-c)^2}{b(n+1)^2} > 0 \qquad \text{(A1.2)}$$

By substituting m with $m = \alpha n$, with α being insiders' market share ($0 < \alpha < 1$), we can calculate α at which a merger does not produce gains nor losses:

$$g(n,\alpha) = \frac{(a-c)^2}{b} \cdot \frac{(n+1)^2 - \alpha n \cdot (n - \alpha n + 2)^2}{(n+1)^2 \cdot (n - \alpha n + 2)^2} = 0 \qquad \text{(A1.3)}$$

(A1.4) equals 0 when the numerator of the second term equals 0, i.e.

$$(n+1)^2 - \alpha n \cdot (n - \alpha n + 2)^2 = 0 \qquad \text{(A1.4)}$$

This equation is cubic in α and has three solutions:

$$\alpha_1 = \frac{1}{n};\ \ \alpha_2 = \frac{(2n+3) + \sqrt{4n+5}}{2n};\ \ \alpha_3 = \frac{(2n+3) - \sqrt{4n+5}}{2n} \qquad \text{(A1.5)}$$

However, only α_3 is relevant, as it satisfies ($0 < \alpha_3 < 1$) for any value of n, consistent with the condition above: ($0 < \alpha < 1$). Solution α_2 is not logical as α_2 is greater than 1 for any value of n, meaning that insiders' market share exceeds 100%. Solution α_1 is irrelevant, as it represents a single company merger.

Appendix 2. The merger paradox and product differentiation

Consider a market with n companies facing the market demand $P = 1 - q_i - d \cdot \sum_{j \neq i}^{n} q_j$, where $d \in (0,1)$ is the level of product differentiation, with $d = 0$ indicating that products are perfectly differentiated, and $d = 1$ corresponds to conventional Cournot analysis. Since the focus here is on product differentiation rather than cost synergies, and for the sake of simplicity in the calculations, it is assumed that the costs are zero. Before the merger, each company made output decisions based on profit maximisation: $\pi_i = p_i \cdot q_i$. The pre-merger equilibrium is:

$$q_i = \frac{1}{2+d(n-1)};\ p_i = \frac{1}{2+d(n-1)};\ \pi_i = \frac{1}{[2+d(n-1)]^2} \qquad \text{(A2.1)}$$

Following a two-company merger and assuming that both companies retain their production plants, the merged entity's profit is: $\pi_I{}^M = p_1{}^M \cdot q_1{}^M + p_2{}^M \cdot q_2{}^M$. The reaction functions of insiders and outsiders are as follows:

$$q_O^M = \frac{1 - 2dq_I^M}{2 + d(n-3)};\ q_I^M = \frac{1 - d(n-2)q_O^M}{2(1+d)} \qquad \text{(A2.2)}$$

Simultaneously solving the reaction functions above, the post-merger equilibrium variables would be as follows:

$$q_O^M = \frac{1}{(2 + dn - d - d^2)};\ q_I^M = \frac{2-d}{2x(2 + dn - d - d^2)} \qquad \text{(A2.3)}$$

$$p_O^M = \frac{1}{(2 + dn - d - d^2)};\ P_I^M = \frac{(1+d)(2-d)}{2x(2 + dn - d - d^2)} \qquad \text{(A2.4)}$$

$$\pi_O^M = \frac{1}{(2 + dn - d - d^2)^2};\ \pi_I^M = \frac{(2 + d - d^2)(2 - d)}{4x(2 + dn - d - d^2)^2} \qquad \text{(A2.5)}$$

For a merger to be privately profitable for insiders, $g = \pi_I^M - 2 \cdot \pi_i > 0$. The value of g is zero when:

$$n = \frac{5d - 2 - b^2 + 2\sqrt{(d + 1)(2 - d)^2}}{d(3 - d)} \qquad \text{(A2.6)}$$

Appendix 3. The merger paradox in a Stackelberg setting

There are n_L number of leaders and $n_F = n - n_L$ number of followers in the Stackelberg model. The Stackelberg equilibrium is determined through backward induction, where the follower's best response function to any leader's output choice is calculated first, and then the leader chooses its profit maximising output, anticipating the follower's reaction. The quantities of leaders (q_L) and followers (q_F) in Stackelberg equilibrium are as follows:

$$q_L = \frac{a - c}{b(n_L + 1)};\ q_F = \frac{a - c}{b(n_L + 1)(n_F + 1)} \qquad \text{(A3.1)}$$

