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ABSTRACT

Predation and Mergers: Is Merger Law Counterproductive?*

This Paper shows that predation might help firms overcome the free-riding problem of mergers by changing the acquisition situation in the buyer's favour relative to the firms outside the merger. It is also shown that the bidding competition for the prey's assets is most harmful to predators when the use of the prey's assets exerts strong negative externalities on rivals, i.e. when their use severely reduces competitors' profits. The reason is that potential buyers are then willing to pay a high price for the prey in order to prevent other buyers from obtaining the assets. This implies that predators prefer predation technologies that destroy the prey's assets since they limit the negative effects of the subsequent bidding competition for the prey. It is also shown that a restrictive merger policy might be counterproductive, since it might increase the incentives for predation by helping predators avoid the bidding competition. Moreover, the incentive for predation under the US failing firm defence might be strong, since it allows mergers but limits the bidding competition.

JEL Classification: K21, L12, L41
Keywords: failing firm defence, merger law, mergers, predation

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NON-TECHNICAL SUMMARY

Firms can basically use two types of business strategy to eliminate rivals; they can either merge with them, or predate in order to induce exit. McGee (1958) claimed that it cannot be rational to engage in predatory behaviour when merger is an alternative, since the predator and the prey can avoid the costs of predation and share the surplus in a merger. Firms in an oligopoly, however, might have limited possibilities of eliminating rivals by mergers, since the costs of such concentration are mainly carried by the acquiring firm, while the gains are spread to all firms in the industry, as illustrated by the following example. In 1987, the Swedish-Swiss industrial combine ABB embarked on a program of acquisitions of district heating pipe producers across Europe. ABB, for its own part, considered that, unfairly, it had to bear all the cost of industry reorganization while other producers obtained a 'free ride'. ('Case No. IV/35.691/E-4: Pre-Insulated Pipe Cartel', *Official Journal of the European Communities*, L 24/1, 30.1.1999.)

Predation, on the other hand, might allow the cost of elimination to be spread out more evenly among firms as illustrated by the same example: from 1992, ABB participated in a cartel where the firms shared the cost of driving one of the competitors out of the district heating pipe market by using joint predatory pricing, joint acquisitions of key staff, and a collective boycott of the prey's customers and suppliers. Thus, predation might be a rational alternative to mergers in a multi-firm industry.

The purpose of the present Paper is to study the interaction between incentives for predation and mergers in a multi-firm setting. In order to derive some conclusions about the appropriate design of merger law, I will also show how the incentives for predation and mergers might depend on the property of the merger law. To this end, I combine a model of endogenous merger formation with an oligopoly model including the possibility of predation. I show that there are two fundamental differences between predation for merger in a duopoly and predation for merger in a less concentrated market structure.

First, I show that the option to predate may help the firms overcome the free-riding problem associated with mergers in multi-firm industries. The reason is that, by predating, predators will change the acquisition situation in favour of the buyer, since the prey will then accept a lower bid. This implies that the free-rider problem is mitigated, since it is then relatively more attractive to become a buyer compared to a non-buyer. Moreover, the cost of predation can be shared and thus the free-rider problem of eliminating the rival can be avoided. This Paper thus provides a rationale of why the incentives for mergers in a multi-firm industry might increase if predation is an option: predation may mitigate the free-riding problem associated with mergers.

Second, predation in a multi-firm setting is followed by a bidding competition for the prey's assets, and it is shown that the price of the prey in an oligopoly might be so high that the incentive for predation for merger vanishes. I thus show that the incentives for predation for merger in a multi-firm industry are mitigated by the subsequent bidding competition for the prey's assets.

The bidding competition for the prey's assets is most harmful to predators when the use of the prey's assets exerts strong negative externalities on rivals, i.e. when their use severely reduces competitors' profits. The reason is that potential buyers are then willing to pay a high price for the prey in order to prevent other buyers from obtaining the assets. There are, however, examples of predation technologies that can reduce the usefulness of the assets. For instance, firms may advertise heavily in order to destroy the appeal of the brand name of the prey. Or, firms may lobby for restrictions on trade, safety or health issues, and thus reduce the usefulness of the assets of the prey in production. Accordingly, firms have incentives to choose a predation technology that destroys the assets, since the negative externalities exerted on rivals by using the prey's assets are then reduced. Consequently, predation might not only be socially harmful by limiting the number of competing firms, but also by reducing the total amount of productive assets in the industry.

I also explore the policy implications of the above mentioned findings in the context of different merger laws. Mergers creating or strengthening dominant positions are illegal according to the competition laws in most developed countries. If the target is failing, an otherwise illegal merger may nevertheless be accepted under the so-called 'failing firm defence'. In the present study, three merger law rules are considered. The first rule is a version of a restrictive merger law, not including a failing firm defence, according to which all mergers are assumed to be forbidden in the present case. The second rule, referred to as the US failing firm defence rule, adds the existing US failing firm defence to the restrictive rule. The US failing firm defence contains a 'least danger to competition' (LDC) condition stating that if more than one firm bids on the failing firm's assets, then the firm constituting the least danger to competition should be favoured. The third rule is a modified version of the US failing firm defence rule, where no firm is favoured in the acquisition process of the failing firm.

I show that a restrictive merger policy may be counterproductive, in the sense of leading to concentration. It may increase the incentives for predation by helping predators avoid a disadvantageous bidding competition for the prey after predation has occurred. Consequently, the incentive for predation for merger under a failing firm defence is limited if potential buyers compete to acquire the failing firm, as is the case in the modified version of the US failing firm defence studied here. On the other hand, the incentive for predation for merger under the existing US failing firm defence might be strong, since it allows mergers but limits the bidding competition by favouring small firms in the acquisition process.

1. Introduction

Firms can basically use two types of business strategies to eliminate rivals; they can either merge with them, or predate in order to induce exit. McGee (1958) claimed that it cannot be rational to engage in predatory behavior when merger is an alternative, since the predator and the prey can avoid the costs of predation and share the surplus in a merger. However, firms in an oligopoly might have limited possibilities of eliminating rivals by mergers, since the costs of such concentration are mainly carried by the acquiring firm, while the gains are spread to all firms in the industry,[1] as illustrated by the following example. In 1987, the Swedish-Swiss industrial combine ABB embarked on a program of acquisitions of district heating pipe producers across Europe. ABB, for its own part, considered that unfairly, it had to bear all the cost of industry reorganization while other producers obtained a 'free ride'.[2]

Predation, on the other hand, might allow the cost of elimination to be spread out more evenly among firms as illustrated by the same example: From 1992, ABB participated in a cartel where the firms shared the cost of driving one of the competitors out of the district heating pipe market by using joint predatory pricing, joint acquisitions of key staff, and a collective boycott of the prey's customers and suppliers.[3] Thus, predation might be a rational alternative to mergers in a multi-firm industry.[4]

The purpose of the present paper is to study the interaction between incentives for predation and mergers in a multi-firm setting. In order to derive some conclusions about the appropriate design of merger law, I will also show how the incentives for predation and mergers might depend on the property of the merger

[1] The observation that there might be a free-rider problem associated with mergers was first pointed out by Stigler (1950) and later formalized by Salant *et al* (1983) in an exogenous merger framework and by Kamien and Zang (1990) in an endogenous merger framework.

[2] Case No IV/35.691/E-4: Pre-Insulated Pipe Cartel, Official Journal of the European Communities, L 24/1, 30.1.1999.

[3] Case No IV/35.691/E-4: Pre-Insulated Pipe Cartel, Official Journal of the European Communities, L 24/1, 30.1.1999.

[4] There are other examples where firms shared the costs of eliminating rivals. In the E.U. CMB case, the Commission found three linear shipping conferences to have collectively abused their dominate position by, among other things, introducing a system of "fighting ships" targeted at particular competitors, involving the joint setting of freight rates to match the competitor's rate, with the sharing of any resulting lost earnings (see Goyder (1998)).

