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Abstract

In our paper targets, by setting a reserve price, screen acquirers on their (expected) ability to generate merger-specific synergies. Both empirical evidence and many common merger models suggest that the difference between high- and low-synergy mergers becomes smaller during booms. This implies that the target's opportunity cost for sorting out relatively less fitting acquirers increases and, hence, targets screen less tightly during booms, which leads to a hike in merger activity. Our screening mechanism not only predicts that merger activity is intense during economic booms and subdued during recessions but is also consistent with other stylized facts about takeovers and generates novel testable predictions.

JEL Classification Numbers: D21, D80, L11.

Key Words: Takeovers, Merger Waves, Defense Tactics, Screening

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1 Introduction

The existence of periods of intense merger activity, typically referred to as merger waves, is well documented (Andrade and Stafford, 2004).[1] Merger activity usually heats up in economic booms and slows down in recessions (see e.g. Maksimovic and Philips, 2001). Empirical papers point to various exogenous economic factors like technological innovations or demand booms as triggers of merger waves. Economic merger theories predict that when economic conditions are better, mergers should be more profitable and therefore more likely to occur (see Harford, 2005, for a discussion of these theories and empirical evidence). These theories, however, do not address a number of stylized facts about mergers. For example, they do not explain why wave mergers are on average less efficient (Rosen, 2006) or why initiated mergers are more likely to be abandoned during downturns (see Figure 1).[2]

We propose a merger screening mechanism that—despite its simplicity—is consistent with stylized facts about mergers, and provides novel testable predictions. In our model, the acquirer possesses more information about the synergy gains than the target (as e.g. in Hirshleifer and Titman, 1990 and Shleifer and Vishny, 1986). The target has less information on the goodness of fit, but can commit to a reserve price (Cramton, 1998; Jehiel and Moldovanu, 2000; Inderst and Wey, 2004). As argued by Cramton, this may be done in reality through the use of defense tactics.[3] When setting a reserve price, the target considers the following trade-off: by requesting a high reserve price, it extracts more

[1] Weston et al. (1990) and Martynova and Renneboog (2005) provide excellent reviews of the literature.

[2] Figure 1 indicates that during the period 1990-2005 the relative number of merger abandonments in the US was higher when economic conditions (as measured by quarterly growth in GDP) were worse. The negative correlation of -0.35 is statistically significant at a 1% level. The figure and correlation are based on quarterly grouped U.S. data from the SDC Mergers and Acquisitions database of Thomson Financial, which provides information on announced M&As valued at $1 million or more.

[3] More generally, by allowing the target to set a reserve price, we utilize the simplest incomplete information bargaining model that is consistent with the target having substantial bargaining power. Practioners and researchers emphasize that—partially due to defense tactics and antitakeover laws—targets have indeed strong bargaining power in the merger process (see e.g. Fuller et al., 2002).

merger rents whenever the post-merger synergy gains are high.[4] In doing so, however, the target risks that it cannot sell if the acquirer turns out to be a relatively worse fit.[5] The target thus compares the gains of setting a high price—and thereby screening the acquirers—to setting a low price and selling for certain—i.e. pooling the acquirers.[6]

We argue that in a boom efficiency gains become relatively less important and, hence, high-type mergers become more similar to low-type mergers. This raises the opportunity cost of sorting out relatively inefficient acquirers as their relative value increases. The target, therefore, sets a reserve price that is acceptable to both high- and relatively low-type acquirers—leading to a hike in mergers. Thus, an exogenous upward shift in the economic conditions causes a lack of screening and, as a consequence, a merger "cluster" or merger "wave".

Hence, central to our argument is the following: improvements in the economic environment make synergy gains relatively less important in the sense that profits of high- and low-type mergers become relatively more similar. This assumption is in line with empirical evidence, which indicates that during booms output shares are reallocated from more-productive to less-productive firms, so that the latter produce relatively more (Lee, 2007; Eisfeldt and Rampini, 2006). Applying Boone's (2000, 2007) results on output reallocation and competition, this suggests that low-type merged firms are punished less harshly for being inefficient when economic conditions are better, and hence earn profits

[4]The hostile takeover of Peoplesoft by Oracle in 2004 fits this setup. Oracle launched a bid in February offering $21 per share. Peoplesoft in response triggered a poison pill and a "Customer Assurance Program", specifying money-back guarantees for customers if PeopleSoft were acquired by Oracle or SAP. Oracle and Peoplesoft finally agreed in December on a takeover price of $26.5 per share.

[5]The failed takeover of Salix by Axcan, two Canadian pharmaceuticals, fits this setup. Salix' shareholders allowed the use of a poison pill, stating that "Mergers and acquisitions must be considered, but one thing we cannot do is allow someone to buy us on the cheap." Axcan initiated a takeover of Salix in April 2003. Due to Salix' defense tactics Axcan finally abandoned its attempt in June, although having raised the bid several times in between.

