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UNIVERSITY OF BELGRADE

FACULTY OF ECONOMICS

Економски факултет
УНИВЕРЗИТЕТ У БЕОГРАДУ

MASTER THESIS

RESOLVING THE MERGER PARADOX: THE INTERSECTION OF THEORY AND PRACTICE

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ABSTRACT

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 thesis aims to explain the concept of the Paradox and reasosns for its emergance, as well as to compare the results of theoretical and empirical analyses of this phenomenon. The empirical analysis is based on the modification of one assumption in Cournot model while keeping the other assumptions constant, in order to identify the one that contributes the most to the emergence of this phenomenon. On the other hand, the empirical analysis aims to test whether this phenomenon also appears in practice, analysing the data on mergers and acquisitions ("M&A") in the USA banking sector in 2021 during the latest M&A wave. The theoretical analysis suggests that the Merger Paradox can be partially addressed by modifying key assumptions of Cournot model, though their practical sustainability remains uncertain. The empirical analysis suggests that the hypothesis that the Merger Paradox holds in practice could not be rejected based on statistical evidence.

Keywords: Merger Paradox, M&A waves, profitability, USA banking sector.

APSTRAKT

Uopšteno govoreći, spajanja u Kurnoovom modelu konkurencije nisu profitabilna za preduzeća koja učestvuju u spajanju osim ukoliko uključuju preko 80% učesnika na nekom tržištu. Ova pojava poznata je u literaturi kao Paradoks spajanja. Cilj ovog rada je da objasni koncept Paradoksa i uzroke njegovog nastanka kao i da uporedi rezultate teorijske i emipirijske analize ovog fenomena. Teorijska analiza se bazira na modifikaciji jedne pretpostavke u Kurnoovom modelu dok se ostale pretpostavke zadržavaju konstantnim, u cilju identifikovanja one koja najviše doprinosi nastajanju ovog koncepta. Sa druge strane, cilj empirijske analize je da proveri da li se ovaj koncept javlja i u praksi, oslanjajući se na analizu podataka o spajanjima u bankarskom sektoru SAD tokom 2021. godine, odnosno tokom poslednjeg talasa spajanja. Teorijska analiza ukazuju da se Paradoks spajanja može delimično rešiti promenom ključnih pretpostavki Kurnoovog modela; međutim, postavlja se pitanje njihove održivosti u praksi. Rezultati empirijske analize sugerišu da hipoteza o postojanju Paradoksa spajanja u praksi nije mogla biti odbačena na osnovu statističkih podataka.

Ključne reči: Paradoks spajanja, talasi spajanja, profitabilnost, bankarski sektor u SAD.

INTRODUCTION

Mergers are used as a strategy by companies to expand their operations, either by acquiring a competitor in the relevant market to strengthen their market position (horizontal mergers), by taking over a company at a different level of the supply chain (vertical mergers), or by diversifying into other industries or markets (conglomerate mergers). Horizontal mergers, in particular, lead to increased market concentration, attracting the attention of antitrust authorities. While horizontal mergers can result in economies of scale and synergies that enhance total welfare, there are also "bad mergers" that can abuse dominant position, undermine competition, increase prices, reduce supply, reduce variety of products, and lower R&D investments. In highly concentrated markets, a merger involving large companies poses a serious risk of substantially reducing competition or creating a monopoly. For these reasons, effective merger control is crucial, necessitating the existence of competition authorities (the CAs) that conduct *ex-ante* analyses of potential merger effects and determine whether to approve or reject them. The CAs evaluate whether a merger creates or further consolidates a highly concentrated market and whether the resulting increase in concentration is sufficient to indicate concerns about reduced competition or the potential formation of a monopoly.

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, and probably the most cited paper on mergers, is Salant, Switzer and Reynolds (1983) (hereafter referred to as "SSR"), who introduced the concept of the *Merger Paradox*. The Merger Paradox, as presented by SSR, analyses the profitability of mergers within a Cournot competition framework. By leveraging the assumptions of the Cournot model where n companies produce identical products, face a linear demand curve, and constant unit costs, 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, while a merger that leads to monopoly is always profitable. This is known in the literature as the *„80% rule".* Furthermore, by analysing pre- and post-merger equilibria, SSR identifies what is known as the *free-riding problem*. This problem indicates that companies not participating in the merger (also referred to as *outsiders*) enjoy greater benefits from mergers due to free-riding on increased prices, but also due to increased output resulting from reduced competition in the market (as symmetric Cournot model assumes equal outputs among market participants, a merger that results in a lower number of market participants increases their individual outputs). Therefore, mergers can be viewed as a public good since they enhance

outsiders' profits at the expense of the merged entity. Thus, the Merger Paradox concludes that mergers are always profitable for outsiders but always unprofitable for insiders themselves (it is right to say that mergers are *always* unprofitable for insiders, given that there are no "real-world" examples of a merger involving 80% of companies in the market). Regardless of the private profitability for insiders and outsiders, mergers consistently negatively impact total welfare, which is reflected in reduced total output and increased prices, subsequently leading to a decrease in consumer surplus, which overweighs the profitability for outsiders. The implications of the Merger Paradox contradict observed market trends: despite SSR's conclusions, mergers have continued to take place throughout history, implying that if they were truly unprofitable and socially harmful, as suggested by SSR, they would not persist.

Considering the findings of SSR and the fact that mergers have occurred even before their 1983 study, many economists have sought to uncover the flaws in SSR's work and resolve the Merger Paradox by modifying key assumptions in their original model. Numerous papers addressing the Merger Paradox were published shortly after SSR's study, but the topic remains of interest and is still being researched by many economists. As a result, it sparked a wave of research in which economists modified certain assumptions related to the Merger Paradox environment, leading to different outcomes. Perry and Porter (1985) demonstrated that with sufficiently convex costs, a merger can be profitable for insiders. Convex costs imply increasing marginal costs of producing additional output for outsiders, when there is a fixed supply of a production factor in the industry. On the other side, the combined entity of insiders after the merger becomes "larger" than its competitors, enabling it to enhance profitability by leveraging the combined production plants of insiders, instead of acting as a multiplant Cournot player that simply "sums" production plants of insiders (as per the Merger Paradox due to constant marginal costs). Davidson and Deneckere (1985) found similar results in a Bertrand model with differentiated goods. Other researchers have also explored the implications of differentiated products, such as Rothschild, Heywood, and Monaco (2000), who examined whether a merger can enhance the profitability of insiders while simultaneously reducing profits for outsiders. Fauli-Oller (2002) assumed demand concavity and demonstrated that a merger could be profitable if companies have sufficiently different costs or, additionally, by reallocating output from high to low-cost plants in the merged entity. 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 where companies' (run by professional managers rather than owners who are profit

maximisers) motive to undergo a merger is not profitability but rather market share and might even undertake unprofitable mergers.

The thesis provides a literature review of some of the most notable studies on the Merger Paradox, with each study altering one assumption at a time in the original framework, aiming to determine which assumption most significantly impacts these controversial results and modification of which assumption could potentially resolve the Merger Paradox completely. The main implications of the Merger Paradox relate to three aspects: i) private unprofitability for insiders, ii) the fact that outsiders benefit more from not participating, and iii) the generally negative impact on total welfare. This thesis focuses on all three aspects to comprehensively address the Merger Paradox and focuses on the three assumptions: cost synergies, product differentiation, and leadership. Modifying the assumption to include cost synergies is based on Farrell and Shapiro (1990), focusing on identifying the necessary cost efficiencies that would result in a profitable merger for insiders and 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. In extreme cases, such as with perfectly differentiated goods, it can completely eliminate it. The section addressing the shift in market participants' behavior from Cournot to Stackelberg is based on Hamada and Takarada (2007), which indicate that mergers between leaders and followers are always profitable but socially harmful, while Huck, Konrad, and Muller (2001) present a case of a merger between followers that behave as a leader following the merger, and it fully resolves all implications of the Merger Paradox. Horizontal mergers are a subject that has been actively researched since the publication of the SSR. Although they have been intensively researched from a theoretical standpoint only over the past 40 years, they have served as a strategic approach to companies for centuries. In this context, this thesis also analyses data on mergers, revealing that they have historically occurred in waves. The analysis will provide empirical explanations for this phenomenon of wave-patterned mergers, and through an analysis of key financial metrics on historical M&A data in the banking sector in the USA, the thesis will assess whether the Merger Paradox truly holds in practice.

The structure of this thesis is organised as follows: The first section explains essential theoretical concepts related to market competition, including the Cournot, Bertrand, and Stackelberg frameworks. The second part of the first section introduces the Merger Paradox as presented by SSR, emphasising its key implications. The second section focuses on resolving the Merger Paradox from the theoretical standpoint and is divided into three parts. The first part addresses the change of assumptions by incorporating the existence of cost synergies, the second part introduces

product differentiation, and the third part discusses a strategic shift where insiders act as Stackelberg leaders following the merger. The final section explores the phenomenon of mergers occurring in waves, examining the reasons behind this trend and compares the theoretical implications of the Merger Paradox with observed empirical regularities.

1. 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. While some view this as a reason why many mergers result in losses, economists find it counterintuitive for companies to pursue predictably unprofitable activities. This section presents the most commonly used single-period oligopoly models. The second part of this section provides a detailed overview of the concept of the Merger Paradox and its key implications.

1.1 Most Commonly Used Single-Period Oligopoly Models

An oligopolistic market is characterised by companies whose actions significantly influence one another, distinguishing them from monopolistic and competitive markets. A fundamental concept used in analysing these markets is the Nash equilibrium, introduced by John F. Nash in 1951. A set of strategies is called a Nash equilibrium if, holding the strategies of all other companies constant, no company can obtain a higher payoff (profit) by choosing a different strategy. Thus, in a Nash equilibrium, no company wants to change its strategy (Carlton & Perloff, 2015). The following sub-sections will explain the three most commonly used models: Cournot, Bertrand, and Stackelberg. These models differ based on whether companies choose output or price and whether they decide simultaneously or sequentially. The Cournot and Stackelberg models involve companies setting quantities, while the Bertrand model focuses on price competition. Consequently, they predict different outcomes for company and industry outputs, prices, profits, and consumer surpluses at equilibrium. When a single company is in the market, all three models predict monopoly behaviour. As the number of companies increases, the Cournot and Stackelberg equilibria approach the social optimum. However, in the Bertrand model with homogeneous products, the equilibrium remains unaffected by the number of companies; as long as there are at least two companies with the same marginal costs and unlimited capacity, the Bertrand equilibrium matches the social optimum.