Morton (1997) showed that the British Shipping Cartels 1879-1929 used predatory pricing to force "weak" rivals out of the market. The cartel members shared the costs of elimination by transfer payments among themselves.

Predation and mergers are also used in combination. In his classical article, Burns (1986) showed that, between 1891 and 1906, American Tobacco used a combination of predatory pricing and subsequent mergers to eliminate 43 of its competitors.

law. To this end, I combine a model of endogenous merger formation, created by Kamien and Zang (1990), with an oligopoly model including the possibility of predation. This model is described in section 2.

McGee's (1958) claim that engaging in predatory behavior when a merger is an alternative cannot be rational was criticized by Yamey (1972) on the ground that the buyout price might be lower if a potential buyer can predate a "weaker" rival.[5] This idea was formalized by Saloner (1987) in a duopoly model where the firms' pricing takes place in an environment of incomplete information. Saloner also showed that if the merged firm faces potential entry, predatory pricing may be necessary to deter entry and make the merger profitable. Predation may thus increase the incentives for mergers. In section 3, I show that there are two fundamental differences between predation for merger in a duopoly and predation for merger in a less concentrated market structure.

First, I show that the option to predate may help the firms overcome the free-riding problem associated with mergers in multi-firm industries. The reason is that, by predating, predators will change the acquisition situation in favor of the buyer, since the prey will then accept a lower bid. This implies that the free rider problem is mitigated, since it is then relatively more attractive to become a buyer compared to a non-buyer. Moreover, the cost of predation can be shared and thus the free rider problem of eliminating the rival can be avoided. This paper thus provides a rational of why the incentives for mergers in a multi-firm industry might increase if predation is an option: predation may mitigate the free-riding problem associated with mergers.[6]

Second, predation in a multi-firm setting is followed by a bidding competition for the prey's assets, and it is shown that the price of the prey in an oligopoly might be so high that the incentive for predation for merger vanishes. I thus show that the incentives for predation for merger in a multi-firm industry is mitigated by the subsequent bidding competition for the prey's assets.

The bidding competition for the prey's assets is most harmful to predators when the use of the prey's assets exerts strong negative externalities on rivals, i.e. when their use severely reduces competitors' profits. The reason is that potential buyers are then willing to pay a high price for the prey in order to prevent other buyers from obtaining the assets. There are, however, examples of predation technologies that can reduce the usefulness of the assets. For instance, firms

[5] Yamey criticized McGee on two grounds. His second argument was that it might be advantageous for the predator to signal aggressive behavior in order to improve future interaction. This argument has later been formalized in two types of asymmetric information models: Signaling models and reputation models. See Ordover and Saloner (1988) for an overview of these models.

[6] Note that this formalization differs from the one provided by Saloner, where predation was used to signal low costs.

may advertise heavily in order to destroy the appeal of the brand name of the prey. Or, firms may lobby for restrictions on trade, safety or health issues, and thus reduce the usefulness of the assets of the prey in production.[7] Accordingly, firms have incentives to choose a predation technology that destroys the assets, since the negative externalities exerted on rivals by using the prey's assets are then reduced. Consequently, predation might not only be socially harmful by limiting the number of competing firms, but also by reducing the total amount of productive assets in the industry.

In section 4, I explore the policy implications of the above mentioned findings in the context of different merger laws.[8] Mergers creating or strengthening dominant positions are illegal according to the competition laws in most developed countries. If the target is failing, an otherwise illegal merger may nevertheless be accepted under the so-called "failing firm defense". In the present study, three merger law rules are considered. The first rule is a version of a restrictive merger law, not including a failing firm defense, according to which all mergers are assumed to be forbidden in the present case. The second rule, referred to as the US failing firm defense rule, adds the existing US failing firm defense to the restrictive rule. The US failing firm defense contains a "least danger to competition" (LDC) condition stating that if more than one firm bids on the failing firm's assets, then the firm constituting the least danger to competition should be favored. The third rule is a modified version of the US failing firm defense rule, where no firm is favored in the acquisition process of the failing firm.

Saloner (1987) showed that the incentive for a potential monopolist to predate increases if he can acquire the prey after predation has occurred. He concluded that market concentration might be increased by a failing firm defense clause. I show that a failing firm clause does not necessarily yield a tendency toward concentration in a multi-firm setting. In fact, a restrictive merger policy may be counterproductive, in the sense of leading to concentration. It may increase the incentives for predation by helping predators avoid a disadvantageous bidding competition for the prey after predation has occurred. Consequently, the incentive

[7] For instance, Bartel and Thomas (1987) argue that Occupational Safety and Health Administration regulations and Environmental Protection Agency regulations have been predatory. Among other things, they show that firms with older plants tend to have higher compliance costs with these regulations than firms with new plants. The value of old plants thus decreases after these regulations have been imposed.

Neumann and Nelson (1982) have documented the exit of small mines resulting from the enforcement of the 1969 Coal Mine Health Safety Act.

[8] It is assumed that the competition authority cannot observe whether or not firms predate. This paper thus focuses on situations where firms have access to business strategies that the authorities find difficult to determine whether they are predatory or not. Examples of such business strategies might be advertisement, pricing, lobbying, and development of new product standards.

for predation for merger under a failing firm defense is limited, if potential buyers compete to acquire the failing firm, as is the case in the modified version of the US failing firm defense studied here. On the other hand, the incentive for predation for merger under the existing US failing firm defense might be strong, since it allows mergers but limits the bidding competition by favoring small firms in the acquisition process.

In Section 5, another interpretation of the criticism raised by McGee (1958) is discussed, i.e. that predation is not rational, since an immediate merger under the threat of predation is more advantageous. Section 6 contains some concluding remarks. Finally, most of the proof appears in the Appendix.

2. The Model

There are s identical owners, each endowed with the unit of assets necessary for producing a homogenous product. Initially, each owner operates a separate firm. These firms will be referred to as the strong firms. There is also an owner d who is identical to the other owners apart from being vulnerable to predation by the strong owners. This firm will be referred to as the weak firm.

Interaction takes place over three periods. In period 1, the firms compete in an oligopoly industry and generate profits. In this period, strong firms might predate in order to make the weak firm bankrupt. In the second period, the firms might merge. Finally, in period 3, firms compete in standard oligopoly fashion and generate profits.

2.1. The merger formation

In the merger formation stage, stage 2, the owners of the firms decide whether to merge. The merger formation is modeled as in Kamien and Zang (1990), where owners simultaneously post bids for other firms and state an asking price for their own firm, and where the possible reallocation of assets is determined on basis of these bids and asks.

Let N be the set of active owners in the industry. Each owner $j \in N$ announces a vector $\mathbf{b}_j = (b_j^1, b_j^2, ..., b_j^n) \in R^n$ of bids for each firm, where n is the number of active owners. The bid b_j^j is the jth owner's bid or asking price for his own firm. Let $\mathbf{b} = (\mathbf{b}_1, \mathbf{b}_2, ..., \mathbf{b}_n)$ denote the $n \times n$ matrix of bids. Following the announcement of $\mathbf{b}$, each firm may be sold to one of the bidders at the bid price, or remain with its original owner.[9]

I will now describe a rule, named the *laissez-faire rule*, which allocates owner *i's* assets to any owner when there are no legal restrictions as to who is allowed

[9] It is assumed that owners cannot bid for the other firms on a contingency basis.

to acquire which assets: The laissez-faire rule allocates owner i's assets to the owner who posts the highest bid for the assets (including owner i). If there is more than one owner with such a bid, each such owner obtains the assets with equal probability.

