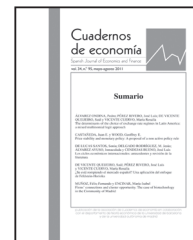




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ARTÍCULO

Mergers in financial services and overlending

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Abstract: In this paper we build a model of banking competition that considers a managerial-overconfidence setup resulting in two main findings. First, a merger between rational banks may change their behaviour in that, in post-merger conditions, they would follow the overconfident bank when they would not have done so pre-merger, thereby amplifying the credit boom. Second, the results overcome the merger paradox, in the sense that the merger would be profitable for participants and thus intrinsically stable.

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Resumen: Se propone un modelo de competencia bancaria que incluye un sesgo de exceso de confianza por parte de algunos gestores. Dos son los principales resultados que se derivan del modelo. Primero, una fusión entre bancos racionales puede cambiar su comportamiento de manera que, tras la fusión, seguirían al banco sesgado en condiciones en las que no lo habrían hecho antes de la fusión, ampliando el volumen de crédito concedido por el mercado bancario. Segundo, los resultados obtenidos resuelven la paradoja de las fusiones, en el sentido de que la fusión sería rentable para los participantes y, por tanto, intrínsecamente estable.

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1. Introducción

Mergers and acquisitions (M&A) are corporate transactions of increasing importance, with the number and value of large capitalization and cross-border operations surging in the last three decades, linked to the growth of financial markets. Indeed, these transactions have become a common feature of many industries, but especially of the financial sector. Recently, after the worldwide financial crisis, and despite the evidence against the too-big-to-fail paradigm, many countries encouraged bank M&A as a solution against financial instability. Reasons alleged are a higher capital solvency if weaker banks are taken over and financially strengthened (Hagendorff and Nieto, 2013), risk diversification (Vallascas and Hagendorff, 2011), a response to reduced margin profits due to information technology and disintermediation (Ekkayokkaya et al., 2009), and a higher efficiency that helps improving financial conditions in distressed economies (Gori, 2016).

However, an argument against these banking consolidation processes that reduce the number of competitors is that the resulting market configuration might, in fact, foster the factors that were behind the recent financial crisis. A growing number of articles have recently provided an intuitive interpretation of how credit booms are fuelled by the banking sector, based on excessive optimism and managerial overconfidence (e.g., Rötheli, 2012a,b; Boz and Mendoza, 2014; Peón et al., 2015a,b). Behavioural traits would be sufficient to explain how credit booms are generated, even in the absence of other plausible explanations such as incentives (Fahlenbrach and Stulz, 2011), securitization (Keys et al., 2010) or risk-taking moral hazard by banks (Acharya and Naqvi, 2012). Behavioural models that consider managerial miscalibration show that when rational banks compete with boundedly rational banks, there is a rationale for rational banks to herd, fostering a credit boom of a larger magnitude. We follow the same rationale based on behavioural finance to contribute with a novel interpretation, aimed at filling a gap to this literature regarding the effects that mergers might have on either moderating or amplifying the credit boom.

Our model sets banks as Cournot competitors having access to cost asymmetries that allow insiders to benefit from a merger. By considering the effects of behavioural traits such as excessive optimism and overconfidence, two are our main results. First, merged rational banks change their behaviour post-merger. We characterize the market conditions where the rational banks now would follow the biased ones in conditions they did not pre-merger. Second, our results resolve the merger paradox as long as we assume that the merger improves bank efficiency. Insiders make a profitable merger in some conditions we define, while outsiders lose (particularly for higher costs).

This way, the article contributes to the literature in two instances. On one hand, it shows that mergers can amplify the scope of behavioural biases and induce additional market inefficiencies; on the other, it contributes to the literature on mergers that follows the classic article by Salant et al. (1983), in the sense that none of the articles that followed have considered how mergers could induce a qualitative change in firms' behaviour. The lessons to be learned

are twofold. First, these mergers are stable (from the point of view of the industry), but lead to a credit boom (which is informationally inefficient). Thus, even if a banking consolidation is beneficial for insiders, it might be a bad strategy in terms of developing a more efficient industry. Second, the results might also be interpreted in terms of the literature on M&As and CEO overconfidence: while the classic result observes biased managers overpaying for target companies and undertaking value-destroying mergers (Malmendier and Tate, 2008), our model suggests that, while bank mergers may be profitable for rational managers competing against overconfident ones, they merely contribute to greater herd behaviour in credit markets.

The structure of the article is as follows. In Section 2 we review the state of arts. In Section 3 the basic model is outlined, and the equilibria are characterized. Section 4 is devoted to analyse the effects of a merger between the rational banks in the industry. Some final remarks are offered in Section 5. The proofs of the propositions are provided in the Appendix.

2. State of the arts

2.1 Waves of M&A in the financial sector

Companies can grow internally, by developing capacity and expanding operations, or can seek to collaborate with other firms. In many instances, the latter involves either merging the assets of a allied firms, or the takeover of one company by another. M&A have become increasingly frequent in most economic sectors in the last three decades. According to the IMAA Institute, in 2015 companies worldwide announced over 47,000 transactions with a total value of more than 4.5 trillion USD (IMAA, 2017). In the eighties, M&A operations were less than 10,000 and their value amounted, yet by mid-1990s, less than 1 trillion USD. Cross-border acquisitions in particular have become increasingly important, peaking at 7,000 transactions in 2007 (2,000 transactions in 1990 and 5,400 in 2012), going from a value of 99 billion USD in 1990 and 1 trillion USD in 2007 (UNCTAD, 2013a,b). For foreign direct investment operations, firms tend to prefer buying an existing company to making a greenfield investment (Contractor et al., 2014).

Financials is the sector with the largest share of M&A worldwide since 1985 in terms of value (16.3%), and the third in number of transactions, more than 111,000 transactions valued at 10,800 billion USD (IMAA, 2017). Figure 1 shows that banking M&As peaked in terms of value in 1999 (the dot-com bubble) and again in year 2007 (just before the worldwide financial crisis). Despite the collapse in market values of financial firms after the crisis, mergers and acquisitions in the financial sector have not become less frequent in recent years; on the contrary, more than 1,200 transactions are performed annually.