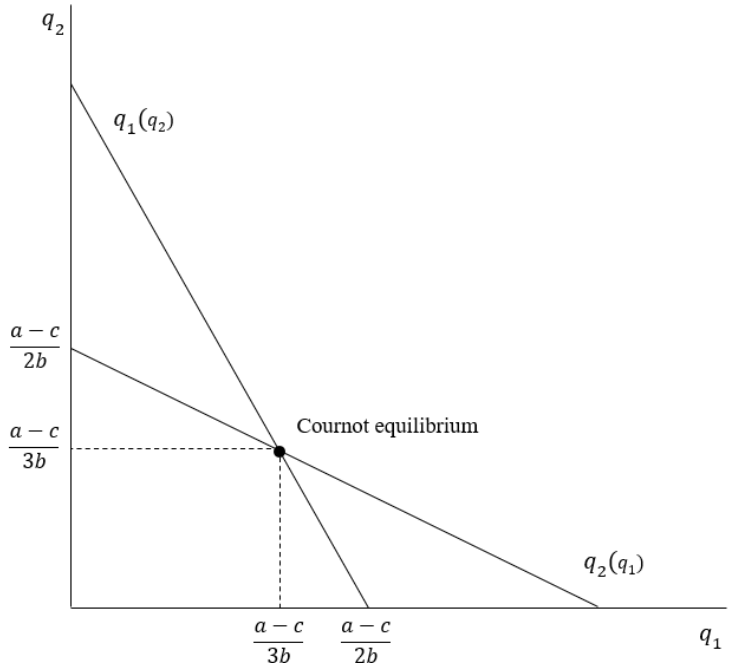
1.1.1 Cournot model

In 1838, French mathematician Augustin Cournot introduced the first, and likely still the most widely used, model of noncooperative oligopoly. Cournot's model assumes that each company operates independently, aiming to maximise profits by selecting its output level. The Cournot equilibrium is a specific case of Nash equilibrium where companies choose quantities, often called Cournot-Nash equilibrium or Nash-in-quantities equilibrium. In the Cournot model, companies produce a homogeneous product, face a linear demand curve, and have constant marginal costs, with entry barriers preventing new competitors. If entry were possible, the market would become increasingly competitive as more companies enter, eventually resembling perfect competition.

Each company determines its output based on its expectations of competitors' outputs. This relationship is known as the *best-response function*, which links each company's optimal quantity to the quantities produced by others. The Cournot equilibrium is found at the intersection of these best-response functions, where no company can increase its profit by changing its output unilaterally. Producing outside the best-response function would result in lower profits for the company.

To illustrate, consider a market with two companies facing a demand curve represented by $P = a - b(q_1 + q_2)$, with each company having a marginal cost of c. Each company's profit is denoted as $\pi_1 = (a - b(q_1 + q_2) - c) \cdot q_1$. Company 1 determines its profit-maximising quantity by differentiating π_1 with respect to q_1 and setting the first derivative to zero, yielding $q_1 = \frac{a - bq_2 - c}{2b}$, which is its best-response function, indicating how much it will produce based on company 2's output. Following a similar process for company 2, it produces a best-response function of $q_2 = \frac{a - bq_1 - c}{2b}$. As shown in Graph 1 below, when best-response functions are plotted, the point where they intersect represents the Cournot equilibrium. To solve for the equilibrium, by substituting company 2's quantity into company 1's best-response function, we find that $q_1 = \frac{a - c}{3b}$; similar for q_2. To generalise, in case with *n* symmetric companies, each company would produce a quantity of $q_{i\ (i=1,2,\ldots n)} = \frac{a - c}{b(n+1)}$.

Graph 1. Best response functions and Cournot Equilibrium



Source: (Binger & Hoffman, 1988)

1.1.2 Bertrand model

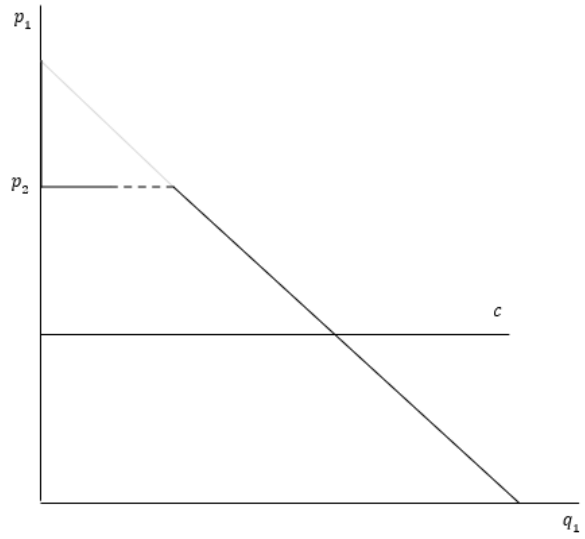
Joseph Bertrand criticised the basic assumption of the Cournot model in 1883, which states that companies set prices rather than quantities. He argued that in a market with homogeneous products, consumers care only about prices. Any price above marginal cost would allow competing companies to lower their prices and take away all consumers (assuming no capacity constraints). Given this, it is logical that the equilibrium price equals marginal cost.

This is illustrated in Graph 2, which shows the residual demand curve. If company 1 charges a price (p_1) higher than p_2, all consumers will buy from company 2 (the vertical portion of the residual demand curve). Conversely, if p_1 is lower than p_2, consumers will buy from company 1. If p_1 and p_2 are the same, both companies split the total market demand.

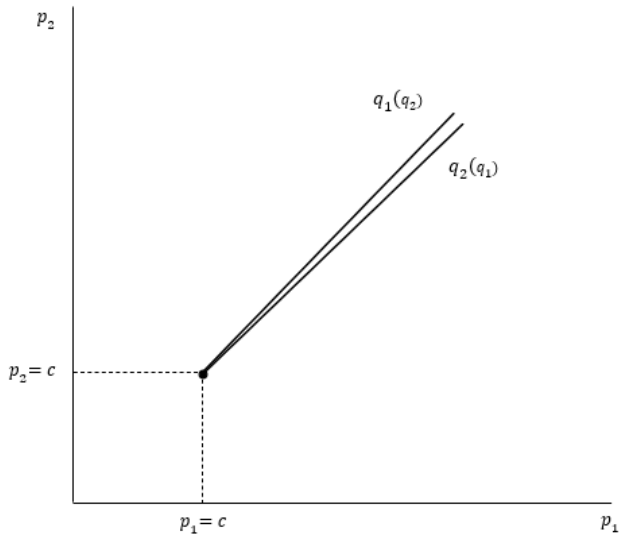
Graph 3 illustrates best response functions of two companies. Given a price p_1 that company 1 sets, company 2 aims to set a price p_2 slightly below p_1 as long as p_2 remains above marginal cost. Therefore, company 2's best response function lies just below the 45° line (where the two prices would be equal) beginning at the point (*c*, *c*). If company 1 sets p_1 below *c*, company 2 will not respond since it cannot make a profit at that price. Similarly, company 1's best response function lies slightly above the 45° line and above *c*.

The only intersection of these best-response functions - and thus the only equilibrium - occurs where the price equals marginal cost. When both companies price at marginal cost, they earn zero profits. Consequently, the Bertrand equilibrium for homogeneous products aligns with the social optimum, suggesting that competitive solutions exist even with just two companies in the market.

Graph 2. Residual demand curve in Bertrand model



Graph 3. Best response functions and Bertrand Equilibrium



Source: (Carlton & Perloff, 2015)

However, the Bertrand model has been criticised for relying on the assumption that an oligopoly company can change its sales from zero (if it sets a price higher than its competitors) to the total market demand (if it sets a lower price). This criticism is valid, considering that such drastic and rapid changes in sales are impossible in reality.

1.1.3 Stackelberg model

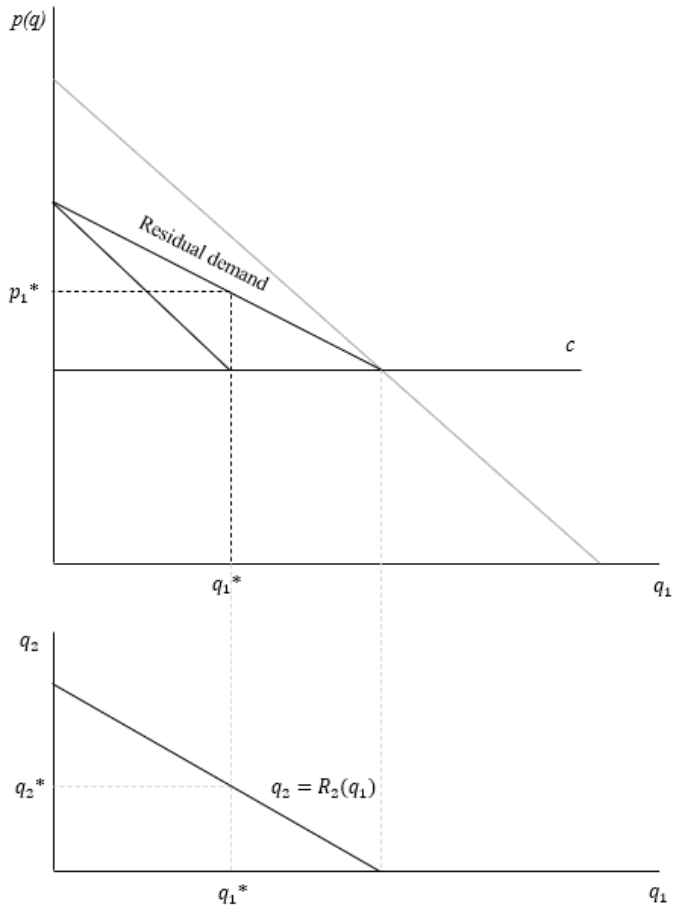
In 1934, Heinrich von Stackelberg introduced the dominant firm model, commonly referred to as the Stackelberg equilibrium model. This model conceptualizes a market structure in which one company acts as the leader, choosing a profit-maximizing quantity over the difference between market demand and the quantity offered by the follower. The follower makes its output decision based on the leader's choice and behaves competitively by using its Cournot best-response function to set the output level.

Therefore, by choosing its output level first, the leader acts as a price maker, while the follower behaves as a price taker, lacking the capability to influence the market price independently. The follower behaves competitively, choosing quantity where its marginal costs equals the market

price. A Stackelberg leader example in the markets is a company that discovers and develops an innovative product, gaining a natural first-mover advantage.

Given that the companies in the Stackelberg model face identical costs, the leader is capable of anticipating the follower's Cournot best-response function, as depicted in Graph 4. This enables the leader to predict the follower's output at any specified output level it chooses. Consequently, the leader can assess the total production corresponding to various output options, ultimately selecting the output level that maximises its profits. By deducting the follower's output from the total market demand, the leader is able to construct its residual demand curve. It then selects its output level at the point where its marginal revenue, derived from this residual demand curve, equates to its marginal cost.