The merger formation game is solved for Nash equilibria in undominated pure strategies. The merger process will give rise to a market structure, denoted M^j, which is a partition of the set $\{1, ..., s+1\}$ of owners into coalitions. Let $\mathcal{M}$ be the set of all possible ownership structures, and let k_i^j denote the number of assets possessed by firm i in market structure M^j. Without loss of generality, suppose $k_1^j \geq k_2^j \geq ... \geq k_n^j \ \forall M^j \in \mathcal{M}$. Consider the case where owner 1 has obtained owner s's assets and owner 2 has obtained owner d's assets. No other mergers have taken place. $\pi_1(2, 1+d, 1, ..., 0, 0)$ then denotes the profit of firm 1 and $\pi_2(2, 1+d, 1, ..., 0, 0)$ denotes the profit of firm 2, etc. It is assumed that predation might affect the productivity of owner d's assets, and therefore there might be a difference between the market structures where owner d's assets have been exposed to predation and those where they have not. To this end, let $\pi_2(2, 1+d^p, 1, ..., 0, 0)$ denote the profit of firm 2 possessing one unit of non-predated assets and one unit of predated assets, etc. The superscript p denotes that owner d's assets have been exposed to predation.

I make the following two assumptions about how profits are affected by asset transfers:

Assumption A1 When firms merge, the profits of firms outside the merger do not decrease.

This assumption is fulfilled in many merger models.[10] The most immediate case where A1 need not be fulfilled arises when the merger creates strong variable cost synergies.

The second assumption relates to a comparison between situations where assets exit or not.

Assumption A2 When a firm increases its ownership of otherwise exiting assets in the industry, its profit does not decrease, and its rivals' profits do not increase.

This assumption is fulfilled in many oligopoly models.[11]

[10] For instance, this assumption holds in the merger models presented by Davidson and Deneckere (1985), Perry and Porter (1985) and Salant et al (1983), since prices increase after a merger in these cases.

[11] For instance, Dixit (1986) shows that, in his quantity-setting conjectural variants oligopoly model under a set of stability criteria, a change which is prima facie favorable to a firm, as an increase in assets typically is, lowers the profits of all other firms.

A central feature of this study is how a redistribution of owner d's assets to owner j and not to owner l affects owner i's profit. Some more notation is needed to define this valuation. The profit for firm i, when owner j obtains owner d's assets for a given initial market structure is denoted $\pi_i^j(d)$, and the profit for firm i when owner d's assets exit is denoted $\pi_i^e(d)$. The valuation of d's assets for owner i , $v_i^{jl}(d)$, is then defined:

Definition 1. $v_i^{jl}(d) \equiv \pi_i^j(d) - \pi_i^l(d)$

This valuation is determined by two components. One is the profit made by owner i when firm j has acquired owner d's assets, and the second is the profit made by owner i when owner l has acquired the assets. Note that $v_i^{il}(d)$ is the gain for owner i of obtaining the assets, given that owner l will otherwise obtain them. Finally, let $v_i^{jl}(d^p)$ denote that owner d's assets have been exposed to predation.

2.2. Predatory behavior

In period 1, the strong firms have the option to predate. Following the approach of Bernheim (1984)[12], the predation technology is intentionally left unspecified, since I want to abstract from the complex issues which arise with regard to particular theories of predation. Firm d is assumed to be bankrupt if its profit is below a threshold value, z. Predation is costly in the short run. Let x_i denote firm i's, $i \neq d$, costs, where $x = \sum_i x_i$. To simplify the analysis, I assume that predation only affects the prey when the total costs of investing in predation are at least as high as $\bar{x}$.[13] In this case, firm d's profit falls to the threshold value z. This assumption is made in order to focus on the trade-off between non-predation and predation for bankruptcy. The profit for a strong firm, firm 1 say, when predating in the initial market structure is $\pi_1(1, ..., 1, d) - x_1$, and the profit for the prey is denoted $\pi_d^p(1, ..., 1, d)$. In several cases, predation is costly not only because it consumes resources, but also because it changes pre- and post bankruptcy profits. This creates no conceptual problems, since we can think of x_i simply as net profits forgone when predating. Predation by one strong firm is assumed to not affect the profit of other strong firms.[14]

Essentially, this construct subsumes any technique by which a strong firm lowers the profit of the weak firm through activities causing its own net profit

[12] The Bernheim (1984) model was applied to entry deterrence.

[13] It is possible that not only the total amount of x will be of importance, but also the distribution of x_i's. However, since I restrict the analysis to symmetric equilibria, this will be of no importance here.

[14] This simplifies the analysis, and the mechanisms identified in the paper would also be present if predation affects the profit of other strong firms.

to fall. Different kinds of predatory practice has been discussed in the literature, among them: (i) predatory pricing, (ii) lobbying for legislative restrictions on, for instance, foreign firms or firms using different technologies, (iii) advertising to establish brand name identification, and (iv) raising a rival's input prices.[15]

3. Incentives for predation and mergers

This section analyzes the firms' incentives for predation and mergers in situations with no restrictions on mergers. The first issue is to show that the option to predate may increase the incentive for mergers in a multi-firm setting.

Period 3. This is the last period and hence, firms have no incentive to predate. They will thus compete in standard fashion and generate profits.

Period 2. There are only two possible situations to consider in period 2. We either have a situation where firm d is bankrupt, or a situation where it is not.

Let us start with the situation where firm d is not bankrupt. Using the approach of Kamien and Zang, we can derive a sufficient condition for no mergers to occur in equilibrium. Consider an equilibrium candidate where owner o is a buyer. Denote the number of assets he possesses by k_o. Let π_o' denote o's profits and let π_o'' be his profits if he lowers his bid to the $k_o - 1$ sellers and becomes a non-buyer, when all other firms maintain their ownership. The buying owner is unwilling to pay the $k_o - 1$ sellers more than $\pi_o' - \pi_o''$. Consider next one of the $k_o - 1$ sellers. If he unilaterally deviates and raises his asking price above the first owner's bid, his assets will not be bought, and he will realize a profit of at least π_s''', where π_s''' is the profit for a single-asset firm. It follows that the first owner has to pay each seller at least π_s'''. Consequently, no mergers take place if the following condition holds:

C1 $\pi_o' - \pi_o'' < (k_o - 1)\pi_s'''$ for all possible mergers.[16]

[15] See Ordover and Saloner (1989). This reduced form predation model could be obtained from, for instance, the model presented in Tirole (1990, pp. 378-379). In this model, the strong firms have "deep pockets", that is, a stock of internally generated funds. Firm d has a "shallow pocket"; it must raise funds from the capital market between period 1 and 2, using a debt contract. Firm d's equity after the first period depends on its earning in period 1. The strong firms reduce firm d's profit by preying and therefore reduces its second period equity. Firm d must borrow more, at a higher interest rate, and finds continuation in this market less attractive. Note that firm d may be in the market in period 1, since it makes a profit even though it is preyed upon; it simply cannot invest enough to stay in the market in period 2. The predation technology used could then, for instance, be predatory pricing. The Bolton and Scharfstein (1990) model could also be used. However, due to space considerations, the relationship is not described here.

[16] The set of all possible mergers are defined in the proof of Lemma 1.

If all the owners' bids for other firms are sufficiently low while the asking prices for their own firms are sufficiently high, then no merger takes place, i.e. an unmerged equilibrium always exists. Thus, we have the following result:

Lemma 1. *If firm d is not bankrupt and C1 holds, then the initial market structure is the unique Nash equilibrium.*

Proof. See Appendix.

Thus, mergers do not occur due to the free-riding problem: it is more profitable to be outside a merger. Consider now the situation where firm d is bankrupt. The merger formation is then conducted under the restriction that owner d must sell his assets.[17] In order to include this restriction in the merger formation model, the allocation rule is modified. The *bankruptcy rule* is identical to the laissez-faire rule, apart from the fact that owner d can neither make a bid on other firms nor put an asking price on its own firm. The reason is that firm *d's* assets are now assumed to be in the hands of a trustee who will sell the assets to the bidder with the highest bid, as long as the bid is positive.[18] If the bid is negative, the assets are assumed to be liquidated at zero costs.