Many M&As in the financial sector – whether voluntary or imposed by public sector intervention – took place in the Eurozone after the financial meltdown. Indeed, large banking consolidation processes were encouraged by authorities as a solution to the banking crisis. This was the case of Spain – one of the EU countries where the public debt and banking crises hit hardest. According to the IMF (2012), by

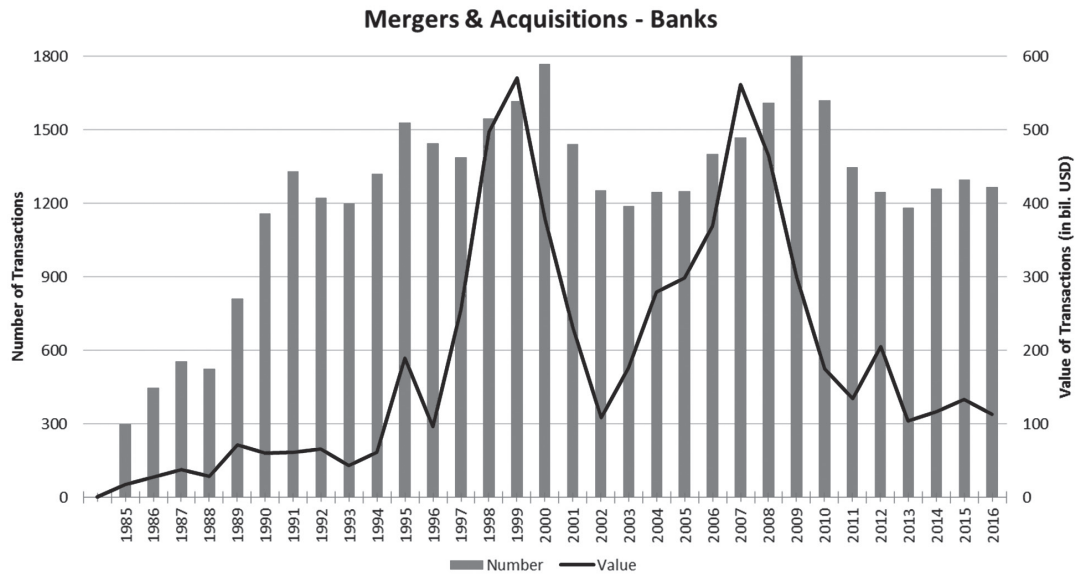


FIGURE 1. M&As in the banking sector worldwide. Number of transactions and value (in billion USD) worldwide, 1985-2016. Source: IMAA (2017)

2011 the industry was dominated by just ten banks, holding most (79.2%)¹ of the sector's assets. This concentration was the result of mergers and acquisitions of about 50 banks that existed before 2009. Some of them remain intervened or part of the institutional protection scheme to date.

Despite the significant number of M&As in the financial sector and the rationale behind such banking consolidation processes, empirical outcomes are not always favourable (e.g., Vallascas and Hagendorff, 2011). Below we review two criticisms in particular. One is the classical theoretical argument against merger incentives and stability, while the other is that banking consolidation processes may be questionable if market outcomes are sensitive to the behavioural traits of managers.

2.2 Rationale for mergers and the merger paradox

In the analysis of M&A, a merged entity is treated as a collection of firms under the control of a single decision-maker in a non-cooperative game. In this configuration, for firms having constant marginal costs in producing an identical good and facing linear demand, a merger paradox arises: there are no incentives for a profitable merger unless the number of merged firms is sufficiently high (Salant et al., 1983). Since the reduced number of competitors after a merger entails output expansion by outsiders, if the proportion of outsiders is large enough, two key results follow: (i) mergers are rarely profitable for insiders, and (ii) outsiders benefit more than the merged companies (Gelves, 2014).

The first component of the paradox goes against the empirical evidence, which shows that mergers are profitable more often than what theoretical models suggest (Atallah, 2015). The mechanisms through which firms may evade the merger

paradox were addressed early in the literature and are not the purpose of this article. However, we mention some of these mechanisms briefly to show that the assumption, key to our model, that merged firms have access to cost cuts, is backed by the theoretical and empirical literature. Perry and Porter (1985) solve the paradox with the simple modification of introducing convex costs. Heywood and McGinty (2007) show, in addition, that “for reasonable degrees of convexity, the minimum market share needed for merger to be profitable remains close to that associated with linear costs” (p.342). Other approaches are based on product differentiation with Bertrand competition (Deneckere and Davidson, 1985), other forms of non-Cournot behaviour (Kwoka, 1989), capacity constraints (Baik, 1995), different properties of the demand function (Faulí-Oller, 1997; Hennessy, 2000), dynamic Cournot competition (Dockner and Gaunersdorfer, 2001), the introduction of delegation through agency contracts (Ziss, 2001) and cost asymmetries between firms (Faulí-Oller, 2002).

These models show that mergers can be profitable, but the second aspect of the paradox, namely, the inherent instability of mergers, is yet to be addressed. If non-merged firms benefit more from the merger than the merged firms, a free-rider problem results, as firms have the incentive to wait for other companies to merge. Recent literature combines different assumptions to provide an answer to both components of the paradox, for instance, Stackelberg competition and convex costs (Heywood and McGinty, 2008), Stackelberg competition and cost asymmetries (Gelves, 2010), and cost asymmetries and product differentiation (Gelves, 2014). Our model follows the assumption of cost asymmetries – after the merged firms have access to cost cuts – but uses the literature on managerial overconfidence as a conceptual framework. The plausibility of these assumptions is discussed below: the literature on overconfidence in the next section, and immediately below, the empirical evidence regarding whether mergers reduce costs, particularly in the financial sector.

¹ The proportion would be even closer to 100% if we included the assets held abroad by Banco Santander and BBVA, larger, in both cases, than the domestic asset holdings.

Three sources for mergers to improve firms' efficiency are economies of scale (via cost-saving technologies or fixed costs spread over a larger base), economies of scope (via entry to new markets and sales to a wider customer base) and improved managerial efficiency (Amel et al., 2004). Harrison (2011), for instance, finds that costs savings from hospital mergers come from economies of scale, and cites positive evidence for other industries (e.g., Pesendorfer, 2003, regarding the paper industry). For the banking sector in particular, several authors have observed value-added mergers, but the evidence is not conclusive as to the source of merger gains. Thus, early results indicate that the bulk of the revaluation might be attributed to projected cost savings (Houston et al., 2001), while the literature review by Berger et al. (1999) suggests that gains come from profit efficiency rather than cost reduction. Amel et al. (2004) find positive cost efficiency results for domestic mergers among banks of equal size, and for the target company in cross-border acquisitions. Cummins et al (2010) identify cost scope economies in the US insurance industry. Banerjee (2017) observes that the policies that favour bank mergers assume enhanced efficiency through economies of both scale and scope – despite the author finds evidence against this assumption.