Graph 4. The Stackelberg Equilibrium



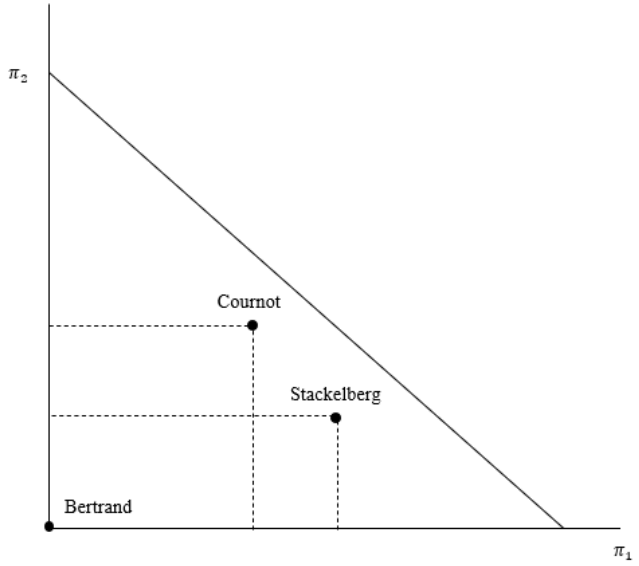
Source: (Carlton & Perloff, 2015)

In a Stackelberg model, the leader produces a higher output while the follower produces a lower output compared to a Cournot competitor. Overall, the total output in a Stackelberg setting exceeds that of a Cournot model, yet it remains below the competitive equilibrium output. The price in the

Stackelberg model is higher than the competitive price but lower than the price established in Cournot competition. Consequently, consumer surplus in a Stackelberg duopoly is greater than that in a Cournot duopoly, although it still falls short of the surplus at the social optimum.

Graph 5 below compares the profits of Cournot, Bertrand and Stackelberg competitors. It can be noticed that Bertrand equilibrium is equal to the social optimum, with none of the companies generating profits. Stackelberg and Cournot's competitors generate a profit, with Stackelberg's leader achieving higher profitability than a Cournot competitor.

Graph 5. Cournot, Bertrand and Stackelberg - Profits comparison



Source: (Carlton & Perloff, 2015)

1.2 The Merger Paradox

To illustrate the Merger Paradox, assume a homogenous product market with $n = 24$ companies[1] 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 $n = 24 - 2 + 1 = 23$,

[1] 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 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.

each producing $q_i = 25$, the total output would be $Q = 575$, resulting in the price of $P = 250$ and, 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.

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

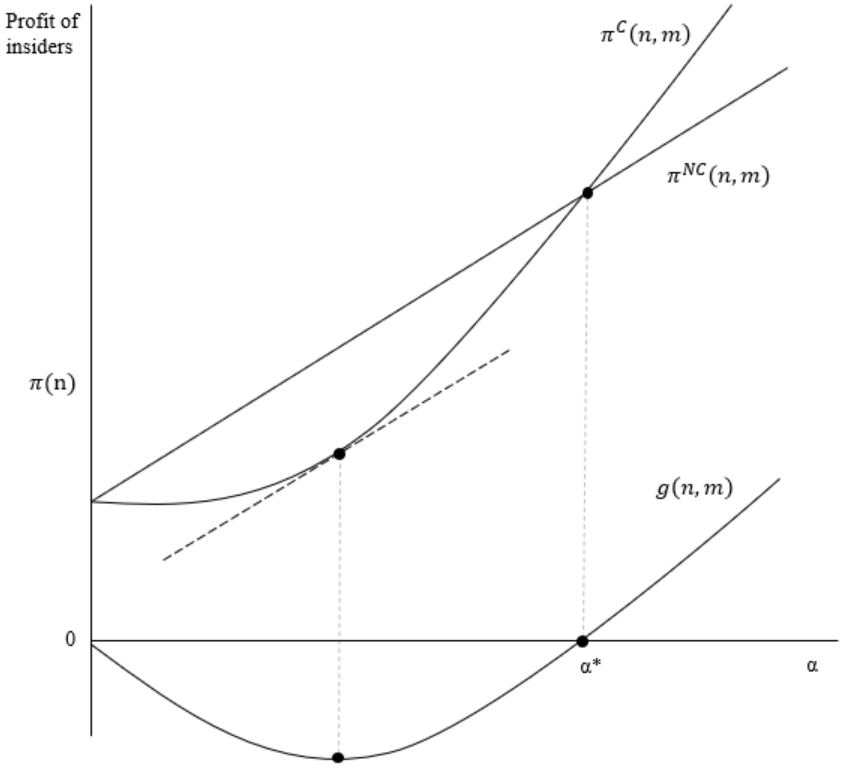
Based on Table 1, it can be observed that as the number of insiders increases, there is an increase in the individual output of each company but a decline in total output, leading to price increases and subsequent rises in the individual profit of each company. However, is the merger profitable for insiders? 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 noticed that up to a certain point, i.e. a specific number of insiders, colluding profit is lower than the non-colluding profit, indicating that the merger is not profitable for insiders. However, beyond this point, the situation reverses, showing that the merger is indeed profitable (as seen in Table 1 in the grey-shaded section).

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 comprising of *n* companies offering a homogenous product, each behaving as a Cournot competitor, 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) needs to be greater than 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.

Joint profit of colluding and non-colluding insiders, as well as gains (losses) from a merger for a changing market share of *m* insiders (α), are shown in Graph 6 below. It can be noticed that in the absence of a merger, there are neither gains nor losses, while a merger to monopoly is always profitable. In between, as the market share of insiders increases, losses escalate until reaching a certain threshold, where they begin to decrease and shift into positive values (gains) after a certain market share of insiders.

Graph 6. Profits of a merger



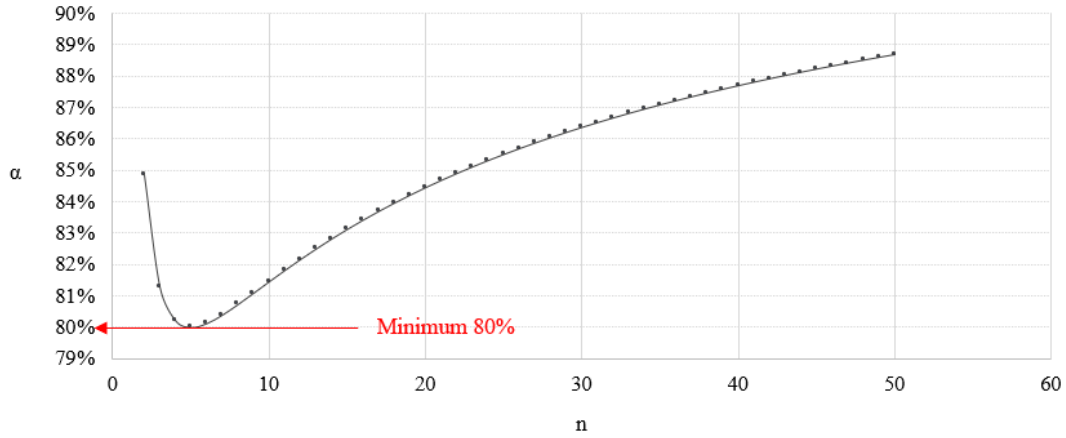
Source: (Salant, Switzer, & Reynolds, 1983), page 192

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:

$$\alpha^* = \frac{(2n+3) - \sqrt{4n+5}}{2n} \tag{1.1}$$

Refer to Appendix 1 for details on calculating α^*. For all values of α greater than α^*, a merger is profitable for insiders. Graph 7 below illustrates the calculated values of α for different values of *n*. Graph 7 shows that for any *n*, α needed for a merger to be profitable does not fall below 80%. This is known in the literature as the *"80% rule"*.

Graph 7. Market share for a profitable merger



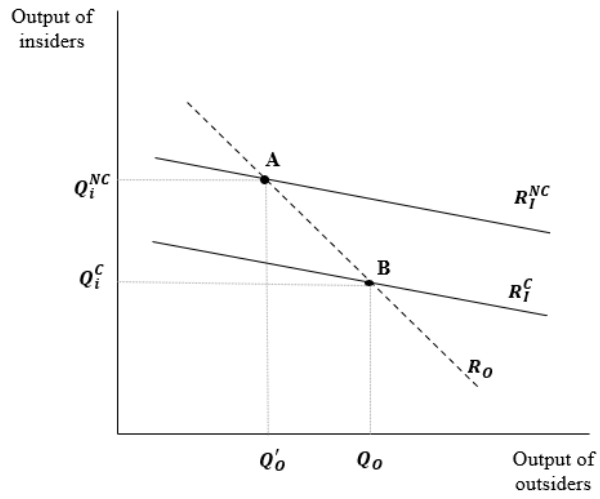
Source: based on (Hamada & Takarada, 2007)

Insights on joint profits of colluding and non-colluding insiders presented above can be depicted in Graphs 8 and 9 below. In Graph 8, R_O represents 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 would shift 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.

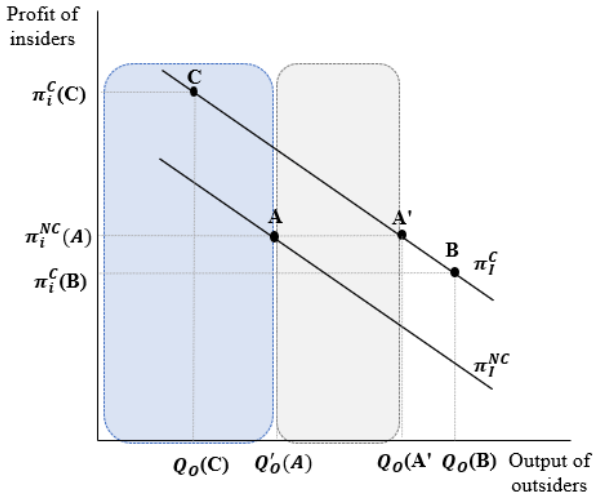
For any given production level by outsiders, the aggregate profit of insiders can only increase, which is shown in Graph 9 with the joint profit function of insiders shifting from π_I^{NC} to π_I^C. As the outsiders' output rises following a merger, the insiders' profits decline. Graph 9 illustrates three situations: i) left of point A (the blue-shaded area), the Merger Paradox is completely eliminated, meaning the number of insiders is large enough (>80%) and resulted in reduced outsiders' aggregate output while increasing the profits of insiders (which is the opposite of the results associated with the Merger Paradox). This is illustrated by point C in the graph, where insiders' profitability rises after the merger while outsiders' output declines; ii) between points A

and A' (the grey-shaded area), 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 8. Production responses from a merger



Graph 9. Profit consequences of a merger



Source: based on (Salant, Switzer, & Reynolds, 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 causes a free-riding problem, with outsiders benefiting more from higher market share and higher prices post-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 since 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 scale economies. Pre-merger, each company has 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, but due

to the free-riding problem, outsiders may benefit more than consumers lose, leading to a positive impact on welfare.

SSR referenced that the Cournot model was used as the simplest to demonstrate the phenomena. However, Hamada and Takarada (2007) later illustrated that the 80% rule also applies in the Stackelberg model. They showed that for a merger to be profitable, at least 80% market share (of the markets that leaders and followers face separately) is required. Notably, the total market share for a profitable merger falls below 80% when calculated concerning all companies – both leaders and followers – in the market. The Merger Paradox in the Stackelberg model is presented in detail in Appendix 2 below.