In order to focus on the elimination of the weak firm only, I derive a sufficient condition for no mergers to occur between the strong firms in equilibrium. The same reasoning as for the derivation of condition C1 then applies, yielding the following condition:

C2 $\pi_o' - \pi_o'' < (k_o - 1)\pi_s'''$ for all possible mergers between strong firms.

In Lemma 2, it is shown that under C2, in equilibrium, no mergers occur between the strong firms, but that a merger involving the weak firm takes place:

Lemma 2. *If firm d is bankrupt and C2 holds, then the market structure is an s-firm market structure in all symmetric Nash equilibria and an owner $i \neq d$ obtains d's assets for a price equal to owner j's, $j \neq i, d$, valuation of obtaining d's assets instead of owner i obtaining them, minus ε, $v_j^{ji}(d^p) - \varepsilon$.*

Proof. See Appendix.

The reason why a merger takes place in this situation is that the weak firm will now accept any positive bid. This implies that the profits for a firm that does not obtain the assets are the same as for the buyer since, as shown by Lemma 2,

[17] According to Chapter 11 of US bankruptcy law, for instance, a bankrupt firm has the chance to re-organize and continue its operations. However, it is assumed here that the bankrupt firm does not re-organize successfully.

[18] Note that this implies that the seller cannot state a strictly positive reservation price.

the price of the prey is equal to the non-buyers' willingness to pay. Consequently, the strong firms are indifferent to buying or not. Thus, in a situation where the target firm is bankrupt, the acquisition price will be so low that the free-riding problem is absent.

Period 1. In the remainder of this section, C1 and C2 are assumed to hold. Thus, there will be no merger in period 2, if firm d is not bankrupt, and if firm d is bankrupt, there will be a merger between one of the strong firms and firm d. In period 1, the strong firms have the option to predate. Predation has the characteristic of a public good in the sense that if firm i predates, all "strong" firms benefit. A free-riding problem might thus arise, since only firm i pays the costs. The following Lemma characterizes the symmetric Nash equilibria:

Lemma 3. *(i) If it is profitable for the strong firms to predate as a group, then* $x_i^* = \frac{\bar{x}}{s}, \forall i \neq d$ *and* $x_i^{**} = 0, \forall i \neq d$ *are the only symmetric Nash equilibria. Moreover,* x_i^* *Pareto dominates* x_i^{**} *for the group of strong firms. (ii) If it is not profitable for the group of strong firms to predate, then* $x_i^* = 0, \forall i \neq d$ *is the only symmetric Nash equilibrium.*

Proof. See Appendix.

I restrict the analysis to the symmetric Pareto dominating equilibrium in provision of predation. This restriction seems reasonable for predation technologies, such as the development of standards and lobbying, where firms are likely to be able to communicate.[19]

In the literature on multi-firm entry deterrence, it has been shown that there might be over- as well as under-provision of entry deterrence from the perspective of the strong firms, depending on the nature of the technology.[20] It is thus possible that the free-riding problem might also be avoided in situations where firms cannot communicate, since multi-firm predation in this set-up resembles multi-firm entry deterrence.

Let us now determine when a strong firm will predate. Recall that the profits over periods 2 and 3 are equal for all strong firms, irrespective of whether they are the buyer or not. Thus, it is sufficient to look at the incentive for one of the strong firms to predate, say firm 1. It follows from the assumption $k_1^j \geq k_2^j \geq ... \geq k_n^j$ that firm 1 is the firm that will merge with firm d in period 2, if firm d is bankrupt. Firm 1's total profit from predation consists of two parts; its net profit in period

[19] Note that it is not the equal sharing, but rather that *a sufficiently large share* of the costs of predation is shared, which is important for the results in this paper. Note also that predation is an equilibrium outcome in Nolan (1998) without the symmetry assumption.

[20] See, for instance, Appelbaum and Weber (1992), Gilbert and Vives (1986), Waldman (1987) and Kovenock and Roy (1995). For instance, there might be a free-rider problem in the provision of predation, if there were uncertainty about the level of z. See Waldman (1987).

1 plus its profit as a merged entity in period 3 minus the price paid for the prey in period 2, i.e. $\pi_1(1,...,1,d)-\frac{\bar{x}}{s}+\pi_1(1+d^p,1,...,1,0)-(\pi_2(1,1+d^p,1,...,1,0)-\pi_2(1+d^p,1,...,1,0))$.[21] If firm 1 does not predate, its profits over periods 1 and 3 are $2\pi_1(1,...,1,d)$. Recall that C1 is assumed to hold and consequently, Lemma 1 applies. Thus, there are no mergers in period 2 if firm 1 does not predate. This implies that firm 1 predates only when the following condition is fulfilled:

C3 $\pi_1(1,...,1,d)-\frac{\bar{x}}{s}+\pi_1(1+d^p,1,...,1,0)-(\pi_2(1,1+d^p,1,...,1,0)-\pi_2(1+d^p,1,...,1,0))>2\pi_1(1,...,1,d)$

We thus have the following result

Lemma 4. *If C1 and C2 hold in period 2, the unique symmetric Nash equilibrium for predation is* $x_i^*=\frac{\bar{x}}{s},\forall i\neq d$ *if C3 holds, and* $x_i^{**}=0,\forall i\neq d$ *if C3 does not hold.*

If we interpret the situation where the cost of predation is infinite as a situation where predation is not an option, it can be shown that a symmetric equilibrium exists where the option of predation increases the incentive for merger. To this end, I use the Cournot model used by Salant et al (1983), and refer to it as "the Salant et al model", in which inverse demand is $P=\beta-\sum_{i=1}^{n}Q_i$ and where each firm's variable costs are α.

Proposition 1. *Consider the Salant et al model with* $s\geq 3$*. Then, if predation is not an option, no symmetric subgame perfect Nash equilibrium will involve a merger, and (ii) if predation is an option and* $\bar{x}$ *is small enough, predation will occur in period 1 in all symmetric subgame perfect Nash equilibria, and is followed by a merger between one of the strong firms and the weak firm in period 2.*

Proof. See Appendix.

The option to predate increases the incentive for merger, since predation weakens the prey's bargaining position. Thus, firms may overcome the free-riding problem associated with mergers by sharing the costs of making the rival bankrupt, and by changing the acquisition situation in favor of the buyer.

[21] Recall that firm 1 will merge with firm d and no other merger will take place in period 2 according to Lemma 2, since C2 is assumed to hold. The correct price is $v_j^{ji}(d^p)-\varepsilon$. However, to simplify the presentation, I will hereinafter use $v_j^{ji}(d^p)$.

3.1. The bidding competition and the choice of predation technology

If the non-buying firms' profits decrease, the price of the prey's assets increases with the same amount since, according to Lemma 2, the price of the prey is determined by the outside firms' willingness to pay. Consequently, the stronger negative externalities exerted by the use of the bankrupt firm's assets, the lower is the net profit for the merged entity. The incentive for predation for merger thus depends on the extent to which predation affects the productivity of the prey's assets, when employed in a strong firm.

Let us say that the firms use a *non-destructive predation technology* when predation does not affect the productivity of the prey's assets, i.e. $\pi_i^i(d) = \pi_i^i(d^p)$ and $\pi_j^i(d) = \pi_j^i(d^p) \forall j \neq i$. For instance, if the assets are physical capital and the predation technology is pricing, then predation is not likely to change the effect of the capital on cost savings. According to the above reasoning, firms have limited incentives for predation for mergers when using a non-destructive predation technology, since the bidding competition after predation might have considerable negative effects. The incentives for predation for merger in a multi-firm industry is thus mitigated by the subsequent bidding competition for the prey's assets.