2.3 Literature on behavioural finance

A key aspect that makes our research a novelty within the literature on mergers that follows on from Salant et al. (1983)'s seminal paper is that previous research has not considered a possible change in behaviour by merged firms. Here we use the literature on behavioural finance as a conceptual framework, in particular, that referring to managerial excessive optimism or overconfidence. Two close behavioural biases that are sometimes confounded, over-optimists are people who underestimate the likelihood of bad outcomes over which they have no control (Kahneman and Riepe, 1998) while overconfidence can manifest at least in three instances (Moore and Healy, 2008): in estimating our own performance, our relative performance compared to others, and an excessive precision in estimating future uncertainty. Here we interpret overconfidence as an overestimation of probabilities of managerial success.

Analyses of the effects on firms' outcomes of decisions by excessively optimistic and overconfident CEOs are a recurrent topic in the literature of behavioural corporate finance (for a review, see Malmendier and Tate, 2015). Examples of effects and outcomes include high rates of business failure (Camerer and Lovo, 1999), share repurchases (Shu et al., 2013) and IPOs (Boulton and Campbell, 2016); biased investment decisions (Malmendier and Tate, 2005a,b) and sensitivity of investment to cash flow (Mohamed et al., 2014); lower dividend payouts (Deshmukh et al., 2013), higher cash holdings (Huang-Meier et al., 2016), and effects on inventory decisions (Lu et al., 2015); earnings smoothing (Bouwman, 2014) and less conservative accounting (Ahmed and Duellman, 2013).

Especially relevant for the purposes of this paper is the evidence of overconfidence effects in two instances. First, on the high rates of unprofitable corporate takeovers observed, a literature that starts with Roll (1986) and which has a high point in the analysis by Malmendier and Tate (2008), and

second, on credit booms fuelled by the banking sector, as explained by a recent series of theoretical models. Peón et al. (2015a) show that bank competition between rational and overconfident managers may aggravate credit booms, as the latter always follow their priors whereas there is a rationale for rational banks to herd. Other recent studies include that by Rötheli (2012a,b), who shows that the presence of even a minority of boundedly rational banks is enough to aggravate the credit cycle, and Boz and Mendoza (2014), who model how overconfidence and financial innovation might amplify the credit cycle.

3. The model

Following our review in Section 2, in order to analyse the effects of excessive optimism by banks involved in M&A activities, we make three key assumptions in our model. First, we use Cournot competition as to better describe banking competition. While intense price competition tends to generate equilibrium where firms do not cover their total costs, competing in quantities often leads to equilibrium where banks obtain profits that exceed those under perfect competition. Second, we consider cost reductions resulting from mergers that allow the merged firms to benefit from the merger. For the sake of simplicity, cost reduction will be modelled as a cost parameter reducing from $2c$ to c after the merger. Finally, we consider how behavioural traits such as managerial overconfidence for some banks in the industry might modify the behaviour of rational competitors when the latter merge.

Let us assume that the economy consists of the banking sector, savers and potential borrowers. Banks may be either rational or biased in terms of excessive optimism and being overconfident in their ability to get their credit loans repaid. There are no information asymmetries and no agency problems between shareholders and managers. Banks' only business is taking deposits and granting loans. For tractability purposes, we also assume the following: (i) deposits can only be invested in loans, i.e., there is no interbank market or, if there is, interest rates are zero; (ii) deposits are held until maturity (banks face no liquidity restrictions, so no fraction of the deposits is held as liquid reserves, $R=0$); (iii) the Central Bank requires no reserves; and (iv) bankruptcy effects are not considered. Banks receive deposits from savers, whose investment alternatives pay a zero-competitive rate of return, hence the interest paid on deposits equals $r_d=0$. There is an unlimited source of deposits available, hence we assume that n banks take the rate r_d as given and set a volume of deposits D^i , $i=1,\dots,n$, equal to the volume of granted loans, as to finance them. Banks are risk-neutral and compete in Cournot fashion by setting, independently and simultaneously, the volume of loans. The banks' cost function, $C(L)$, where L stands for loans, is linear and defined as $C(L)=2cL$, $c>0$, given that the banks set a volume of loans equal to the volume of deposits.

Peón et al. (2015a) show that all borrower markets are separable when banks have linear costs. Thus, we may model this market as having only one type of borrower, associated with a repayment probability θ , $0 < \theta < 1$, while when the borrower defaults the bank gets zero. Banks face a downward sloping linear demand function for loans, $L(r)=\alpha-r$,

with $\alpha > 0$ and $r > r_c$. Key to our model is the assumption of rational and optimistic banks in terms of probability θ . Formally,

Assumption 1. The repayment probability is such that $1 > \theta_o > \theta > 0$, where subscript O denotes overconfidence.

That is, rational banks estimate the true repayment probability, whereas an overconfident bank estimates a lower probability of default. Assumption 1 sets the overestimation repayment probabilities as the main driver of the model.

Assumption 2. Parameters α and c are such that $\theta > \frac{1+3c}{1+\alpha}$.

Assumption 2 imposes a restriction on the demand size for loans. It states that the size of the market needs to be sufficiently large to guarantee that interest rates are well defined in all the equilibria analysed in the article, meaning they are neither negative nor they exceed the maximum possible value α in the equilibrium.

In this setup, we model this market following the Monti-Klein approach of an oligopoly, where the banks' decision variables are the volume of loans, L . Each bank i analyses borrower quality and decides how much credit to grant by solving

$$\max_{(L^i)} E\Pi^i = \left[\theta_\phi r(L^i, L^j) - (1 - \theta_\phi) \right] L^i - rD^i - 2cL^i \Bigg\}, \quad (1)$$

$$s.t.: L^i = D^i$$

where $i, j = 1, \dots, n$; $i \neq j$, and $\theta_\phi \in \{\theta, \theta_o\}$ depending on whether the bank i is rational or overconfident.

3.1 Benchmark case

In what follows we consider a three-bank oligopoly. We can expect a rational market configured by all banks being rational, a so-called biased market where all banks are overconfident, or two asymmetric markets consisting of either one or two biased banks. The asymmetric and biased markets lead to credit booms, as the credit granted to borrowers would exceed the total credit granted if all market participants were rational.