2. THEORETICAL SOLUTIONS TO THE MERGER PARADOX

As mentioned in the introduction section of this thesis, the intriguing results of the Merger Paradox 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, relying on studies by Farrell and Shapiro (1990), Gelves (2014), Huck, Konrad and Muller (2001) and Daughety (1990), to present their key findings.

2.1 Merger Paradox and Cost synergies

The Merger Paradox, as presented by SSR, suggests that mergers are unprofitable (unless involving 80% of the market share) and create a free-riding problem, necessarily lead to an increase in prices and that there is generally an inverse relationship between market concentration and total welfare. However, this is not always the case. Farrell and Shapiro (1990) have 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 beneficially or anticompetitively. As Simon Sinek wrote in 2010: "Mergers are like marriages. They are bringing

together of two individuals. If you wouldn't marry someone for the 'operational efficiencies' they offer in the running of a household, then why would you combine two companies with unique cultures and identities for that reason?", (Sinek, 2010).

Two extremes can be identified: one in which all companies prior to the merger have equal and constant marginal costs, and the merged entity maintains the same costs following the merger – this indicates that the mergers are anticompetitive. The other involves differing marginal costs among companies, where a merger can provide an opportunity to rationalise production, meaning that output can be shifted to the facility with lower marginal costs without changing the total output. Additionally, mergers may create synergies, allowing insiders to produce more efficiently than they could individually.

Unlike SSR, Farrell and Shapiro (1990) believed that privately unprofitable mergers would not be proposed. In this regard, from the perspective of acceptability, according to antitrust, whether such a merger is permitted depends solely on whether the external effects are negative and significant enough to outweigh the private profitability of the merger for the insiders. However, to determine whether mergers are indeed always privately profitable for insiders, let's revisit the example from section 1, the Merger Paradox, following the same logic as in Pepall, Richards, and Norman (2014). In this example, companies are facing the same liner demand curve $P = 1400 - 2Q$. However, in this case, instead of assuming identical marginal costs among all 24 companies,we will assume that $c_{i\ (i=1,2,\dots,23)} = 200$, while $c_{24} = 200b$, where b > 1, and measures the cost disadvantage faced by company 24. In Cournot equilibrium, by solving a system of 24 equations, the outputs produced by these companies can be expressed as follows: $q_{i\ (i=1,2,\dots,23)} = 20 + 4b$ and $q_{24} = 120 - 96b$[2]. Total output is $Q = 580 - 4b$, and price is $P = 240 + 8b$. Profit of these companies is given as $\pi_{i\ (i=1,2,\dots,23)} = 2 \cdot (20 + 4b)^2$ and $\pi_{24} = 2 \cdot (120 - 96b)^2$.

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:

[2] For company 24 to be in the market, *b* should be lower than 1.25.

$$1{,}250 - (2 \cdot (20 + 4b)^2 + 2 \cdot (120 - 96b)^2) > 0 \quad (2.1)$$

Simplifying (2.1):

$$9{,}232 \cdot \left(\frac{1{,}442}{1{,}154} - b\right) \cdot \left(b - \frac{2{,}835}{2{,}308}\right) > 0 \quad (2.2)$$

Based on the conditions for b outlined in (2.2) and the condition in footnote 2, b must be approximately 1.25[3]. 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, in a merger between two companies, price will fall if and only if:

$$p - c_M > (p - c_1) + (p - c_2) \quad (2.3)$$

where p is the pre-merger price, c_1 and c_2 are marginal cost of these two insiders at pre-merger output levels, and c_M is marginal cost at the sum of pre-merger output levels. By symplifying (2.3), the price will fall if:

$$c_2 - c_M > p - c_1 \quad (2.4)$$

Therefore, based on (2.4), 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, k_i is the amount of capital employed, and l_i inverse measure of knowledge at the company *i*, we can identify three types of cost savings resulting from a merger. Farrell and Shapiro analysed each of these three types of cost savings and established the necessary conditions for them to effectively contribute to a decrease in price post-merger.

1. **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

[3] More precisely, the intersection of the intervals from condition (2.2) and footnote 2 results in b∈(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.

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.

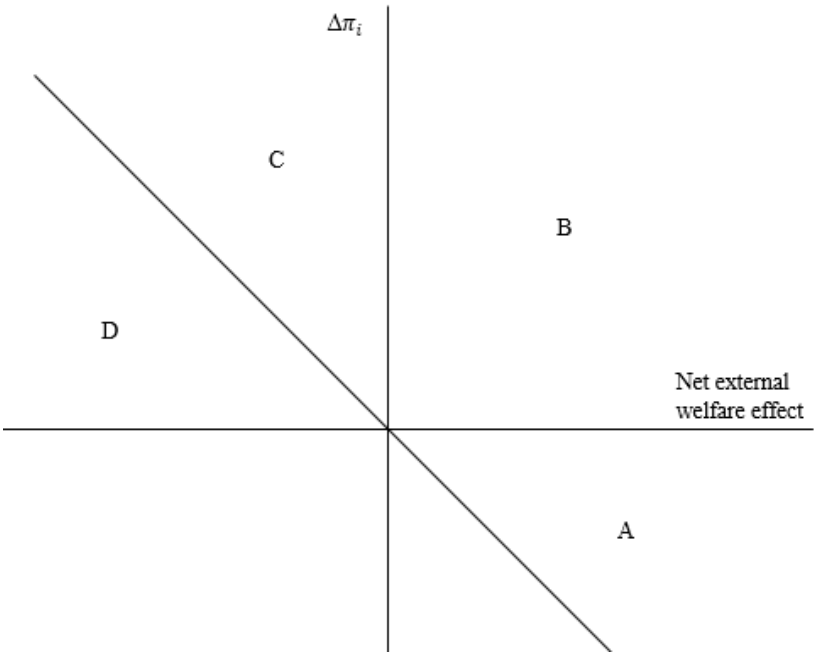
2. **Capital reallocation** occurs when insiders shift and better re-combine capital among themselves, allowing them to change the distribution of k_i without affecting the total available capital. This is beneficial in the case of economies of scale and applies only in the short run when additional capital cannot be obtained externally. However, this type of cost efficiency may be limited by the immobility of capital across facilities, which can lead to an increase in prices. Assuming these cost efficiencies can be realized, Farrell and Shapiro demonstrated that for a merger between two companies to lower prices, the combined input (twice the capital) must produce at least 2.4[4] times the output.
3. **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%[5] in l_i.

From the perspective of antitrust policy, whether a merger is permitted largely depends on the net external welfare effect, given that, as previously mentioned, it is assumed that no privately unprofitable merger will be proposed. Graph 10 shows different combinations of the level of private profitability for insiders and net external welfare effects caused by a merger. The diagonal line in Graph 10 represents mergers that have a neutral total welfare effect, i.e. the sum of net external welfare effect and change in insiders' profitability equals zero. Mergers to the right of the diagonal 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 Graph 10 will be approved by Antitrust authorities. However, such a policy would be overly conservative and restrictive, so it is essential to identify which mergers may also be socially beneficial. For mergers in area A to occur, some form of compulsion or subsidy would need to be expected for insiders for a merger to occur. Conversely, mergers in area D would not be allowed, as they are profitable but socially undesirable. Area C includes mergers that are profitable for insiders but have a negative net external welfare effect, raising potential concerns for Antitrust authorities. However, some of these

[4] 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 elesticity.
[5] Reduction in l_i of 25% applies under the same conditions as described in footnote 4.

mergers may produce significant synergistic effects that positively affect consumer surplus, outweighing the negative effects on outsiders' profitability and resulting in only a slightly negative net external welfare effect. When combined with the positive impact on insiders' profitability, these mergers can yield an overall positive total welfare effect, providing a rationale for Antitrust authorities to consider approval of these mergers. Therefore, a strong presence of synergistic effects is important for permitting mergers in area C.

Graph 10. Implications for Antitrust Policy



Source: (Farrell & Shapiro, 1990)

2.2 Merger Paradox and Product differentiation

SSR assumes that companies produce homogenous products. However, do the results of the Merger Paradox change when products are differentiated? Gelves (2014) demonstrated in his study that product differentiation can lead to mergers being privately profitable without requiring 80% of companies in the market to be involved, thus showing that the *80% rule* does not apply.

Gelves (2014) demonstrated that the level of product differentiation (*d*) influences the response of outsiders. Product differentiation varies between 0 and 1, where $d = 0$ indicates that the products are perfectly differentiated, while for $d = 1$, we are back to conventional Cournot analysis with homogenous products. Product differentiation results in segmented markets. In this context, a merger does not necessarily lead to the closing of a merging company’s production plant and the

transfer of all production to another insider (as seen with cost synergies) since that would mean losing one market segment entirely. Instead, insiders would retain their own production facilities.

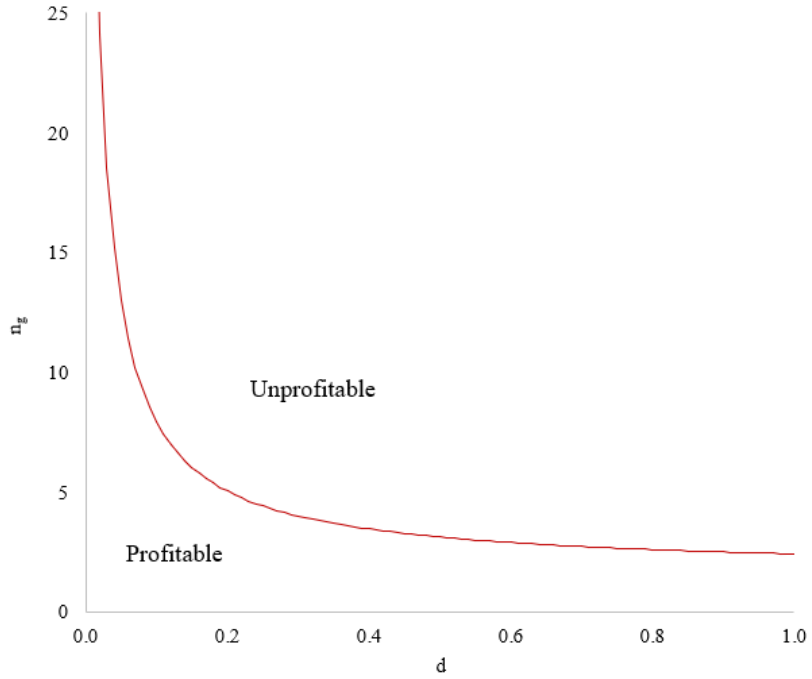
Recall from the Merger Paradox that there was a free-riding problem, where reduced competition from the merger led outsiders to increase their output, negatively impacting insiders' profitability. This is not the case here. Based on the reaction functions (A3.4) and (A3.5) in Appendix 3, it can be seen that as product differentiation increases (with the value of *d* approaching 0), the reaction of outsiders decreases. A value of *d* equal to 1 would be equivalent to the Merger Paradox, where the free-riding problem would re-emerge. From this, we can conclude that as product differentiation approaches perfect differentiation, the free-riding problem is diminished, and the likelihood of a profitable merger increases. In the extreme case where goods are perfectly differentiated, there is no negative externality from outsiders, and the merger is at least as favourable as having no merger at all.[6]

We concluded above that the likelihood of a profitable merger increases as the level of product differentiation increases. However, what specific level of product differentiation is required for a merger to be profitable? Following the logic used in the Merger Paradox illustration and by 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 (A3.3) and (A3.11) in Appendix 3) must be greater than zero. By calculating this, we find that for a merger to be profitable, the total number of companies should be less than the threshold value on the right-hand side of the inequality (2.5).

$$n < \frac{5d - 2 - d^2 + 2\sqrt{(d+1)(2-d)^2}}{d(3-d)} \tag{2.5}$$

[6] Please refer to Appendix 3 to see the reaction functions of insiders and outsiders after a two-company merger in an n-company market.