There are, however, several examples of predation technologies that can reduce the usefulness of the assets. For instance, firms may advertise heavily in order to destroy the appeal of the brand name of the prey. Or, firms may lobby for restrictions on trade, safety or health issues, and thus reduce the usefulness of the assets of the prey in production. In order to capture these situations, we denote the other extreme where $\pi_i^i(d^p) = \pi_i^e(d^p)$ and $\pi_j^i(d^p) = \pi_j^e(d^p) \forall j \neq i$, as one where firms use a *destructive predation technology*, i.e. a technology making the bankrupt firm's assets useless.

Let us now assume that the strong firms could choose either the non-destructive predation technology, or the destructive predation technology and that C1, C2 and C3 hold. The net profit, excluding the cost of predation, from predating for a strong firm is $\pi_2(1 + d^p, 1, ..., 1, 0)$. Consequently, the strong firms choose the destructive predation technology, since $\pi_2(1 + d^p, 1, ..., 1, 0)$ is then maximized. Thus we have the following result:[22]

Proposition 2. *When C1, C2 and C3 hold, and if the strong firms must choose between the non-destructive and the destructive predation technology, they choose the destructive one.*

The bidding competition is most harmful to predators when the use of the prey's assets exerts strong negative externalities on rivals, since potential buyers

[22] It is assumed that the strong firms can coordinate on the predation technology that is most advantageous for the group of strong firms.

are then willing to pay a high price for the prey in order to prevent other buyers from obtaining the assets. Accordingly, firms have incentives to choose a predation technology that destroys the assets, since the negative externalities exerted on rivals by using the prey's assets are then reduced.[23] Consequently, predation might not only be socially harmful by limiting the number of competing firms, but also by reducing the total amount of productive assets in the industry.

4. The role of Merger Law

In this section, I analyze how different merger laws affect the incentives for predation and mergers. Mergers creating or strengthening dominant positions are illegal according to the competition laws in most developed countries. This type of merger law will here be referred to as the "restrictive merger law".

If the target is failing, a merger leading to high concentration may nevertheless be accepted under the so-called failing firm defense. The failing firm defense is well established in the US case-law. Citizen Publishing Co. v. United States assessed the requirement that before the failing company defense can be used, the defendant must show 1) that the acquired firm is almost certain to go bankrupt and cannot be reorganized successfully; and 2) that no less anticompetitive acquisition (i.e., by a smaller competitor or a noncompetitor) is available as an alternative.[24]

In the EU, neither Article 2 of the Merger Regulation nor any other provision of the Community merger legislation contain an explicit reference to the "failing firm defense" as a ground for authorizing a merger that would create or strengthen a dominant position in the EU. Despite the lack of statutory definition, however, the Commission has developed the concept of a "rescue merger" in its case-law, which is similar to the US failing firm defense.[25]

To focus on the difference between the restrictive merger law and the merger law including a failing firm defense, any merger between firms in the industry is assumed to be blocked when the restrictive merger law is applied.[26] More specifically, three merger law rules are considered. Under the first rule all mergers are assumed to be forbidden in the present case. This is referred to as the restrictive rule. The second rule adds the existing US failing firm defense rule, included

[23] Note that if the firms are asymmetric, it might be the case that the buyer generates a surplus in the auction, and thus might prefer a non-destructive predation technology.

[24] See Hovenkamp (1994, p. 496).

[25] See the Contribution by the European Commission Delegation in OECD Roundtables, Failing Firm Defense, OECD/GD(96)23.

For a more detailed discussion of the failing firm defense doctrine, see Persson (1998a).

[26] This assumption puts restrictions on the underlying oligopoly model. Basically, it means that the merger increases concentration in a non-neglible way and that cost savings associated with the merger are limited.

in the Department of Justice and Federal Trade Commission US 1992 Horizontal Merger Guidelines, to the restrictive rule. This rule is referred to as the US failing firm defense rule. The third rule, which is suggested here, is a modified version of the US failing firm defense rule, called the modified failing firm defense rule.

4.1. The restrictive merger law

There are three periods to consider. To simplify the presentation I will, however, not directly refer to the third period, where the remaining firms compete in standard oligopoly fashion, in the subsequent discussion.

Period 2. No mergers occur due to the restrictive merger law. Consequently, firm d exits, if it is bankrupt.

Period 1. Since I restrict the analysis to symmetric equilibria, it is sufficient to consider one of the strong firms' incentive to predate, firm 1, say. Firm 1's profits when predating are $\pi_1(1,...,1,d) - \frac{\bar{x}}{s} + \pi_1(1,...,1,0)$, since no mergers are allowed in period 2 and firm d exits after predation. If firm 1 does not predate, its profits are $2\pi_1(1,...,1,d)$, since no mergers are allowed in period 2. Thus firm 1 predates in period 1, if and only if C3' holds:

C3' $\pi_1(1,...,1,d) - \frac{\bar{x}}{s} + \pi_1(1,...,1,0) > 2\pi_1(1,...,1,d)$

The market structure in period 3 will thus be an $s+1$-firm market structure if predation does not occur in period 1 and an s-firm market structure if predation occurs in period 1. Let x^s be the cost at which the strong firms are indifferent to predating or not. We then have the following result:

Lemma 5. *Under the restrictive merger law, the equilibrium market structure is (i) an $s+1$-firm market structure if $\bar{x} > x^s$ and (ii) an s-firm market structure if $\bar{x} < x^s$.*

4.2. The US failing firm defense

Let us turn to the case where interaction between firms takes place under the US 1992 Merger Guidelines, which state that an otherwise anti-competitive merger may be permitted if four conditions are met: *l) the allegedly failing firm would be unable to meet its financial obligations in the near future; 2) it would not be able to reorganize successfully under Chapter 11 of the Bankruptcy Act; 3) it has made unsuccessful good-faith efforts to elicit reasonable alternative offers of acquisition of the assets of the failing firm*[27] *that would both keep its tangible and intangible*

[27] *Any offer to purchase the assets of the failing firm for a price above the liquidation value of those assets – the highest valued use outside the relevant market or equivalent offer to purchase the stock of the failing firm – will be regarded as a reasonable alternative offer.*

assets in the relevant market and pose a less severe danger to competition than does the proposed merger; and 4) absent the acquisition, the assets of the failing firm would exit the relevant market.

The first condition requires that the failing firm must be unable to meet its financial obligations. The second condition ensures that the firm does not only have short-term difficulties, but is also not viable in the long run. These two conditions are fulfilled in this set up if the prey is bankrupt. Moreover, Condition 4 is fulfilled if and only if Condition 3 is fulfilled, since it is assumed that the failing firm will be liquidated, and thus exit, if not acquired. Hence, the 1992 failing firm defense is valid in my set up if, and only if, Condition 3 is satisfied. Condition 3 refers to an alternative buyer that would pose *less severe danger to competition.* It is assumed that this is interpreted by the authority as a firm with a smaller market share. Furthermore, this alternative buyer must make a *reasonable offer*, which I interpret as the highest bid from a firm outside the industry.

In order to incorporate these restrictions into the merger formation model, some more notation is required. Let owner e be an owner who will use the prey's assets outside the industry. The valuation of obtaining the bankrupt firm's assets for owner e is denoted $v_e^e(d^p)$, and owner e's bid is denoted b_e^d. The assets in the industry are assumed to be partly industry specific: owner e's valuation of obtaining the assets is lower than the value for firms in the industry of obtaining the assets if the assets would otherwise exit, i.e. $v_e^e(d^p) < v_i^{ie}(d^p)$. In order to ensure that owner e does not obtain any of the strong firms' assets, the insiders' assets are assumed to be of no value to owner e and to ensure that no insider obtains owner e's assets, owner e's assets are assumed to be of no value to the insiders. Let firm i's market share be denoted by $m_i \equiv \frac{q_i}{Q}$, and let $\mathbf{m}$ be an arbitrary vector of market shares in the industry. Furthermore, let h be defined as the smallest firm in the industry that posts a bid at least as high as the bid posted by owner e. If firms are identical, it is assumed that after the bidding has taken place, the competition authority picks one of the firms with equal probability of being the smallest.[28] The failing firm defense allocation rule, $S^f(\mathbf{b}, \mathbf{m}, i)$, is defined:

Definition 2. $S^f(\mathbf{b}, \mathbf{m}, i) = \left\{ \begin{array}{c} i;\ \textit{for } i \neq d \\ h \textit{ if } h \textit{ exists, } e \textit{ otherwise; for } i = d \end{array} \right\}.$

Thus, all assets owned by non-bankrupt owners stay with their original owners, and owner d's assets are sold either to one of the strong firms or to owner e.