The case that is interesting to analyse, as we will see below, is to see what happens if two rational banks, competing against a biased competitor, decide to merge. Thus, let us assume that banks A and B are rational, in the sense that they estimate the true probability of borrower default, $1 - \theta$, and they compete against a biased bank C, which underestimates such probability of default to observe $1 - \theta_o$. Now, assume rational banks play strategically². Let $\theta_o^{Th1} = \frac{5\theta(1+2c)}{7(1+2c) - 2\theta(\alpha+1)}$ be the threshold level for θ_o above which a rational bank herds

while its rational counterpart stays rational. In turn, let

$$\theta_o^{Th2} = \frac{7\theta(1+2c)}{9(1+2c) - 2\theta(1+\alpha)}$$

be the threshold level for θ_o below which a rational bank follows its rational counterpart when this herds. It is satisfied that $\theta_o^{Th1} > \theta_o^{Th2}$, while any monopoly or duopoly markets that might appear would require a biased estimation θ_o above θ_o^{Th1} . The following proposition summarizes the possible equilibria.

Proposition 1. In a three-bank industry with at least one bank overoptimistic regarding loan default by borrowers, one of two possible market configurations can emerge:

- (i) If the biased estimation θ_o by the over-optimistic bank is not too high, because $\theta_o < \theta_o^{Th1}$, none of the rational banks would herd to follow the biased bank.
- (ii) If the biased estimation is high enough, because $\theta_o > \theta_o^{Th1}$, one of the rational banks, but not both, would herd to follow the biased bank (that is, bank A plays biasedly and bank B plays rationally, or vice versa).

Proof. See the Appendix.

In other words, if the bias of the overconfident bank C is such that θ_o is above θ_o^{Th1} , the rational banks A and B have an incentive to play differently from their rational counterpart. Thus, equilibrium holds where one, but not both, would play biasedly and follow bank C. Otherwise, both banks will play rationally. We may describe this in two steps. First, if the bias of the overconfident bank C is intermediate – that is, θ_o lies in the range between θ_o^{Th2} and θ_o^{Th1} – then both banks A and B will play rationally. This is because if a rational competitor chooses to herd, its counterpart – for θ_o above θ_o^{Th2} – will choose to stay rational; but if the latter chooses to play rationally, then the first bank will play rational, too. Second, below θ_o^{Th2} we have a scenario where rational banks A and B would choose to play identically, that is, to stay rational if the other rational bank stays rational, or to herd if the other rational bank herds. It is easy to show that both rational banks will prefer a rational-rational over a herd-herd result; hence, below θ_o^{Th2} we will always have a true-nature scenario where all banks follow their priors.

3.2 Merger effects

Let us now assume that rational banks A and B merge to become bank M, and that this resulting rational bank competes with biased bank C. We only analyse rational banks merging as this is the interesting case for two reasons. First, considering a merger between a rational and an overconfident bank would require to imposing an additional assumption: is the merged bank run by rational or overconfident managers? Second, if the assumption is that it is run by rational managers, our model would offer none insights, as both competitors would now be rational: the absence of behavioural biases would lead to a known result, where levels of credit granted to borrowers would be informationally efficient. Contrariwise, if we assume the merged bank

² Peón et al. (2015a) show biased banks will always follow their true nature, so we focus on the strategic behaviour of rational banks.

is run by overconfident managers, we end up in the same case as the one we analyse here – a three-bank oligopoly with two rational banks that evolves into a duopoly with one rational and one biased bank – and with similar results.

Now, the fact that bank M is larger and operates with lower costs gives it a larger share of the market and enables it to offer higher volumes of credit. Banks M and C simultaneously solve

$$\max_{(L^M)} \text{E}\Pi^M = \left[\theta_\phi r(L^M, L^C) - (1 - \theta_\phi) \right] L^M - cL^M \quad (2a)$$

and

$$\max_{(L^C)} \text{E}\Pi^C = \left[\theta_\phi r(L^M, L^C) - (1 - \theta_\phi) \right] L^C - 2cL^C \quad (2b)$$

where $\theta_\phi \in \{\theta, \theta_o\}$, depending on whether banks M and C play rationally or biasedly. In order to make the assumptions of the model more plausible, the effects of such cost reduction on the equilibria in our model is limited by imposing a non-monopoly condition (Assumption 2) that ensures that the merger of the rational participants does not expel the biased competitor.

In these circumstances, we can identify a herding threshold

$$\theta_o^h = \frac{(3 + 4c)\theta}{4(1 + c) - (1 + \alpha)\theta} \quad \text{such that whenever } \theta_o < \theta_o^h$$

the rational bank M herds to grant more credit than it would grant if there were no biased competitors. Since the herding threshold is always above θ_o^{Th2} – as we prove in the Appendix – the following proposition holds.

Proposition 2. *In a three-bank industry with one bank overoptimistic regarding loan default by borrowers, a merge between the unbiased banks leads the merged bank to herd the biased bank more likely than the unmerged banks would herd before the merge.*

Proof. See the Appendix.

Thus, we have delimited a scenario, for biased probabilities by bank C below the herding threshold θ_o^h , where banks A and B did not herd before the merge, but would change their behaviour if they merge, to follow the biased bank. Mergers always change agents' behaviour since they change the output volumes they offer in equilibrium. However, the novelty in our setup is that the merger would lead to a qualitative change in behaviour, where the rational agents might choose to herd their biased competitor when they would not have done otherwise.

Finally, regarding market incentives and the merger paradox, we need to observe whether this merger could be profitable and stable – the latter in the sense of whether the non-merged firms are able to benefit more from the merger than the merged entities themselves. In this setup, the following result holds.

Proposition 3. *In a three-bank industry with one of them being over-optimistic, a cost-saving merger between the rational banks is likely to be:*

(i) *more profitable for the merged banks in inefficient industries and the lower the probability of default by credit borrowers.*

(ii) *more stable in inefficient industries, and the greater the overoptimism of the biased bank – but provided this bias is small enough to induce herd behaviour by the merged banks, that is, whenever $\theta_o < \theta_o^h$.*

Proof. See the Appendix.

The figures A2 and A3 in the Appendix characterize these regions. On one hand, the post-merger outcome for the merged banks (bank M) is higher profits (i) the higher the cost parameter c , which in our model it also implies a measure of the cost-saving effects, (ii) the higher the probability of repayment, θ , and (iii) the lower the bias of bank C, given by a lower θ_o . As for bank C, the increase in profits will be lower than their competitors after the merger in less cost-efficient industries (higher costs, c) and the higher its bias (θ_o).