Graph 11. The inverse relationship between product differentiation and the number of companies



Source: (Gelves, 2014)

Graph 11 demonstrates that there is an inverse relationship between the number of companies and the level of product differentiation required for a merger to be probitable. Mergers are consistently profitable for outsiders, as demonstrated by a comparison of their pre- and post-merger profits shown in Appendix 3, which supports the conclusion of the Merger Paradox. Consequently, one of the issues related to the Merger Paradox remains unresolved even with product differentiation taken into account. 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 negatively impacts the total welfare, confirming another implication of the Merger Paradox.

We can summarise the following results when product differentiation is incorporated into the original presentation of the Merger Paradox: 1) Mergers may be profitable for insiders, but the likelihood of it depends on the level of product differentiation; specifically, mergers tend to be more profitable when product differentiation is high; 2) Outsiders always benefit from mergers,

regardless of the level of product differentiation.; and, 3) Mergers have a negative impact on total welfare.

Furthermore, Gelves (2014) demonstrated that when product differentiation is combined with cost asymmetry and technology transfer, it fully resolves the Merger Paradox. However, this thesis focuses on changing only one of the assumptions at a time. Therefore, the results from Gelves's work will not be presented here.

2.3 Merger Paradox and Stackelberg Leadership

In this section, the focus is on analysing the impact of market structure and the strategic power of insiders on 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. The other assumptions remain the same: costs are linear, and products are homogenous. 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.

The first scenario has been briefly presented in section 1 above. Namely, a merger between two leaders or two followers fully mirrors the Merger Paradox and is privately unprofitable for insiders who face the free-riding problem. This merger leads to a decrease in consumer surplus and ultimately affects 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 timing in the industry (Hamada & Takarada, 2007). 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 2 for further details.

Unlike a merger between two market participants with the same output choice timing, a merger between a leader and a follower is always profitable (Huck, Konrad, & Muller, 2001). This merger changes the number of followers to $n_f = n - n_l - 1$, while leaving the number of leaders unchanged. Substracting the combined pre-merger profits of a leader and a follower (sum of equations presented with A4.1 in Appendix 4) from the post-merger profit of a leader (presented with equation A4.2 in Appendix 4), the resulting difference (g) can be used to draw the conclusion about the profitability of this type of mergers:

$$g > \frac{1}{(n_l + 1)^2 (n - n_l)(n - n_l + 1)^2} \tag{2.6}$$

Calculated value of g is greater than zero for any $n_l < n$, suggesting that mergers between a leader and a follower are always profitable. The quantity produced by the merged entity after the merger is the same as the quantity produced by the leader alone before the merger; however, the price increase is significant enough to offset the reduction in quantity, resulting in an overall increase in profit.

However, how do they affect outsiders, consumers, and total welfare? Specifically, aside from the private profitability of the merger, does it address any of the negative implications of the Merger Paradox? Unfortunately, no; total output produced decreases, and the price increase following the merger reduces total welfare. Consequently, from the perspective of antitrust authorities, they may have valid concerns if two companies with differing strategic powers intend to merge.

However, what if two leaders merge and, after the merger, adjust their strategic power and continue operating as market leaders? This scenario would show that mergers can be both privately profitable and beneficial for total welfare in markets that are very close to symmetric and with a low number of leaders (Daughety, 1990).

In a Stackelberg model, a merger between two followers that results in a company that becomes a leader, the total number of companies after the merger would be n-1, while the number of leaders would increase to n_l+1. Comparing the profitability metrics before and after the merger, as shown in Appendix 5, a merger is considered profitable for insiders if the difference (g) as calculated in Appendix 5 satisfies:

$$(n - n_l + 1)^2 (n_l + 1)^2 - 2 \cdot (n - n_l - 1)(n_l + 2)^2 > 0 \tag{2.7}$$

This holds true for any n_l<n. However, what are the effects on total output and, consequently, on price and consumers? As shown in Appendix 5, the total output after the merger is greater than the output before the merger, making it socially desirable when:

$$3 \cdot (n_l + 1) < n \tag{2.8}$$

Simplifying (2.6):

$$n_l < \frac{n}{3} - 1 \tag{2.9}$$

Based on (2.9), 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 confition for a merger to be both privately profitable and socially desirable, given that condition (2.7) always holds true.

3. REALITY CHECKPOINT

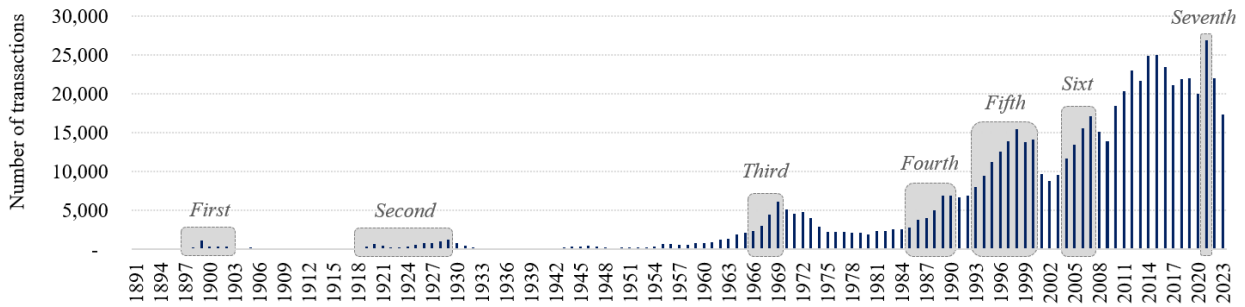
3.1 M&A waves

In the context of M&A transactions, there is a significant focus on the latest developments, as experts in the field closely monitor ongoing market transactions to identify key market patterns. However, it is crucial also to analyse historical transactions to understand different trends, causes, and consequences. This historical perspective allows us to comprehend how each wave of M&A activity has influenced regulatory changes and the tightening of controls over these transactions. Merger waves refer to periods characterised by unusually high levels of M&A activity, which are typically cyclical and often associated with phases of economic growth.

3.1.1 The Seven Waves

Mergers and acquisitions (M&A) are a longstanding practice dating back to the inception of corporate structures. It was observed that M&A transactions have followed a cyclical pattern and came in waves (Golbe & White, 1993). Starting in the 1890s, M&A activity has been segmented into seven distinct waves to date. While the exact beginning of each of the seven M&A waves is not precise, they typically conclude around major wars or the onset of economic crises. Based on historical data on the number of M&A transactions from Thomson Reuters (up to 2001) and S&P Capital IQ (from 2002 to 2023), the chart below shows the Seven M&A Waves in the USA that are elaborated below.

Graph 12. The Seven Waves



Source: Author's calculation

The First Wave of mergers occurred after the 1883 depression, peaking from 1898 to 1902 and ending in 1904. It significantly impacted industries like metals, chemicals, and petroleum, which accounted for about two-thirds of all mergers during this time. Characterised by intra-industry horizontal consolidations, this wave led to near-monopolistic market structures, notably forming U.S. Steel, the first billion-dollar corporation in the USA, which controlled nearly half of the nation's steel production. The wave ended with the 1904 stock market crash, economic stagnation, and the First World War threat. Its emergence is attributed to loose enforcement of the Sherman Antitrust Act due to the understaffed Justice Department, allowing monopolies to thrive. Additionally, relaxed corporation laws made it easier for companies to raise capital and acquire other businesses, while the post-Civil War expansion of the rail system facilitated national markets and reduced transportation costs, further promoting mergers.

The Second Wave and the First Wave are contrasted as "merging for oligopoly" versus "merging for monopoly", as the Nobel Prize-winning economist George Stigler said (Gaughan, 2018). In response to the limitations of the Sherman Antitrust Act, the Clayton Act was enacted in 1914 to strengthen anti-monopoly provisions. The stricter Clayton Act during the Second Wave led to fewer monopolies but rather more oligopolies, with a focus on inter-industry vertical mergers. The wave ended with the 1929 stock market crash and the enforcement of the Clayton Act. The Second Wave emerged due to the post-World War I economic boom, which infused the securities markets with substantial investment capital. During this period, several corporations were formed that still operate, such as General Motors and IBM.

The Third Wave is characterised by conglomerate mergers that accounted for around 80% of the mergers during this period, thereby not significantly increasing industrial concentration. Companies seeking expansion turned to conglomerates due to the increased restrictions on horizontal and vertical mergers. During this wave, high demand for loans led to increased fund prices and interest rates. The booming stock market facilitated equity-funded conglomerates, boosting earnings per share (EPS). The Third Wave was driven by companies with high price-to-earnings (P/E) ratios acquiring those with lower ratios to raise stock prices. Large companies offered significant premiums to smaller companies, increasing EPS and stock prices, as long as the combined entity's P/E ratio exceeded that of the acquirer before the merger. This trend eventually resulted in a decline in suitable acquisition targets, slowing the merger wave. The 1969 stock market crash caused P/E ratios to drop, further dampening acquisition activity and decelerating the Third Wave. Additionally, accounting manipulations, such as recognising gains on undervalued target assets and using convertible debt for acquisitions, were common during this time. New regulations to curb these practices ended the conglomerate boom.

The Fourth Wave was marked by aggressive takeovers and leveraged buyouts as key strategies for company acquisitions. The Fourth Wave was distinguished by large-volume megamergers, particularly impacting several industries such as oil and gas, pharmaceuticals and medical equipment due to deregulation, creating higher concentration within those industries. Corporate raiders and M&A arbitragers played significant roles, with investment banks driving the growth of the junk bond market for financing takeovers. Additionally, this wave witnessed some foreign involvement in takeovers, setting the stage for more international participation in subsequent merger waves. The wave ended in 1989 with an economic slowdown after a period of expansion, leading to a mild recession in 1990.