Period 2. According to the US failing firm defense rule, no mergers are allowed in period 2, if firm d is not bankrupt. If firm d is bankrupt, its assets

[28] This assumption seems compatible with the situation where the competition authority cannot perfectly observe the firms' market share, but uses estimates.

are sold. The outcome under the US failing firm defense rule is described in the following Lemma:

Lemma 6. *If firm d is bankrupt in period 2, owner $i \neq d, e$ obtains owner d's assets at a price equal to the value of the assets outside the industry minus ε, $v_e^e(d^p) - \varepsilon$, in all symmetric equilibria.*

Proof. See Appendix.

The US failing firm defense rule restricts the bidding competition between the firms in the industry, since the assets can only be obtained by the smallest firm in the industry with a bid above that of the outsider. The important thing for the result here is that the acquisition price under the failing firm defense never exceeds the value of the assets outside the industry. This is also shown to hold for asymmetric firms in Persson (1998a).

Period 1. Firm 1's profit when predating is given by $\pi_1(1,...,1,d) - \frac{\overline{x}}{s} + \frac{s-1}{s}\pi_1(1, 1+d^p, 1, ..., 1, 0) + \frac{1}{s}(\pi_1(1+d^p, 1, ..., 1, 0) - v_e^e(d^p))$[29], since owner 1 obtains the prey's assets with probability of $\frac{1}{s}$, and does not with probability of $\frac{s-1}{s}$. The profit for firm 1 when not predating is $2\pi_1(1,...,1,d)$, since no mergers are allowed in period 2, if firm d is not bankrupt. Consequently, firm 1 predates if and only if C3" holds:

C3" $\pi_1(1,...,1,d) - \frac{\overline{x}}{s} + \frac{s-1}{s}\pi_1(1, 1 + d^p, 1, ..., 1, 0) + \frac{1}{s}(\pi_1(1 + d^p, 1, ..., 1, 0) - v_e^e(d^p)) > 2\pi_1(1, ..., 1, d)$.

Let x^f denote the cost at which the strong firms are indifferent to predation or non-predation. We then have the following result:

Lemma 7. *Under the US failing firm defense, the equilibrium market structure is (i) an $s+1$-firm market structure if $\overline{x} > x^f$ and (ii) an s-firm market structure if $\overline{x} < x^f$.*

4.3. The modified failing firm defense

Let us now turn to a modified version of the US failing firm defense, a rule that is suggested here. It is identical to the rule in the US 1992 Merger Guidelines, apart from the last two conditions being omitted. Thus, only mergers with bankrupt firms are allowed and the bidder with the highest bid obtains the bankrupt firm's assets. This corresponds to the situation under the bankruptcy rule, described in

[29] The correct acquisition price is $v_e^e(d^p) - \varepsilon$, but to simplify the presentation, I use $v_e^e(d^p)$.

Section 3, with the restriction that no mergers between non-bankrupt firms are allowed.[30]

Period 2. If firm d is not bankrupt, no mergers are allowed. If firm d is bankrupt, Lemma 2 applies, since no other mergers are allowed and since it is assumed that $v_e^e(d^p) < v_i^{ie}(d^p)$. Thus, firm d is acquired by one of the strong firms at the price $v_i^{ij}(d^p) - \varepsilon$.

Period 1. Lemma 4 applies and thus the strong firms predate iff C3 holds.

Letting x^l be the cost at which the strong firms are indifferent between predating or not yields the following result:

Lemma 8. *Under the modified failing firm defense, the equilibrium market structure is (i) an $s+1$-firm market structure if $\bar{x} > x^l$ and (ii) an s-firm market structure if $\bar{x} < x^l$.*

4.4. The equilibrium market structure under the different merger laws

Let us now compare how the different merger laws affect the equilibrium market structure. The following result can be derived from Lemmas 5, 7 and 8:

Proposition 3. *The equilibrium market structure is (1) at least as concentrated under the restrictive merger law as under the modified failing firm defense and more concentrated for some parameter values; (2) at least as concentrated under the US failing firm defense as under the modified failing firm defense and more concentrated for some parameter values, when $v_i^{ij}(d^p) > v_e^e(d^p)$; and (3) more concentrated under the US failing firm defense than under the restrictive merger law for some parameter values.*

Proof. See Appendix.

The results suggest that the restrictive merger law might be counterproductive, in the sense of leading to concentration. It may increase the incentives for predation by helping predators avoid a bidding competition for the prey after predation has occurred. The incentive for predation for merger under a failing firm defense is limited if the potential buyers compete to acquire the failing firm. On the other hand, the incentive for predation for merger under the US failing firm defense might be strong, since it allows mergers but limits the bidding competition by favoring small firms in the acquisition process.

Under the restrictive merger law, the market structure might not only be the one with the smallest number of firms, but also the one with the smallest industry capital stock. This is due to the fact that the prey's assets exit under

[30] The merger formation model in this situation corresponds to the auction model provided by Jehiel and Moldovanu (1996).

the restrictive merger law, whereas they might be obtained by a rival under the failing firm defense policies. Thus, the restrictive merger law might not only lead to few firms in the industry, but also to a situation where these few firms only have a small amount of capital.

5. Mergers and the threat of predation

The results derived in this paper might be subject to another interpretation of the criticism raised by McGee (1958), i.e. that predation is not rational, since an immediate merger *under the threat of predation* is more advantageous. First note that this is not an issue in Section 4, since only mergers with bankrupt firms are allowed. However, the McGee argument might be valid in Section 3. In order to examine the argument, I include a period 0, where firms have the option to merge under the threat of predation. It is then possible to show that the two frictions in the merger process highlighted in Section 3 weaken this interpretation of the McGee argument in a multi-firm setting.

The first friction is the free-riding problem. Despite the fact that the threat of predation decreases firm d's reservation price, the price of the target might still be too high for the buyer, i.e. z might be too high. A free-riding problem might therefore exist. But as argued above, firms may overcome the free-riding problem associated with mergers by sharing the costs of making the rival bankrupt, and by changing the acquisition situation in favor of the buyer.[31]

But, if the prey's bargaining position is much weakened by predation, i.e. $z = 0$, is McGee's argument then not valid? The answer is "no", since predation might limit the negative effects of the bidding competition of the prey. In this situation, two Nash Equilibria might exist.[32] In the first, firms merge in period 0, and this equilibrium is referred to as the *immediate merger*. In the second, firms do not merge in period 0, but predate in period 1 and merge in period 2. This equilibrium is referred to as the *delayed merger*.

Let us look closer at these equilibria. By using symmetry, we have that firm 1's net profit when merging immediately is given by $\pi_2(1 + d, 1, ..., 1, 0)$, and the

[31] In Persson (1998b), it is shown that in the Salant et al model with $\beta = 1$, $\alpha = 0$, $s = 3$, $\bar{x} = 0.015$, and $z > 0.0275$, there are no mergers in period 0 but predation in period 1 followed by exit of firm d in period 2, in all symmetric subgame perfect Nash equilibria.