An important feature is that the limits of arbitrage (Shleifer and Vishny, 1997) for the banking sector to correct the misallocations of biased and herding banks are implicit in the profit-maximizing behaviour of rational participants. Following Shleifer (2000), the behavioural approach to test the informational efficiency of markets involves three consecutive steps. First, observing whether market participants are rational. Second, if some participants are boundedly rational, identifying whether their strategies are correlated. Third, if herding is observed, how do inefficiencies survive to price corrections by rational arbitrageurs? In our model, some banks are assumed to be overconfident, and we provide the conditions for rational banks to herd with their biased competitors. Now, the limits of arbitrage that allow price inefficiencies to survive are implicit: rational banks will not have economic incentives to hedge credit markets and correct the misallocations of the biased banks. Indeed, for such purpose, rational banks should either reduce credit and lose market share, or pay a higher rate on deposits – forcing their competitors to do the same – which is neither a profitable strategy for the rational bank. Thus, the only presence of a biased bank is a sufficient condition for excess credit to be generated.

4. Conclusions

Some mergers between banks may lead to over-lending when rational participants compete with biased managers in terms of over-optimistic estimates of borrower default probabilities. Our results introduce two novelties. On the one hand, we observe how rational managers may change their behaviour after merger if they are competing against an overconfident bank, and herd to follow their biased competitor when they would not have done before the merger. On the other hand, in some circumstances this scenario may lead to stable mergers where the outsider is worse off.

The limitations of the model are relevant and lie mainly in its simplicity and the restrictive conditions considered. First, this is a three-bank model where herding that occurs after the merger relies on the elimination of rational competitors. Second, we use a simplified industry structure with assumptions such as no other bank activities except

taking deposits and granting loans, the absence of an interbank market, and that we consider neither liquidity restrictions nor bankruptcy effects. This allows us to focus on the effects of biased competition among banks, but the analysis of more complex industries can offer more insights. Finally, the modelling of overconfidence as only affecting the probability of repayment of loans, and of the cost function reducing costs to a half after the merger, were both considered for tractability purposes. Future developments might improve the plausibility of the model by considering multiple banks, introducing an interbank market, or assuming more complex effects of merging on cost efficiency.

Despite these limitations, the model results suggest some implications in terms of regulation. The introduction of behavioural biases in analyses of bank mergers that lead to fewer rational banks competing in an industry suggests that herd behaviour that leads to overlending would be more frequent. The underlying intuition is that when overoptimistic banks compete in an industry, rational banks must decide whether to follow either the biased banks or their rational counterparts. When competing with unbiased banks, a rational bank is more likely to grant credit to borrowers following its own priors – but might change its behaviour if a rational competitor is eliminated through a merger or acquisition. Thus, the model offers a rationale that favours regulation against excessive bank concentration: even if – undoing the merger paradox – a merger leads to greater cost efficiency, a larger market share and greater profits by insiders, the results are informationally inefficient. This happens because the merger would foster a greater credit boom than if there were more rational competitors in the sector that did not herd. This has implications in terms of macroprudential regulation to mitigate the systemic risk of the banking system. In particular, the procyclicality of credit risk might be more severe under conditions like bounded rationality and banking concentration depicted in our model.

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Appendix

PROOF OF PROPOSITION 1

Industry before merger. We first calculate the volumes of loans granted in the possible market configurations and the corresponding rates that clear the market. Each bank $i, j = A, B, C; j \neq i$, simultaneously solves the Cournot problem defined by

$$\max_{(L^i)} E\Pi^i = \left[\theta_\varphi r(L^i, L^j) - (1 - \theta_\varphi) \right] L^i - r_d D^i - 2cL^i \left\{ \begin{array}{l} \\ \text{s.t.: } L^i = D^i \end{array} \right. \quad (\text{A1})$$

where $\theta_\varphi \in \{\theta, \theta_o\}$ depending on whether bank i is rational or biased, and where the demand for credit is $L(r) = \alpha - r$. Given $r_d = 0$, we may insert $r(L) = \alpha - \Sigma L^i$ in (A1), to obtain the generic expressions

$$\max_{(L^i)} E\Pi^i = \left[\theta \left[(\alpha + 1) - (L^i + \Sigma L^{j*}) \right] - (1 + 2c) \right] L^i \quad (\text{A1a})$$

$$\max_{(L^i)} E\Pi^i = \left[\theta_o \left[(\alpha + 1) - (L^i + \Sigma L^{j*}) \right] - (1 + 2c) \right] L^i \quad (\text{A1b})$$

when a bank is rational or overconfident, respectively.

Market outcomes will depend on the alternative rational/biased configurations:

(i) All banks rational. Loan volumes and interest rate will be defined as

$$L^A = L^B = L^C = \frac{(1 + \alpha)\theta - (1 + 2c)}{4\theta} \quad (\text{A2})$$

$$r = \frac{(\alpha - 3)\theta + 3(1 + 2c)}{4\theta} \quad (\text{A3})$$

(ii) Two banks rational, one biased. Loan volumes and interest rate will be defined as

$$L^A = L^B = \frac{(1 + \alpha)\theta\theta_o + (1 + 2c)\theta - 2(1 + 2c)\theta_o}{4\theta\theta_o} \quad (\text{A4})$$

$$L^C = \frac{(1 + \alpha)\theta\theta_o + 2(1 + 2c)\theta_o - 3(1 + 2c)\theta}{4\theta\theta_o} \quad (\text{A5})$$

$$r = \frac{\left[(\alpha - 3)\theta + 2(1 + 2c) \right] \theta_o + (1 + 2c)\theta}{4\theta\theta_o} \quad (\text{A6})$$

This market configuration results in a monopoly if $L^A = L^B = 0$, which yields the monopoly condition:

$$\theta_o^M \geq \frac{(1 + 2c)\theta}{2(1 + 2c) - (1 + \alpha)\theta} \quad (\text{A7})$$

(iii) One bank rational, two biased. Loan volumes and interest rate will be defined as

$$L^A = \frac{(1 + \alpha)\theta\theta_o - (1 + 2c)(3\theta_o - 2\theta)}{4\theta\theta_o} \quad (\text{A8})$$

$$L^B = L^C = \frac{(1 + \alpha)\theta\theta_o + (1 + 2c)(\theta_o - 2\theta)}{4\theta\theta_o} \quad (\text{A9})$$

$$r = \frac{1}{4} \left(\alpha - 3 + \frac{1 + 2c}{\theta} + \frac{2(1 + 2c)}{\theta_o} \right) \quad (\text{A10})$$

This market configuration results in a duopoly by the biased banks if $L^A = 0$, which yields the duopoly condition:

$$\theta_o^D \geq \frac{2(1 + 2c)\theta}{3(1 + 2c) - (1 + \alpha)\theta} \quad (\text{A11})$$

It is easy to show that $\theta_o^M \geq \theta_o^D$, provided $\theta > \frac{1 + 2c}{1 + \alpha}$, which is ensured by Assumption 2.