The Fifth Wave continued with large transactions similar to those in the previous wave, despite scepticism about a return to the previous wave levels. Companies sought expansion after the recession, favouring strategic mergers over hostile takeovers. Unlike the debt-financed transactions of the Fourth Wave, this period saw a shift toward equity-based financing, resulting in less leverage. This wave included *"roll-ups"*, which aimed to consolidate fragmented industries by merging smaller companies into national businesses for economies of scale. However, many roll-up attempts failed, leading to bankruptcies and value loss. While bidding shareholders benefited in the first half of the wave, they faced significant losses from 1998 onward. Initially, managers were cautious and learned from past mistakes, but as the stock market bubble inflated, high P/E ratios led them to mistakenly credit rising share values to their abilities rather than market trends, contributing to overvaluation. The number of transactions continued to grow until a sudden decline followed the Internet bubble burst and the 2001 recession.

The Sixth Wave began with the economic boost from low interest rates set in response to the 9/11 economic shock. This led to a global speculative real estate bubble as investors sought mortgage-backed securities and other debt securitisation. The availability of cheap debt in the private equity sector made leveraged acquisitions more affordable, and a thriving market enabled successful equity financing. Private equity companies capitalised on this environment by acquiring companies, boosting their value, and then selling them for profit, driving M&A activity. However, declining housing prices raised concerns about asset values, leading to write-downs, diminished bank capital and a slowdown in lending. Despite the Federal Reserve's efforts to boost banking liquidity, new lending remained limited. A relatively short but intense wave ended during the 2007 crisis, as cheap debt waned and oil prices rose, culminating in the 2008 recession that swiftly halted the Sixth Wave.

The Seventh Wave emerged at the beginning of 2021 as a boom following the low merging activity during the COVID-19 pandemic in 2020, which significantly impacted M&A activity. Numerous deals that were postponed in 2020 re-emerged, leading to a surge in activity and transaction volumes. With certain industries heavily affected by the pandemic, companies are now focused on repositioning their businesses by divesting non-core divisions and acquiring new capabilities in response to the changing business landscape. Key factors contributing to the Seventh Wave included government stimulus aimed at pandemic recovery, successful vaccine distribution that reduced uncertainties, and a favourable low-interest rate environment promoting growth. While there is some debate about the future progression of the Seventh Wave, a decline in transactions in 2022, possibly influenced by the war in Ukraine causing macroeconomic uncertainties and high interest rates, can be observed from Graph 12. Although the Seventh Wave was brief, it is notable that the number of transactions reached a historic high in 2021.

Table 2. The Seven Waves overview

Wave	Period	Type	Trigger	End of wave
First	1897-1904	Intra-industry, Horizontal	Lax legislation and technological innovation	1904 stock market crash and WW1
Second	1916-1929	Inter-industry, Vertical	Post WW1 economic boom	1929 stock market crash and more stringent antitrust environment
Third	1965-1969	Conglomerate	Booming stock market	1696 stock market crash, changes in regulation and exhaust market
Fourth	1984-1989	Hostile megamergers	Increased use of junk bonds to finance mergers and breakup of conglomerates	1990 recession
Fifth	1992-2001	Friendly megamergers	Management's overconfidence and post-recession expansion	Internet bubble burst, and the 2001 recession
Sixth	2004-2007	Cross-border transactions	Favorable economic environment	2008 recession
Seventh	2021	Intra-industry	Post COVID-19 environment	The 2022 war in Ukraine

Source: Author's research

3.1.2 Theoretical Insights into the Cyclical Patterns of M&A Transactions

The occurrence of M&A transactions in waves has been a subject of interest for many economists seeking to explain this cyclical pattern of M&A transactions. One such is Fauli-Oller (2000), who

attempted to clarify why mergers happen in waves. He identified two explanations: non-strategic and strategic.

The *non-strategic* explanation proposes that M&A transactions occur when a common exogenous factor renders them profitable; specifically, it suggests that low demand increases the profitability of these transactions. The *strategic* explanation focuses on the interrelationships among companies, arguing that the clustering of transactions arises from the fact that companies find it beneficial to merge only if their competitors also engage in mergers. This phenomenon is usually called the *bandwagon effect*. In this context, previous mergers stimulate new mergers. Fauli-Oller draws a parallel with SSR, referencing the Merger Paradox and the fact that outsiders, by increasing their post-merger output, negatively impact the profitability of insiders. As more mergers occur, this negative effect diminishes, meaning fewer outsiders will be able to free-ride, thereby promoting the occurrence of new mergers to mitigate this effect completely and initiating a merger wave.

However, the reasons behind the occurrence of M&A transactions in waves remained ambiguous, which resulted in many other theories on the factors triggering this cyclical pattern. These factors are typically categorised into three main groups: (i) environmental shocks, (ii) managerial decisions, and (iii) capital markets development.

Environmental shocks can be industry or company-specific. The duration and size of M&A waves are influenced by the number of industries impacted by disruptions and the extent of their impact.

Economic disruptions often necessitate corporate restructuring, which can initiate M&A activity. These disruptions frequently result in valuation discrepancies among companies, with the mismatches in valuations triggering increased M&A activity. A strong relation between rising market demands and the strategic advantages of mergers, which often benefit from economies of scale, suggests that the cyclicality of product market demand mirrors the cyclical nature of M&A activity. Similarly, when markets experience rising demand, more efficient companies tend to acquire less efficient ones, indicating that positive demand shocks could result in increased M&A activity.

Technological advancements and changes are also crucial, as reflected in the Q-Theory of Mergers. The Q-Theory of investment says that a company’s investment rate should rise with its Q (the ratio of market value to replacement cost of capital) (Jovanovic & Rousseau, 2002). An

M&A investment is more influenced by its Q ratio than its direct investment due to the high fixed costs and low marginal adjustment costs associated with M&A activity.

Financial aspects are pivotal; companies that maintain financial flexibility, particularly those with significant cash reserves, are more capable of engaging in M&A during periods of capital market growth. Therefore, M&A waves are typically triggered by significant economic, technological, or regulatory shocks, but only if sufficient cash buffers among market participants are available.

Managerial decisions: Agency problems, specifically conflicts of interest between shareholders and managers with access to large free cash flows, play a significant role in driving M&A activity. Managers may be incentivised to pursue growth beyond optimal levels in order to increase their power, leading to value destruction for shareholders in some cases. Industrial shocks or financial market expansions can boost free cash flow levels, intensifying agency conflicts and stimulating heightened M&A activities. Furthermore, managers may opt for conglomerate mergers to lower risk for the merged entity by reducing earnings volatility and mitigating employment risk, even if such mergers may not provide additional value to shareholders as they could replicate the investment through their own diversified portfolios.

Managers frequently exhibit herd behaviour in their investment decisions, following the actions of others without relying on their judgment. This behaviour, influenced by reputational concerns and the unpredictability of investment outcomes, can lead to a “sharing-the-blame” effect (Scharfstein & Stein, 1990) in case of unfavourable results. Herd behaviour can, therefore, result in the clustering of M&A operations, potentially resulting in increased M&A activity triggered by successful deals. This coincides with the strategic explanation provided by Fauli-Oller (2000).

Capital markets can also drive M&A activity, with M&A waves coinciding with financial market expansions and stock overvaluations. In times of financial booms, managers leverage their company’s “overvalued” equity to invest in other companies. Typically, companies with lower stock prices tend to acquire those with higher overvalued stocks during such boom periods.

3.2 Empirical Validation of the Merger Paradox

This section focuses on the analysis of M&A data from the most recent seventh M&A wave. The goal of the analysis is to compare key financial metrics before and after the merger wave and to evaluate how the transaction impacted the performance of the acquirer.

3.2.1 Data

Data for the analysis were obtained from CapitalIQ. To replicate the Merger Paradox framework, which focuses on horizontal mergers, the analysis focused on M&A transactions within the financial sector, specifically the banking sector, to exclude vertical mergers. Additionally, to avoid international mergers, the analysis was limited to one market: the USA. The choice of the market was based on the (un)availability of data in other regions, as the number of transactions completed annually and their corresponding data are limited outside the USA. Only whole company acquisitions (i.e. majority stakes) were included, excluding transactions involving branches or assets, since purchasing only part of a target does not reflect the Merger Paradox. The search of all transactions that occurred during the most recent, seventh M&A wave in 2021, which met all the previously mentioned criteria, resulted in a sample of 179 companies.

All transactions announced in years prior to 2021 were excluded from the sample, as the transaction announcement impacts the performance (for example, stock price and consequently equity) of both the acquiring company and the target company. This exclusion ensured the elimination of "external" effects on financial performance in the years prior to the merger completion. As a result, the sample was reduced to 127 transactions.

An additional challenge in the analysis was the unavailability of data as some transaction participants were small banks whose data were not publicly disclosed, or the target stopped disclosing data after the transaction announcement. Furthermore, since some acquirers were large banks that close several transactions annually, transactions involving such acquirers were excluded from the analysis to avoid skewing the results. This resulted in the final sample of 40 transactions. Please refer to Appendix 6 for the sample of transactions included in this analysis.

The analysis focused on the pre-merger financial indicators of 40 acquirers and 40 post-merger financial indicators of the combined entities. To control for the size, financials expressed in absolute terms that typically increase in mergers (e.g. Total Assets, Total Equity, Net Interest Income, etc.) were not considered, as when compared on a pre- and post-merger basis, would notoriously show a significant increase in absolute values. Therefore, only financial indicators standardised for the size have been included in the analysis. Three groups of indicators have been analysed:

i) profitability - Return on average assets (ROAA), Return on average equity (ROAE), Net Interest Margin (Net Interest Income / Average Interest Earning Assets), Net Interest Income / Average Assets, Efficiency ratio (Operating Expenses / Operating Income);

ii) asset quality - Loan Loss Reserve/Gross loans and NPL ratio (NPLs / Gross Loans); and

iii) capital adequacy - Risk-based capital ratio.

Although the analysis focuses on changes in profitability before and after the M&A wave, it also includes other groups of indicators to assess whether M&A transactions, if they reduce profitability, positively impact other aspects of business operations. The Results in the following section provide a more detailed description of how these transactions affected these three aspects of banks' operations.

This resulted in up to 80 observations (n) per variable, as presented in Table 4 below, along with their respective summary statistics, including mean, standard deviation, minimum and maximum values. Some variables had fewer observations due to data unavailability or data not being meaningful (e.g. extreme values due errors in data entry or reporting).