[32] In Persson (1998b), it is shown that when $s = 3$, when there are no mergers between strong firms in period 0 and period 2, when strong firms predate in period 1, and when $z = 0$, two subgame perfect symmetric Nash equilibria exist: (i) the triopoly structure where owner $i \neq d$ obtains d's assets at a price equal to owner j's, $j \neq i, d$, valuation of obtaining d's assets instead of owner i, $v_j^{ji}(d)$, in period 0; and (ii) the triopoly structure, where no merger occurs in period 0, predation occurs in period 1, and firm $i \neq d$ obtains d's assets at a price equal to firm j's, $j \neq i, d$, valuation of obtaining d's assets instead of owner i, $v_j^{ji}(d^p)$, in period 2.

net profit when merging in period 2 is given by $-\frac{\bar{x}}{s}+\pi_2(1+d^p,1,..,1,0)$. Thus, the cost of predation is $\frac{\bar{x}}{s}$ and the gain is $\pi_2(1+d^p,1,...,1,0)-\pi_2(1+d,1,...,1,0)$, which captures the fact that the gain from predation comes from limiting the strength of negative externalities of the prey's assets. Let x^p denote the costs of predation at which the strong firms are indifferent between the two equilibria. If $\bar{x}> x^p$, the strong firms are thus better-off merging in period 0. The immediate merger thus Pareto dominates the delayed merger for $\bar{x}> x^p$, since owner d prefers to be acquired irrespective of whether $\bar{x}> x^p$ or not.

On the other hand, if $\bar{x}< x^p$, no equilibrium Pareto dominates the other, since the strong firms then prefer the delayed merger. Thus predation must be carried out to limit the negative effects of the bidding competition among the potential buyers. If the costs of predation are sufficiently low, the firms benefit from taking these costs. Consequently, the strong firms will be better-off if they can agree not to bid on the weak firm in period 0. This might be accomplished if the strong firms create a bidding ring based on a threat to punish in future interactions.[33]

The threat of predation does thus not, in itself, affect the productivity of the target's assets for the potential buyers. Firms may therefore prefer to actually carry out predation, since the bidding competition might then be reduced.

Finally, as shown above, the incentive for predation might vanish in a multi-firm setting, since there is a bidding competition for the prey after predation. Consequently, the threat of predation might not be credible in a multi-firm setting.

6. Concluding Remark

In this paper, it has been argued that in a multi-firm setting, predation is less prone to the free-rider problem than mergers. The reason is that, by definition, mergers concentrate the costs of eliminating a rival with one firm; whereas predation allows the cost to be spread out more evenly among firms.[34] This implies that predation might be rational in a multi-firm setting.

Moreover, it has been shown that predators prefer predation technologies that destroy the prey's assets. At first, this seems counterintuitive, since the prey's assets might be considered to be valuable to predators if acquired at a later merger stage. The reason is that any benefits from acquiring the prey's assets are competed away in the bidding competition among the potential buyers. All that is left are any negative externalities on rivals the acquired assets might generate,

[33] Note that the delayed merger might be unstable, since owner d has an incentive to arrange separate bargaining with any of the strong firms.

[34] It should be noted that there might be a free-rider problem also when the costs can be shared. For instance, there might be a free-rider problem when there is uncertainty about the prey's financial situation.

externalities that might be mitigated by destroying the prey's assets. Thus, a second rational for predation in a multi-firm setting is that it might limit the negative effects of the bidding competition for the prey.

The analysis has also suggested that, contrary to received wisdom, relaxing merger policy to allow a falling-firm defense may reduce market concentration. The reason is that a failing-firm defense induces the firms to engage in a bidding war for the dying prey, which may be so costly as to induce the firms not to prey to begin with. Consequently, the incentive for predation for merger under a failing firm defense is limited, if the potential buyers compete to acquire the failing firm. On the other hand, the incentive for predation for merger under the US failing firm defense might be strong, since it allows mergers but limits the bidding competition by favoring small firms in the acquisition process. Thus, if the welfare costs of concentrated market structures are high, i.e. involve large dead weight losses, the existing merger laws thus seem unsuitable. The modified failing firm defense suggested here, where firms compete to buy the failing firm, then seems more appropriate.[35] However, as shown by Persson (1998a), one might also argue the importance of taking the efficiency argument into account when designing a policy for the selling of a failing firm. The challenge is then to construct a rule allocating the failing firm's assets in a socially efficient way, without creating strong incentives for predation.

[35] However, this rule might increase the incentive for the use of destructive predation technologies. An extended welfare analysis, incorporating the welfare effects of losses due to assets exiting or being destroyed, would be interesting.

Appendix

Proof of Lemma 1

Denote the set of all market structures with at least one merger, $\mathcal{M}_m$. Denote M_m^j as an arbitrary market structure in that set and let $\mathcal{O}_m^j$ be the set of all owners possessing two assets or more in M_m^j.

Consider a market structure $M_m^j \in \mathcal{M}_m$ and let owner $o_i^j \in \mathcal{O}_m^j$ be one of the owners with more than one assets in that market structure. Denote the number of assets he possesses with k_o. Let π_o' denote o's profits and let π_o'' be his profits if he lowers his bid to the $k_o - 1$ sellers and becomes a non-buyer when all other firms maintain their ownership. He can do at least as well if one of the other owners buys any of the assets which he now abstains from buying, since an outsider does not lose when other firms merge according to Assumption A1. The buying owner is unwilling to pay the $k_o - 1$ sellers more than $\pi_o' - \pi_o''$. Consider next one of the $k_o - 1$ sellers. If he unilaterally deviates and raises his asking price above the first owner's bid, his assets will not be bought, and he will realize a profit of at least π_s''', where π_s''' is the profit for a single asset firm. If the deviating seller possesses more than one asset, he can decrease his bids on these other assets and become a single asset firm. It then follows that the first owner has to pay each seller at least π_s'''. Consequently, an merged equilibrium is impossible if $\exists o \in \mathcal{O}_m^j : \pi_o' - \pi_o'' < (k_o - 1)\pi_s''', \forall M_m^j \in \mathcal{M}_m$.

If all owners' bids for other firms are sufficiently low, while the asking prices for their own firms are sufficiently high, then no merger takes place, i.e. an unmerged equilibrium always exists ■

Proof of Lemma 2

Denote the set of all market structures with at least one merger between any of the strong firms and where the bankrupt firm's assets are either obtained by one of the strong firms or have been liquidated, $\mathcal{M}_{sm}$. Denote M_{sm}^j as an arbitrary market structure in that set and let $\mathcal{O}_{sm}^j$ be the set of all owners possessing two strong assets or more in M_{sm}^j. The same reasoning as in the proof of Lemma 1 applies and an equilibrium with merger(s) between strong firms is impossible if $\exists o \in \mathcal{O}_{sm}^j : \pi_o' - \pi_o'' < (k_o - 1)\pi_s''', \forall M_{sm}^j \in \mathcal{M}_{sm}$.

Let $v_i^{id}(d^p) > 0$ and consider the symmetric equilibrium candidate $\mathbf{b}^*$, where $b_i^{d*} = b^{d*}, \forall i \neq d$. Let the remaining bids and asks in $\mathbf{b}^*$ consist of an asking price at $\pi_1(s+1, 0, ..., 0) + \varepsilon$, and a bid at $\pi_1(1, ..., 1) - \varepsilon$. $b_i^{d*} \geq v_i^{ij}(d^p)$ cannot be an equilibrium strategy, since owner i then knows that with a positive probability he obtains the assets. He then benefits from deviating to $b_i^d = b_i^{d*} - \varepsilon$, since he will then not obtain the assets which he paid a price for which was higher than his valuation of obtaining them. Or, he is not picked as the buyer, and then his payoff will not change if he deviates. Accordingly, he will deviate, since he gains with a positive probability. If $b_i^{d*} < v_j^{ji}(d^p) - \varepsilon$, owner $j \neq w, d$ benefits from deviating to $b_j^d = b_i^{d*} + \varepsilon$, since he then obtains the assets according to the definition of $S^b(i)$ and pays a price for the assets which is lower than his valuation of obtaining them. If $b_i^{d*} = v_j^{ji}(d^p) - \varepsilon$, then no owner has an incentive to deviate. It also follows directly that no owner has an incentive to deviate from the other bids and asks in $\mathbf{b}^*$. Thus, $\mathbf{b}^*$ is a Nash equilibrium.