(iv) All banks biased. Loan volumes and interest rate will be defined as

$$L^A = L^B = L^C = \frac{(1 + \alpha)\theta_o - (1 + 2c)}{4\theta_o} \quad (\text{A12})$$

$$r = \frac{(\alpha - 3)\theta_o + 3(1 + 2c)}{4\theta_o} \quad (\text{A13})$$

Strategic behaviour. Consider an industry where banks A and B are unbiased, in the sense that they observe the borrowers' true repayment probability, θ , while bank C is biased in the sense that it overestimates such probability to θ_o . Rational banks would consider whether to herd with their biased competitor if the expected profits of the herding strategy exceed those of playing rationally. Peón et al. (2015a) show that biased banks will always follow their true nature, so we focus only on the strategic behaviour of the rational banks.

Case 1 - all rational banks follow their true nature

Following expressions (A4), (A5) and (A6), the expected profits of the rational and biased banks will be given by the expressions

$$E\Pi_{RT} = \frac{\left((1 + 2c)\theta + \left((1 + \alpha)\theta - 2(1 + 2c) \right) \theta_o \right)^2}{16\theta\theta_o^2} \quad (\text{A14})$$

$$E\Pi_{OT} = \frac{\left(\left((1+\alpha)\theta + (1+2c)\right)\theta_o - 3\theta(1+2c)\right)^2}{16\theta^2\theta_o} \quad (A15)$$

where subscripts R and O mean rational and overconfident, respectively, and subscript T means ‘true nature’.

Case 2 - one rational bank herds

If one of the rational banks decides to herd, while the other continues to act according to its true nature, the credit volumes and interest rates will be given by expressions (A8), (A9) and (A10). However, the expected profits the herder can anticipate will depend on the borrowers’ repayment probability, which is the unbiased estimation θ . Thus, the expected profits of the rational, disguised (herder) and biased banks will be given by the expressions

$$E\Pi_{RhT} = \frac{\left(2\theta(1+2c) + \left((1+\alpha)\theta - 3(1+2c)\right)\theta_o\right)^2}{16\theta\theta_o^2} \quad (A16)$$

$$E\Pi_{RhD} = \frac{\left(2\theta(1+2c) + \left((1+\alpha)\theta - 3(1+2c)\right)\theta_o\right)\left(\left(1+2c + (1+\alpha)\theta\right)\theta_o - 2\theta(1+2c)\right)}{16\theta\theta_o^2} \quad (A17)$$

$$E\Pi_{Oh} = \frac{\left(\left(1+2c + (1+\alpha)\theta\right)\theta_o - 2\theta(1+2c)\right)^2}{16\theta^2\theta_o} \quad (A18)$$

where subscript h means ‘one bank herding’ scenario, and subscripts T and D mean ‘true nature’ and ‘disguised’.

Case 3 - both rational banks herd

If both the rational banks herd, the credit volumes and interest rates will be given by expressions (A12) and (A13), although the expected profits the herders can anticipate are estimated using the borrowers’ true repayment probability, θ . Thus, the expected profits of the disguised and the biased banks will be given by the expressions

$$E\Pi_{RH} = \frac{\left((1+\alpha)\theta_o - (1+2c)\right)\left(3\theta(1+2c) + \left((1+\alpha)\theta - 4(1+2c)\right)\theta_o\right)}{16\theta_o^2} \quad (A19)$$

$$E\Pi_{OH} = \frac{\left((1+2c) - (1+\alpha)\theta_o\right)^2}{16\theta_o} \quad (A20)$$

where subscript H means ‘both banks herd’ scenario.

Under this setup, the equilibrium market for banks A and B playing strategically depends on the payoff functions given by

		RATIONAL BANK B	
		R	OC
RATIONAL BANK A	R	[(A14), (A14)]	[(A16), (A17)]
	OC	[(A17), (A16)]	[(A19), (A19)]

Consider bank A’s behaviour:

a) If bank B stays rational

We compare (A14) and (A17), $(A14) - (A17) = \frac{(1+2c)(\theta - \theta_o)\left[5\theta(1+2c) + (2\theta(1+\alpha) - 7(1+2c))\theta_o\right]}{16\theta\theta_o^2}$, which is

positive if

$$\left[5\theta(1+2c) + (2\theta(1+\alpha) - 7(1+2c))\theta_o \right] < 0.$$
 Thus, we obtain the threshold

$$\theta_o^{Th1} = \frac{5\theta(1+2c)}{7(1+2c) - 2\theta(\alpha+1)}, \quad (A21)$$

such that – with bank B playing rationally – if bank C is not overly biased (that is, if $\theta_o < \theta_o^{Th1}$), bank A will choose to stay rational; however, if bank C is overly biased, then bank A will choose to herd.

b) If bank B herds

We compare (A16) and (A19),

$$(A16) - (A19) = \frac{(1+2c)(\theta - \theta_o)(7\theta(1+2c) + (2\theta(1+\alpha) - 9(1+2c))\theta_o)}{16\theta_o^2}$$

which is positive if

$$(7\theta(1+2c) + (2\theta(1+\alpha) - 9(1+2c))\theta_o) < 0.$$
 Thus,

we obtain the threshold

$$\theta_o^{Th2} = \frac{7\theta(1+2c)}{9(1+2c) - 2\theta(1+\alpha)} \quad (A22)$$

such that if bank B herds, then bank A will play rationally if bank C is overly biased (that is, if $\theta_o > \theta_o^{Th2}$) or will herd with both A and C if bank C is not overly biased.

By doing (A21)-(A22) it is easy to prove that $\theta_o^{Th1} > \theta_o^{Th2}$ provided $\theta > \frac{1+2c}{1+\alpha}$ – ensured by Assumption 2. It is also

easy to see that this same condition ensures that the edge markets – either a natural monopoly by the biased bank C, or a duopoly by bank C and a disguised rational bank that herds – occur at higher levels than threshold θ_o^{Th1} .

Bank B would consider identical alternatives, so we have the scenarios analysed in Section 3. Above θ_o^{Th1} one of the rational banks would herd, while between θ_o^{Th1} and θ_o^{Th2} both would remain playing rationally. The scenario below θ_o^{Th2} may result either in a rational-rational or a herd-herd result. Thus, we have to compare (A14) and (A19), to see which configuration would be a better option for the rational banks. Executing $(A14) - (A19) = \frac{(1+2c)^2(\theta - \theta_o)^2}{4\theta_o^2}$

we can clearly see it always results positive. This completes the proof of the proposition.