The total output at the equilibrium is $Q = \frac{(a-c)(n_L n_F + n_L + n_F)}{b(n_L+1)(n_F+1)}$, and the price $P = a - \frac{(a-c)(n_L n_F + n_L + n_F)}{(n_L+1)(n_F+1)}$. Subtracting the marginal cost from the price yields the marginal revenue $(P - c)$ as follows:

$$(P - c) = \frac{a - c}{(n_L + 1)(n_F + 1)}; \qquad \text{(A3.2)}$$

The profits of leaders and followers, can be expressed as follows:

$$\pi_L = \frac{(a - c)^2}{b(n_L + 1)^2(n_F + 1)};\ \pi_F = \frac{(a - c)^2}{b(n_L + 1)^2(n_F + 1)^2} \qquad \text{(A3.3)}$$

If m leaders (followers) merge, the joint profit of colluding insiders is:

$$\pi_L^C = \frac{(a - c)^2}{b(n_L - m + 2)^2(n_F + 1)};\ \pi_F^C = \frac{(a - c)^2}{b(n_L + 1)^2(n_F - m + 2)^2} \qquad \text{(A3.4)}$$

To ensure that the merger of m leaders (followers) is profitable, $g(n_L, m_L) = \pi_L^C - m \cdot \pi_L > 0$ ($g(n_F, m_F) = \pi_F^C - m \cdot \pi_F > 0$) must be satisfied, which leads to:

$$(n_L + 1)^2 - \alpha n_L \cdot (n_L - \alpha n_L + 2)^2 > 0, \text{ for leaders, and} \qquad \text{(A3.5)}$$

$$(n_F + 1)^2 - \alpha n_F \cdot (n_F - \alpha n_F + 2)^2 > 0, \text{ for followers,} \qquad \text{(A3.6)}$$

where α is the insiders' (outsiders') market share. Comparing equations (A1.4), (A2.5) and (A2.6), we find the same condition except for the number of companies. Defining the number of companies as $n^* = \{n, n_L, n_F\}$, these conditions (but for $m + 1$ insiders for the simpler calculations) can be written as:

$$m + 1 < n^* < m + \sqrt{m + 1} \tag{A3.7}$$

Let $\alpha = \frac{m+1}{n}$ be the insiders' market share; then (A2.8) can be written as:

$$\frac{m + 1}{m + \sqrt{m + 1}} < \alpha < 1 \tag{A3.8}$$

This means that the minimum market share for a profitable merger is $\frac{m+1}{m+\sqrt{m+1}}$. Solving the first-order condition with respect to m, we obtain $m = 3$ and the minimum profitable market share is equal to 80%.

Appendix 4. A merger between a leader and a follower

Consider a market of n companies producing goods that are perfect substitutes. There are n_l leaders and $n_f = n - n_l$ in the market. The demand function is $P = 1 - Q$, where $Q = \sum_{l=1}^{m} q_l + \sum_{f=1}^{n-m} q_f$. The costs are linear and assumed to be zero as the focus in this section is on market structure.

Pre-merger equilibrium quantities are $q_l = \frac{1}{n_l+1}$ for leaders and $q_f = \frac{1}{(n_l+1)(n-n_l+1)}$ for followers. Pre-merger leaders' and followers' profits are:

$$\pi_L = \frac{1}{(n_l + 1)^2 (n - n_l + 1)}; \; \pi_F = \frac{1}{(n_l + 1)^2 (n - n_l + 1)^2} \tag{A4.1}$$

Following a merger between a leader and a follower, the number of leaders would not change (equal to n_l), while the number of followers would be $n - n_l - 1$. The post-merger profit of leaders is:

$$\pi_L^M = \frac{1}{(n_l + 1)^2 (n - n_l)} \tag{A4.2}$$

For a merger between a leader and a follower to be profitable, the difference between post-merger profit for a leader and pre-merger profits of a leader and a follower (g) should be greater than zero. As presented in (A4.4), g is always greater than zero for any $n_l < n$:

$$g = \pi_L^M - \pi_L - \pi_F = \frac{1}{(n_l + 1)^2 (n - n_l)(n - n_l + 1)^2} \tag{A4.3}$$

Appendix 5. The merger paradox and Stackelberg leadership

Using the same set-up as in Appendix 4, a merger between two followers that results in a company that behaves like a leader leads to an increase to $n_l + 1$ leaders in the market and a reduction in the total number of companies to $n - 1$. The post-merger profit for a leader is:

$$\pi_L^M = \frac{1}{(n_l+2)^2(n-n_l-1)} \tag{A5.1}$$

To determine the conditions under which the merger is privately profitable, we should compare (A5.1) with the combined pre-merger profits of two followers. The difference (g) must be greater than zero:

$$g = \pi_L^M - 2\cdot\pi_F = \frac{(n_l+1)^2(n-n_l+1)^2 - 2(n_l+2)^2(n-n_l-1)}{(n_l+2)^2(n-n_l-1)} > 0 \tag{A5.2}$$

For the merger to be socially beneficial, the total output post-merger, $Q^M(n_l+1, n-1)$, must exceed the pre-merger output $Q(n_l, n)$. This holds if:

$$n > 3(m+1) \tag{A5.3}$$

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