Table 3. Summary statistics

Descriptive statistics	n	mean	st. dev.	min	max
ROAA (%)	80	1.12	0.59	-1.52	2.88
ROAE (%)	80	11.19	6.85	-21.03	22.82
Net Interest Margin (%)	80	3.52	0.83	-0.35	5.14
Net Interest Income / Avg. Assets (%)	65	3.40	0.64	1.78	4.72
Efficiency ratio (%)	80	62.46	11.49	40.94	113.62
Loan Loss Reserve/Gross loans (%)	80	1.16	0.38	0.14	2.29
NPLs/Gross Loans (%)	66	0.88	1.47	0.00	10.87
Risk-based capital ratio (%)	52	15.04	3.95	10.46	30.21

Source: Author's research

3.2.2 Methodology

Pre-merger and post-merger means for a set of key financial ratios described above were calculated for the two years prior to and the two years following the year of merger completion, specifically year-end 2018 and year-end 2023. The two-year period was chosen due to data availability, as the latest annual accounts are available for 2023. Moreover, the rationale for considering more than one year after the merger is to allow sufficient time for the integration to be completed and for the synergistic effects to materialise. Prior to the merger (i.e. 2018), only the financial ratios of the acquiring company are considered. After the merger (i.e. 2023), the financial ratios for the combined company are assessed.

For each of the variables described in the Data section, means for the acquirers' sample on a pre-merger basis and means for the entities combined on a post-merger basis were compared. Statistical significance of the differences identified in means pre- and post-merger was assessed by using the t-test, testing the following hypotheses:

$$H_0: \mu_{acquirer} = \mu_{combined}$$

$$H_1: \mu_{acquirer} > \mu_{combined}$$

where the null hypothesis evaluates whether the difference in means of selected indicators, on the pre- and post-merger basis, is equal to zero. The alternative hypothesis tests whether the difference in means is positive, suggesting that the mean of selected indicators is lower post-merger compared to pre-merger levels. Failure to reject this hypothesis would provide statistical evidence in favour of the Merger Paradox. The analysis was conducted using the Stata statistical software package.

3.2.3 Results

Observing the calculated differences in means between pre- and post-merger indicators, the overall conclusion is that mergers seem to reduce profitability but improve asset quality. This observation is confirmed through the t-test results, which indicate lower post-merger means for the profitability ratios, with an exception for the Efficiency ratio, which has shown higher post-merger mean. Such a result does not come as a surprise, given the definition of the efficiency ratio, whereby a higher efficiency ratio indicates a higher share of operating expenses in the operating income, implying a higher cost increase than an increase in income due to the merger, which is consistent with the findings for all the other profitability ratios. The result for the NPL ratio indicates that the share of NPLs in the gross loans decreases post-merger.

While the above-mentioned results are economically significant, the statistical significance was confirmed only for the following three indicators: ROAA, Net Interest Margin, and Net Interest Income / Average Assets. Consequently, the null hypothesis of equal means is rejected at 1% of level of statistical significance.

Table 4. Results summary

Variable	t-test
ROAA (%)	2.68
	(0.342)**
ROAE (%)	1.30
	(1.988)

Net Interest Margin (%)	3.21
	(0.565)**
Net Interest Income / Avg. Assets (%)	2.66
	(0.404)**
Efficiency ratio (%)	-1.43
	(-3.643)
Loan Loss Reserve/Gross loans (%)	-0.54
	(-0.047)
NPL ratio (%)	1.67
	(0.598)
Risk-based capital ratio (%)	1.41
	(1.591)

p-value in parentheses
* p<0.05, ** p<0.01

Source: Author's research

Hence, all these financial indicators worsened after mergers.

3.2.4 Limitations and suggestions for further research

The limitations of this analysis can be divided into two aspects: statistical and economic/merger. From a statistical standpoint, achieving the most accurate statistical results requires a large sample size. Due to the data constraints outlined in the Data section, a sample size of 40 transactions is acceptable for t-test analysis. However, proper regression analysis controlling for various variables must be conducted to investigate causal relationships. Regression analysis typically necessitates a considerably larger sample size. By controlling for certain variables, such as company size, it might be useful to evaluate the impact on financial performance expressed in absolute terms.

From the economic/merger standpoint, three critical points should be noted: i) the integration process may have extended beyond two years period, meaning that the financial statements may not reflect the consolidated financial indicators of the merged entity but rather the standalone financials of the acquirer; ii) this may imply that synergistic effects are yet to materialise and be reflected in the financial statements; and, perhaps most importantly, iii) the seventh M&A wave was triggered by the post-COVID-19 environment, occurring only a year after the onset of the pandemic. During this period, the economy remained vulnerable, and consumers became sceptical, resulting in reduced consumer spending, low credit activity, and weaker banks' performance, which may be reflected in their diminished profitability in 2022-2023.

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.

Market concentration in any industry poses negative consequences for consumers. The importance of preventing such adverse effects is reflected in the existence (and ongoing updates/improvements) of regulatory frameworks, including Merger Guidelines and the CAs. The significance of this issue is further highlighted by the active involvement of government officials in addressing it. For instance, during her 2016 presidential campaign, Hillary Clinton made a statement in Toledo, Ohio, emphasising that, if she became president, she would "*appoint tough, independent authorities to strengthen antitrust enforcement and really scrutinise mergers and acquisitions, so the big don't keep getting bigger and bigger*."

Salant, Switzer and Reynolds (1983) were the 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.

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 resolutions to the Merger Paradox, the conditions for achieving a profitable merger 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 differentiated goods, the Paradox appears to be resolved; yet this raises concerns whether a merger between companies offering perfectly differentiated products is advantageous and benefitial for acquirer; 3) the shifts in strategy following a merger raises a question whether merging two followers - typically firms with lower market power - would genuinely enhance their competitive strength post-merger. Moreover, it should be noted these three approaches change one assumption in isolation while holding other assumptions constant. This is particularly relevant since the concept of the Merger Paradox is based on the Cournot 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.

By comparing theoretical insights with the data based on the analysis of the profitability of M&A transactions in the banking sector in the USA during the most recent M&A wave in 2021, the established theoretical insights were confirmed. Specifically, the analysis reaffirmed that mergers are not profitable, thereby supporting the notion that the Merger Paradox cannot be fully resolved from either a theoretical or practical standpoint. These results were somewhat expected, given the existence of numerous academic studies that have tracked historical M&A transactions and concluded that 70% of transactions are dilutive, both in the short and long term following the completion of the transaction.

However, it is essential to approach these findings with caution and consider the limitations in the analysis. These limitations include the size of the sample that was analysed, the completion of integration, and the materialisation of the merger effects on the financial performance of the merged entity. Additionally, it should be acknowledged that the most recent M&A wave occurred just one year after the onset of the COVID-19 pandemic (which at the same time triggered this wave). As a result, the economy was still experiencing a slow recovery, characterised by reduced consumer spending and, consequently, diminished credit activity.

If all of this is true, one might wonder why M&A transactions still occur. The underlying reason likely stems from the continuous pressure on management to increase shareholder value, driven by incentives linked to short-term performance metrics. Achieving organic growth typically requires time, such as building a new plant or expanding into a new market. In contrast, inorganic growth through mergers aligns more closely with management’s short-term incentives. Therefore, it is not surprising that management often chooses mergers as a strategy for company growth. This

situation resembles the classic *principal-agent problem*, where the management of the acquiring company acts as the agent, primarily motivated by their compensation.

Considering this perspective, it may be more beneficial to reduce the pressure on management and set more realistic goals rather than pursuing every potential transaction to fulfil short-term growth. As Donald Trump once stated, *"Sometimes your best investments are the ones you don't make."* Interpreted within this context, it means that while mergers can be useful for achieving short-term growth, academic research indicates that they often destroy long-term shareholder value.

APPENDICES

Appendix 1. Merger Paradox

In a market comprising of *n* identical Cournot competitors with each company facing a liner demand curve $P(Q) = a - bQ$ and all companies having identical (linear) total costs as $C(q_i) = c \cdot q_i$, each company would produce the same output given as:

$$q_i = \frac{(a-c)}{b(n+1)} \tag{A1.1}$$

with $Q = \sum_{i=1}^{n} q_i$ being total supply. The Cournot-Nash equilibrium implies that each of the *n* companies in the market earns a profit of:

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

When *m* companies decide to merge (*m*<*n*), the post-merger market would have *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 should be greater than the joint profit of not colluding insiders:

$$g(n,m) = \pi^{C}(n,m) - \pi^{NC}(n,m) = \frac{(a-c)^2}{b(n-m+2)^2} - m \cdot \frac{(a-c)^2}{b(n+1)^2} > 0 \tag{A1.3}$$

By substituting *m* with *m*=α*n*, with α being the market share of insiders (0<α<1), we can calculate the market share of insiders at which a merger does not produce neither gains not losses:

$$g(n,\alpha) = \frac{(a-c)^2}{b} \cdot \frac{(n+1)^2 - \alpha n \cdot (n-\alpha n+2)^2}{(n+1)^2 \cdot (n-\alpha n+2)^2} = 0 \tag{A1.4}$$

Equation (A1.4) is equal to 0 when the numerator of the second term is equal to 0, i.e.

$$(n+1)^2 - \alpha n \cdot (n-\alpha n+2)^2 = 0 \tag{A1.5}$$

By solving the equation:

$$\alpha_1 = \frac{1}{n};\ \alpha_2 = \frac{(2n+3)+\sqrt{4n+5}}{2n};\ \alpha = \frac{(2n+3)-\sqrt{4n+5}}{2n} \quad \text{(A1.6)}$$

This equation is cubic in α and has three solutions, but 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 $\alpha_2>1$ for any value of *n*, indicating an impossible insiders' market share exceeding 100%. Solution α_1 is also irrelevant, as it represents a scenario involving a merger of a single company.

Appendix 2. Merger Paradox in Stackelberg setting

There are n_L number of leades and $n_F = n - n_L$ number of followers in the Stackelberg model. The Stackelberg equilibrium implies that the quantities of leaders (q_L) and followers (q_F) are as follows:

$$q_L = \frac{a-c}{b(n_L+1)};\ q_F = \frac{a-c}{b(n_L+1)(n_F+1)} \quad \text{(A2.1)}$$

and the total quantity as:

$$Q = \frac{(n_L n_F + n_L + n_F)(a-c)}{b(n_L+1)(n_F+1)} \quad \text{(A2.2)}$$

Marginal revenue $(P-c)$, and thus the profits of leaders and followers, can be expressed as follows:

$$(p-c) = \frac{a-c}{(n_L+1)(n_F+1)}; \quad \text{(A2.3)}$$

$$\pi_L = \frac{(a-c)^2}{b(n_L+1)^2(n_F+1)};\ \pi_F = \frac{(a-c)^2}{b(n_L+1)^2(n_F+1)^2} \quad \text{(A2.4)}$$

If *m* leaders (followers) merge, joint profit of colluding insiders would be as follows:

$$\pi_L^C = \frac{(a-c)^2}{b(n_L-m+2)^2(n_F+1)};\ \pi_F^C = \frac{(a-c)^2}{b(n_L+1)^2(n_F-m+2)^2} \quad \text{(A2.5)}$$

To provide 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:

$$(n_L+1)^2 - \alpha n_L \cdot (n_L - \alpha n_L + 2)^2 > 0, \text{ for leaders, and} \quad \text{(A2.6)}$$

$$(n_F + 1)^2 - \alpha n_F \cdot (n_F - \alpha n_F + 2)^2 > 0, \text{ for followers} \quad \text{(A2.7)}$$

where α represents the market share of insiders leaders (followers). Comparing equations (A1.5), (A2.6) and (A2.7), 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:

$$m + 1 < n^* < m + \sqrt{m + 1} \quad \text{(A2.8)}$$

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

$$\frac{m + 1}{m + \sqrt{m + 1}} < \alpha < 1 \quad \text{(A2.9)}$$

Meaning 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 get that *m*=3 and the minimum profitable market share equal to 80%.