PROOF OF PROPOSITION 2

Industry after merger. Now we have two banks, which for simplicity sake we denote as a rational bank M (the merged A and B banks) and a biased bank C. We assume that the merged bank, larger in size, operates with lower costs, c (see Section 2 for the rationale underlying this assumption). We first calculate the volumes of loans granted in the different possible market configurations and the correspond-

ing rates that clear the market. Banks M and C simultaneously solve

$$\max_{(L^M)} \text{E}\Pi^M = \left[\theta_\phi r(L^M, L^C) - (1 - \theta_\phi) \right] L^M - cL^M \quad (A23a)$$

and

$$\max_{(L^C)} \text{E}\Pi^C = \left[\theta_\phi r(L^A, L^C) - (1 - \theta_\phi) \right] L^C - 2cL^A \quad (A23b)$$

where $\theta_\phi \in \{\theta, \theta_o\}$, depending on whether banks M and C are rational or biased, and where the demand for credit is $L(r) = \alpha - r$. Market outcomes will depend on the alternative configurations:

(i) Both banks rational. Loan volumes and interest rate will be defined as

$$L^M = \frac{(1+\alpha)\theta - 1}{3\theta} \quad (A24)$$

$$L^C = \frac{(1+\alpha)\theta - (1+3c)}{3\theta} \quad (A25)$$

$$r = \frac{(\alpha - 2)\theta + 2 + 3c}{3\theta} \quad (A26)$$

This market configuration results in a monopoly if $L^C = 0$. From (A24) a non-monopoly condition may be derived that sets a limit on cost reductions by the merged banks that does not expel the outsider. That is, $\theta_o^{M1} > \frac{1+3c}{1+\alpha}$, which we set as Assumption 2 in our model.

(ii) One bank rational, one biased. Loan volumes and interest rate will be defined as

$$L^M = \frac{(1+\alpha)\theta\theta_o + (1+2c)\theta - 2(1+c)\theta_o}{3\theta\theta_o} \quad (A27)$$

$$L^C = \frac{(1+\alpha)\theta\theta_o + (1+c)\theta_o - 2(1+2c)\theta}{3\theta\theta_o} \quad (A28)$$

$$r = \frac{(1+2c)\theta + (1+c + (\alpha - 2)\theta)\theta_o}{3\theta\theta_o} \quad (A29)$$

This market configuration results in a monopoly if $L^C = 0$. From (A28) we derive the non-monopoly condition $\theta_o^{M2} < \frac{(1+c)\theta_o}{2(1+c) - (1+\alpha)\theta}$. If θ_o^{M1} is satisfied (cost reductions are not so large as to expel a rational outsider), this θ_o^{M2} condition only imposes $\theta < \theta_o$ – which holds by definition. Thus, θ_o^{M2} does not impose any additional condition in our model.

(iii) Both banks biased. Loan volumes and interest rate will be defined as

$$L^M = \frac{(1+\alpha)\theta_o - 1}{3\theta_o} \quad (\text{A30})$$

$$L^C = \frac{(1+\alpha)\theta_o - (1+3c)}{3\theta_o} \quad (\text{A31})$$

$$r = \frac{(\alpha - 2)\theta_o + 2 + 3c}{3\theta_o} \quad (\text{A32})$$

Strategic behaviour. We now turn to an industry in which a rational bank M (the result of a merge between banks A and B) and a biased bank C compete for credit. In particular, we want to derive the conditions for the rational bank M to herd (for a complete derivation of this model, see Peón et al., 2015a). Bank M would consider herding with its biased competitor if the expected profits of the herding strategy exceed those of playing according to its true nature.

If bank M does not herd, its expected profits will be the result of setting the policies given by expressions (A27), (A28) and (A29), yielding

$$E\Pi_{RT} = \frac{\left((1+2c)\theta + \left((1+\alpha)\theta - 2(1+c) \right) \theta_o \right)^2}{9\theta\theta_o^2} \quad (\text{A33})$$

$$E\Pi_{OT} = \frac{\left((1+c + (1+\alpha)\theta)\theta_o - 2\theta(1+2c) \right)^2}{9\theta^2\theta_o} \quad (\text{A34})$$

where subscript T indicates we are in the ‘true nature’ scenario.

Alternatively, if bank M herds, credit volumes and interest rate will be given by expressions (A30), (A31) and (A32). However, the expected profits that the herder can anticipate will depend on the observed borrowers’ repayment probability, which is the unbiased estimate θ . Thus, the expected profits will be given by the expressions

$$E\Pi_{RH} = \frac{\left((1+\alpha)\theta_o - 1 \right) \left((2+3c)\theta + \left((1+\alpha)\theta - 3(1+c) \right) \theta_o \right)}{9\theta_o^2} \quad (\text{A35})$$

$$E\Pi_{OH} = \frac{\left(1+3c - (1+\alpha)\theta_o \right)^2}{9\theta_o} \quad (\text{A36})$$

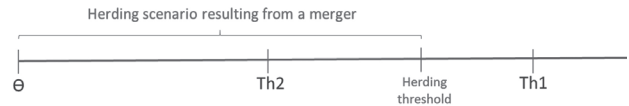
where subscript H indicates we are in the ‘herding’ scenario.

Merged bank M will herd if the expected profits of the herding strategy, given by (A35), exceed those given by (A33). Solving for θ_o we obtain the herding threshold as

$$\theta_o^h < \frac{(3+4c)\theta}{4(1+c) - (1+\alpha)\theta} \quad (\text{A37})$$

By comparing the post-merger herding threshold with the thresholds θ_o^{Th1} and θ_o^{Th2} , given by (A21) and (A22), it is easy to prove that $\theta_o^{Th2} < \theta_o^h$ for all θ levels satisfying Assumption 2. On the other hand, the herding threshold θ_o^h may fall either above θ_o^{Th1} , what happens in less efficient industries (higher c levels), or below it, when banks are highly efficient. Whatever the relationship between θ_o^{Th1} and θ_o^h , the fact that $\theta_o^{Th2} < \theta_o^h$ ensures that we have delimited a scenario, for biased probabilities by bank C below the herding threshold (A37), whereby banks A and B do not herd before the merge, but would change their behaviour to herding with bank C when they merge – as illustrated in Figure A1.

FIGURE A1. Herding scenario resulting from a merger



Source: Own elaboration

This completes the proof of the proposition.