If $v_i^{id}(d^p) = 0$, no owner will post a positive bid and the assets are liquidated. ■

Proof of Lemma 3

Case (i): predation is profitable for the strong firms as a group. Consider the symmetric equilibrium candidate $x_i^* = \frac{\bar{x}}{s} \forall i \neq d$. Firm i has no incentive to deviate to $x_i' < \frac{\bar{x}}{s}$, since firm d is then not bankrupt and firm i's loses from predation not being successful. If firm i deviates to $x_i' > \frac{\bar{x}}{s}$, firm d is still bankrupt, but firm i pays more. Another symmetric Nash equilibrium might exist: all firms provide zero. However, the first Nash equilibrium Pareto dominates the second, since predation is assumed to be profitable for the group of predators.

There is no symmetric equilibrium, x', where $x_i' > \frac{\bar{x}}{s}$. Firm i then has an incentive to deviate to $x_i'' = x_i' - \varepsilon$, since firm d will still be bankrupt, but firm i pays less. There is no symmetric equilibrium, x', where $x_i' \in (0, \frac{\bar{x}}{s})$. Firm i then has an incentive to deviate to $x_i'' = x_i' - \varepsilon$, since firm d will still not be bankrupt.

Case (ii): predation is not profitable for the group of strong firms. Consider the symmetric equilibrium candidate $x_i^* = 0 \forall i \neq d$. Firm i has no incentive to deviate to $x_i' \in (0, \bar{x})$, since firm d is still not bankrupt. If firm i deviates to $x_i' > \bar{x}$, firm d will be bankrupt, but firm i pays more than its profit increases.

There is no symmetric equilibrium, x', where $x_i' \in (0, \frac{\bar{x}}{s})$. Firm i then has an incentive to deviate to $x_i'' = x_i' - \varepsilon$, since firm d will still not be bankrupt. There is no symmetric equilibrium candidate, x', where $x_i' \geq \frac{\bar{x}}{s}$. Firm i then has an incentive to deviate to $x_i'' = 0$, since firm d will not be bankrupt, but firm i's cost decreases more than its profits. ■

Proof of Proposition 1

According to Lemma 1, there is no merger when predation is not an option and C1 holds. On the other hand, strong firms predate in period 1 and acquire owner d's assets in period 2, according to Lemmas 4 and 2, when C1, C2 and C3 hold. The fact that C1, C2 and C3 can hold simultaneously in the Salant et al model completes the proof. In the Salant et al model $\pi(a) = (\frac{\beta-\alpha}{a+1})^2$ in equilibrium, where a is the number of active firms. This implies that (1) $\pi_o' - \pi_o'' - (k_o - 1)\pi_s''' = \pi(m - (k_o - 1)) - \pi(m) - (k_o - 1)\pi(m - (k_o - 2)) =$

$$(\frac{\beta-\alpha}{m-k_o+2})^2-(\frac{\beta-\alpha}{m+1})^2-(k_o-1)((\frac{\beta-\alpha}{m-k_o+3})^2), \qquad (6.1)$$

where m is the number of active firms, if the k_o-1 assets remain with the initial owners. Consequently, C1 and C2 hold if $(\frac{\beta-\alpha}{m-k_o+2})^2-(\frac{\beta-\alpha}{m+1})^2-(k_o-1)(\frac{\beta-\alpha}{m-k_o+3})^2<0$. First, note that $m\geq k_o$ and $k_o\geq 2$. Then, note that $\frac{(\frac{\beta-\alpha}{m-k+2})^2}{(\frac{\beta-\alpha}{m-k+3})^2}=\frac{(m-k+3)^2}{(m-k+2)^2}<\frac{9}{4}$. Consequently, C1 and C2 hold if $k_o\geq 4$. Let $k_o=3$, then 6.1 yields $-2\left(\beta-\alpha\right)^2\frac{m^4-2m^3-2m^2+1}{(m-1)^2(m+1)^2m^2}<0$ for $m\geq 3$. Let $k_o=2$, then 6.1 yields $-\left(\beta-\alpha\right)^2\frac{m^2-2m-1}{m^2(m+1)^2}<0$ for $m\geq 3$.

(2) that we can rewrite $C3$: $-\frac{\bar{x}}{s}+(\frac{\beta-\alpha}{s+1})^2-(\frac{\beta-\alpha}{s+1+1})^2>0$ for small enough $\bar{x}$ ■

Proof of Lemma 6

According to the US failing firm defense rule, owner $i\neq d$ acquiring owner d's assets is the only possible acquisition. Note first that $b_e<v_e^e(d^p)$, since $b_e\geq v_e^e(d^p)$ is a weakly dominated strategy.

Consider the symmetric equilibrium candidate $\mathbf{b}^{d*}:b_i^{d*}=b^{d*}\geq b_e^{d*}\;\forall i\neq d,e$. If $b_i^{d*}<v_e^e(d^p)-\varepsilon$, then owner e has an incentive to deviate to $b_e^d=b_i^{d*}+\varepsilon$, since he will then obtain the assets according to the definition of S^f, but pay a price lower than his valuation of these. $b_i^{d*}>v_e^e(d^p)-\varepsilon$ cannot be an equilibrium strategy, since owner i then knows that with a positive probability, he is considered the smallest agent with a bid above b_e and correspondingly, obtains the assets according to the definition of S^f. He then benefits from deviating to $b_i^d=v_e^e(d^p)-\varepsilon$, since he still obtains the assets, but pays a lower price. Or, he is not considered the smallest agent with a bid above b_e, and then his payoff will not change if he deviates. Accordingly, he will deviate, since he gains with a positive probability. Last, consider the candidate $b_i^{d*}=v_e^e(d^p)-\varepsilon$. Then, no owner has an incentive to deviate. Thus, $b_i^{d*}=v_e^e$ is a Nash equilibrium and the only Nash equilibrium where owner $i\neq d,e$ obtains the assets.

Consider now the equilibrium candidate $\mathbf{b}^{d**}:b_e^{d**}\geq b_i^{d**},\forall i\neq d,e$. Then, owner e obtains the prey according to the definition of S^f. Note that $b_e<v_e^e(d^p)-\varepsilon$. But owner i might then deviate to $b_i^d=b_e^{d**}+\varepsilon$ and obtain the assets according to the definition of S^f, but pay a price lower than his valuation of obtaining them, since $v_i^{ie}(d^p)>v_e^e(d^p)$ by assumption. Thus, owner e will not obtain the assets in equilibrium. ■

Proof of Proposition 3

We have that

(1) $x^s-x^l=s(\pi_2(1,...,1,0)-\pi_2(1+d^p,1...,1,0))\geq 0$ by assumption A2.

(2) $x^f - x^l = \pi_1(1 + d^p, 1, ..., 1, 0) - v_e^e(d^p) - \pi_2(1 + d^p, 1, ..., 1, 0) > 0$, since $\pi_1(1 + d^p, 1, ..., 1, 0) - \pi_2(1 + d^p, 1, ..., 1, 0) = v_i^{ij}(d^p) > v_e^e(d^p)$ by assumption.

(3) $x^s - x^f = (s-1)(\pi_1(1, ..., 1, 0) - \pi_1(1, 1+d^p, 1, ..., 1, 0)) - v_i^{ie}(d^p) + v_e^e(d^p) \lesseqgtr 0$, since $v_e^e(d^p) \in (0, v_i^{ie}(d^p))$. ■

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