Appendix 3. 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 $d\epsilon(0,1)$ measures the degree of product differentiation, with *d*=0 indicating that goods are perfectly differentiated and *d*=1 indicating that goods are perfect substitutes. Since the focus here is on product differentiation rather than cost synergies, and for the sake of simplicity in calculations, it is assumed that costs are zero. Prior to the merger, each company makes output decisions based on profit maximisation: $\pi_i = p_i \cdot q_i$. Pre-merger equilibrium variables are:

$$q_i = \frac{1}{2 + d(n - 1)} \quad \text{(A3.1)}$$

$$p_i = \frac{1}{2 + d(n - 1)} \quad \text{(A3.2)}$$

$$\pi_i = \frac{1}{[2 + d(n - 1)]^2} \quad \text{(A3.3)}$$

Following a two-companies merger and assuming that both companies would retain their production plants, the merged entity's profit is: $\pi_I{}^M = p_1{}^M \cdot q_1{}^M + p_2{}^M \cdot q_2{}^M$.

Reaction functions of insiders and outsiders are as follows:

$$q_O^M = \frac{1 - 2dq_I^M}{2 + d(n-3)} \tag{A3.4}$$

$$q_I^M = \frac{1 - d(n-2)q_o^M}{2(1+d)} \tag{A3.5}$$

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

$$q_O^M = \frac{1}{(2 + dn - d - d^2)} \tag{A3.6}$$

$$q_I^M = \frac{2 - d}{2x(2 + dn - d - d^2)} \tag{A3.7}$$

$$p_O^M = \frac{1}{(2 + dn - d - d^2)} \tag{A3.8}$$

$$P_I^M = \frac{(1+d)(2-d)}{2x(2 + dn - d - d^2)} \tag{A3.9}$$

$$\pi_O^M = \frac{1}{(2 + dn - d - d^2)^2} \tag{A3.10}$$

$$\pi_I^M = \frac{(2 + d - d^2)(2-d)}{(2 + dn - d - d^2)^2} \tag{A3.11}$$

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

$$n = \frac{5d - 2 - b^2 + 2\sqrt{(d+1)(2-d)^2}}{d(3-d)} \tag{A3.12}$$

Appendix 4. 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. Demand function is $P = 1 - Q$, where $Q = \sum_{l=1}^{m} q_l + \sum_{f=1}^{n-m} q_f$. Costs are liner 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. Total output is $Q = \frac{n_l n - {n_l}^2 + n}{(n_l+1)(n-n_l+1)}$ and therefore the price is $p = \frac{1}{(n_l+1)(n-n_l+1)}$. 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. 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 $n_l < n$.

$$g = \pi_L^M - \pi_L - \pi_F \tag{A4.3}$$

$$g = \frac{1}{(n_l+1)^2(n-n_l)(n-n_l+1)^2} \tag{A4.4}$$

Appendix 5. Merger Paradox and Stackelberg leader

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 condition holds true if:

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

Appendix 6. Sample

No	Target	Buyer	Announcement date	Completion date
1	1st Bank	Yellowstone Bank	24/04/21	18/09/21
2	Altabancorp	Glacier Bancorp, Inc.	18/05/21	30/09/21
3	Bank of Commerce	Welch State Bank of Welch	24/10/21	31/12/21
4	Bank of Fincastle	First Bank	18/02/21	01/07/21
5	Bank of Louisiana	Peoples Bank & Trust Co.	08/03/21	11/12/21
6	Bank of Palmer	Union State Bank	22/09/21	01/12/21
7	Bank of Saint Elizabeth	Mid America Bank	27/10/21	31/12/21
8	Bank of Santa Clarita	Bank of Southern California	27/04/21	01/10/21
9	Cache Bank & Trust	Mountain Valley Bank	27/08/21	08/12/21
10	Community Bankers Trust Corporation	United Bankshares, Inc.	03/06/21	03/12/21
11	Eagle Community Bank	Falcon National Bank	30/04/21	30/04/21
12	EnerBank USA	Regions Bank	08/06/21	30/09/21
13	Farmers & Traders Savings Bank	Fidelity Bank & Trust	27/11/21	31/12/21
14	Farmers Security Bank	TruCommunity Bank	31/12/21	31/12/21
15	Farmers State Bank of Munith	The State Bank	22/06/21	01/12/21
16	First National Bank	Washington Savings Bank	18/02/21	20/08/21
17	First State Bank	Riverstone Bank	22/06/21	05/11/21
18	Hillsboro Bank	The Bank of Tampa	18/03/21	01/10/21
19	International City Bank	United Fidelity Bank, Fsb	30/11/21	30/11/21
20	Landmark Bancorp, Inc.	Fidelity D & D Bancorp, Inc.	26/02/21	01/07/21
21	Laurens State Bank	Community State Bank	18/05/21	09/07/21
22	LINKBANK	LINKBANK	18/09/21	18/09/21
23	Mainstreet Bank	Western National Bank	10/02/21	01/07/21
24	Mariner’s Bank	Spencer Savings Bank	16/07/21	18/11/21
25	Melvin Savings Bank	Iowa State Bank	30/04/21	30/06/21
26	Meridian Bancorp, Inc.	Independent Bank Corp.	22/04/21	12/11/21
27	Ohana Pacific Bank	CBB Bancorp, Inc.	28/01/21	01/07/21
28	Olpe State Bank	The Citizens State Bank	25/05/21	06/11/21
29	Rowley Savings Bank	BankIowa	14/07/21	04/12/21
30	Security State Bank, North Dakota	Unison Bank	27/01/21	21/05/21
31	State Bank of Arcadia	First National Bank and Trust Company	23/06/21	01/10/21
32	Stroud National Bank	First Bank & Trust Company	05/04/21	30/06/21
33	Texico State Bank	Legence Bank	15/10/21	04/12/21
34	TGR Financial, Inc.	First Foundation Inc.	03/06/21	17/12/21
35	The Citizens State Bank of Finley	Bravera Bank	03/03/21	13/11/21
36	TNB Bank	TrustBank	08/09/21	15/11/21
37	Tri-State Bank of Memphis	Liberty Bank and Trust Company	03/06/21	09/10/21
38	Two Rivers Bank	RVR Bank	08/09/21	08/12/21
39	Union State Bank of Browns Valley	Prairie Sun Bank	31/07/21	31/07/21
40	West Suburban Bancorp, Inc.	Old Second Bancorp, Inc.	26/07/21	01/12/21

Appendix 7. Overview of t-test output

ROAA

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
1	40	1.295	.0668379	.4227201	1.159808	1.430192
2	40	.953	.1084661	.6859999	.7336066	1.172393
Combined	80	1.124	.0661576	.5917312	.9923167	1.255683
diff		.342	.1274057		.0883548	.5956452

diff = mean(1) - mean(2) t = 2.6843
H0: diff = 0 Degrees of freedom = 78

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9956 Pr(|T| > |t|) = 0.0089 Pr(T > t) = 0.0044

ROAE

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
1	40	12.1855	.5914699	3.740784	10.98914	13.38186
2	40	10.19775	1.405509	8.889219	7.35484	13.04066
Combined	80	11.19162	.7658121	6.849632	9.667314	12.71594
diff		1.98775	1.524891		-1.048075	5.023575

diff = mean(1) - mean(2) t = 1.3035
H0: diff = 0 Degrees of freedom = 78

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9019 Pr(|T| > |t|) = 0.1962 Pr(T > t) = 0.0981

Net Interest Margin

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
1	40	3.80575	.1007732	.6373458	3.601917	4.009583
2	40	3.24075	.1440563	.9110923	2.949369	3.532131
Combined	80	3.52325	.0929476	.831349	3.338242	3.708258
diff		.565	.1758052		.2149987	.9150013

diff = mean(1) - mean(2) t = 3.2138
H0: diff = 0 Degrees of freedom = 78

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9990 Pr(|T| > |t|) = 0.0019 Pr(T > t) = 0.0010

Net Interest Income / Avg. Assets

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
1	33	3.595455	.1061277	.6096571	3.37928	3.81163
2	32	3.19125	.1089149	.6161156	2.969117	3.413383
Combined	65	3.396462	.0795354	.6412352	3.237571	3.555352
diff		.4042045	.1520458		.1003653	.7080438

diff = mean(1) - mean(2) t = 2.6584
H0: diff = 0 Degrees of freedom = 63

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9950 Pr(|T| > |t|) = 0.0099 Pr(T > t) = 0.0050

Efficiency ratio

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
1	40	60.641	1.237014	7.823565	58.1389	63.1431
2	40	64.28375	2.233356	14.12498	59.76636	68.80114
Combined	80	62.46237	1.284868	11.49221	59.90491	65.01984
diff		-3.64275	2.553054		-8.725489	1.439989

diff = mean(1) - mean(2) t = -1.4268
H0: diff = 0 Degrees of freedom = 78

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0788 Pr(|T| > |t|) = 0.1576 Pr(T > t) = 0.9212

Loan Loss Reserves / Gross Loans

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
1	40	1.141	.0670503	.4240634	1.005378	1.276622
2	40	1.18775	.0536196	.3391202	1.079294	1.296206
Combined	80	1.164375	.0427351	.3822347	1.079313	1.249437
diff		-.04675	.0858534		-.217671	.124171

diff = mean(1) - mean(2) t = -0.5445
H0: diff = 0 Degrees of freedom = 78

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.2938 Pr(|T| > |t|) = 0.5876 Pr(T > t) = 0.7062

NPLs / Gross Loans

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
1	33	1.179697	.3384978	1.944522	.4901995	1.869194
2	33	.5815152	.1145686	.6581466	.3481465	.8148838
Combined	66	.8806061	.1811401	1.471589	.5188443	1.242368
diff		.5981818	.3573608		-.1157285	1.312092

diff = mean(1) - mean(2) t = 1.6739
H0: diff = 0 Degrees of freedom = 64

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9505 Pr(|T| > |t|) = 0.0990 Pr(T > t) = 0.0495

Risk based capital ratio

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
1	33	15.62091	.7746686	4.450132	14.04296	17.19886
2	19	14.03	.6241003	2.72039	12.71881	15.34119
Combined	52	15.03962	.5483573	3.954261	13.93874	16.14049
diff		1.590909	1.127872		-.6744891	3.856307

diff = mean(1) - mean(2) t = 1.4105
H0: diff = 0 Degrees of freedom = 50

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9177 Pr(|T| > |t|) = 0.1646 Pr(T > t) = 0.0823

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