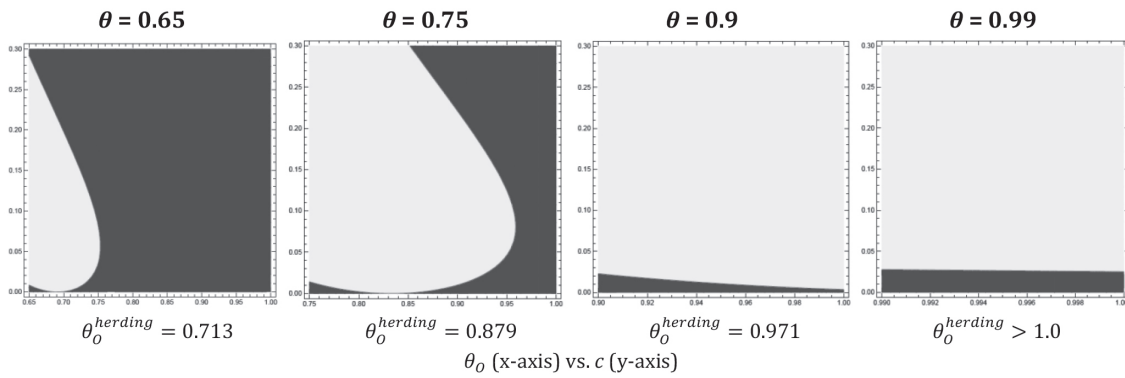
PROOF OF PROPOSITION 3

Merger paradox. We check the stability of this merger by comparing whether insiders are better or worse off after the merger, and by considering the expected increase or decrease in profits by the outsider (the biased bank C). First, we compare the expected profits of merged bank M if the herding threshold holds – given by (A35) – with the sum of the expected profits of pre-merger banks A and B when neither of them herd – given by two times (A14) – and so we obtain an expected profit increase of

$$E\Delta\Pi_{ins} = -\frac{(5+6c)^2\theta^2 + 2\theta(-6(5+2c(7+6c)) + (5+6c)(1+\alpha)\theta)\theta_o + (144c^2 + (-6+(1+\alpha)\theta)^2 - 48c(-3+(1+\alpha)\theta))\theta_o^2}{72\theta\theta_o^2} \quad (\text{A38})$$

Observe that, for different combinations of the expected default probabilities (the inverse of θ and θ_o), cost structure c , and market size α , there are indeed situations where the merger would be stable. For the sake of interpretability, consider $\alpha=1$. The different combinations of θ , θ_o and c would yield profitable – and thus stable – mergers in the lighter coloured areas in Figure A2.

FIGURE A2. Increase in expected profits by the merged banks



In the lighter-coloured areas, the rational banks, for scenarios in which they did not herd pre-merger, would find it profitable to merge and to herd with their biased competitor. Thus, mergers tend to be profitable for insiders in less efficient industries and the lower the probability of borrower default.

Finally, we consider what happens with the outsider in this merger, the biased bank C. If it is worse off after the merger, this would make the merger stable. We follow the same reasoning as above for the insiders, comparing the expected profits of the outsider bank C if the herding threshold holds –given by (A36) – with its expected profits before the merger when neither of the rational banks herd – given by (A15). We obtain an expected profit increase given by

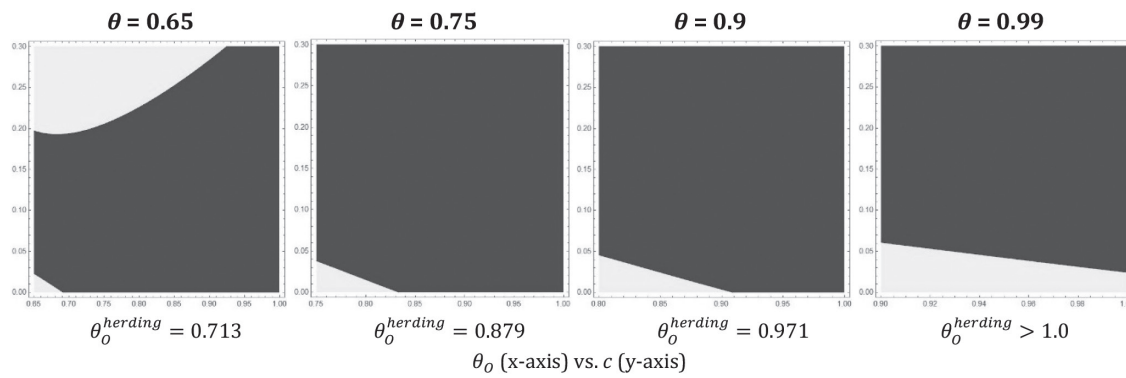
$$E\Delta\Pi_{out} = \frac{((5+6c)\theta + (-6-12c+(1+\alpha)\theta)\theta_o)(-(13+30c)\theta + (6+12c+7\theta(1+\alpha))\theta_o)}{144\theta^2\theta_o} \quad (\text{A39})$$

Comparing what bank C would earn (A39) with what the insiders would expect to earn (A38), subtracting (A39) minus (A38), produces a negative result and provides the area where mergers would tend to be stable, given by the expression

$$\frac{-36(1+2c)^2\theta_o^3 - 36(1+2c)\theta_o^2(-5-10c+\theta_o+\theta_o\alpha)\theta + \theta_o(-468c^2 + (5+\theta_o(1+\alpha))(-37+7\theta_o(1+\alpha)) - 12c(47+7\theta_o(1+\alpha)))\theta^2 + 2(5+6c+\theta_o(1+\alpha))^2\theta^3}{144\theta_o^2\theta^2} \quad (\text{A40})$$

Observe that, for different combinations of the expected default probabilities (the inverse of θ and θ_o), cost structure c , and market size α , there are indeed situations where bank C would lose out on expected profits, which would make the merger more stable. For the sake of interpretability, consider $\alpha=1$. The different combinations of θ , θ_o and c would yield lower profits for bank C – and thus lead to more stable mergers – in the darker-coloured areas in Figure A3:

FIGURE A3. Increase in expected profits by the outsider compared to the insider banks



In the darker-coloured areas, the biased bank, for the scenarios in which its competitors did not herd before the merger, would make lower increased profits than their competitors after their merge-and-herd strategy. This renders mergers more stable in the areas where they are profitable for insiders: (i) in inefficient industries (higher costs, c); and (ii) the more biased bank C is (indicating a higher possible herding effect), provided its bias is small enough to induce herd behaviour (given by the herding threshold). This completes the proof of the proposition.