[6]The use of defense tactics as a successful screening device is consistent with empirical evidence. Comment and Schwert (1995), for example, show that defense tactics lead (i) to higher takeover prices when the takeover takes place, but (ii) also force some acquirers to abandon mergers they had previously initiated. Of course, however, defense tactics may also be motivated by agency problems.

that are relatively more similar to those of high types. We also show below that this assumption is satisfied in most of the commonly used simple horizontal merger models.[7]

The lack of screening during booms not only helps explain procyclical spikes in merger activity but also predicts that more efficient acquirers extract higher rents during booms. This is consistent with recent evidence that in a merger wave bidders gain on average higher (short term) abnormal returns than bidders outside a wave (Harford, 2003; Gugler et al., 2006; Rosen, 2006).[8] Furthermore, in line with our mechanism, Carow et al. (2004) find that during waves high-type acquirers earn relatively more from a merger than low-type acquirers. At the same time, we also explain why, on average, mergers that occurred in a wave are less efficient than non-wave mergers. Mergers during a baisse should stay relatively more profitable in the long term, since these are better filtered out by the target. Indeed, in the long term, wave mergers perform on average significantly worse than non-wave mergers, as Gugler et al. (2006), Harford (2003) and Rosen (2006) document. In our model, merged entities may be even less efficient than non-merging firms—consistent with empirical evidence in Carow et al. (2004).

Other recent theoretical work has made advances in explaining the procyclicality of merger activity. The first strand, to which we will refer as "economic shock" theories relies on economic fundamentals. Lambrecht (2004) shows that when merger synergies

[7]A noteworthy exception is a homogenous-good Cournot model with constant marginal costs in which a merger can be interpreted as the closure of the less efficient firm. This model provides a rationale for excess capacity-reducing mergers and can be used to explain merger clustering in troubled industries (see Fauli-Oller, 2000). A sufficient condition for Cournot models to satisfy our assumption is that mergers absent efficiency gains are profitable as is often the case with product differentiation or increasing marginal costs (see Perry and Porter, 1985 and our results below).

[8]Some of the stylized facts come from the so-called "event-studies", which measure the stock price changes after a merger (announcement). They are based on three assumptions (see e.g. Cox and Portes, 1998): (i) the semi-strong version of the "efficient markets hypothesis", (ii) that merger announcements are unanticipated, and (iii) that there is no interference by confounding effects. Despite these underlying assumptions, event studies dominate the empirical research on mergers and acquistions, since they are less prone to individual bias and arguably rely on less questionable assumptions than valuations produced through such alternative methods as discounted cash flow analysis or accountancy data.

are an increasing function of a stochastic product market demand, then each firm's payoff from merging has features similar to call options. Firms therefore have an incentive to merge—exert their option—in periods of economic expansion. Toxvaerd (2004) shows that if an increase in an economic fundamental increases the number of expected future mergers, this in turn can induce preemptive mergers today, leading to cluster effects. Jovanovic and Rousseau (2002) argue that technological shocks may lead to a higher dispersion of efficiency in an industry. This leads to a reallocation of physical assets from less efficient targets to more efficient acquirers. Rhodes-Kropf and Robinson (2008), on the other hand, predict that mergers occur between firms with similar efficiencies and complementary assets. Since search costs are lower during economic booms, they predict that economic booms induce more assortative matching because firms can search longer for the ideal partner.

The second strand of literature, called "misvaluation" theories, builds on stock market misvaluations. Shleifer and Vishny (2003) argue that acquirers with temporary overvalued shares interchange these shares for real assets of undervalued targets, which targets are willing to accept due to having shorter time horizons. Rhodes-Kropf and Viswanathan (2004) develop a model of uncertainty about sources of misvaluation. Targets with imperfect information will accept more bids from overvalued bidders during market valuation peaks because they overestimate synergies during these periods. Similar to ours, the above mentioned theories find pro-cyclical merger clustering. We highlight the observable differences between our predictions and those of these existing theories in Section 5 below.

The paper is structured as follows. In the next section, we introduce the model. Section 3 establishes, based on one potential acquirer per merger-match, our screening mechanism and provides sufficient conditions and examples. In Section 4, we outline the case of multiple potential acquirers and derive the optimal selling mechanism when partial ownership suffices to generate the merger synergies. Section 5 discusses our predictions. Finally, in Section 6, we conclude. All proofs are relegated to the Appendix.

2 Model

We now introduce a simple takeover process in a general model of firm competition. In the subsection thereafter, we relate the merging profits to the state of the economy.

2.1 A simple takeover process

A given firm, "the acquirer", is potentially interested in buying another firm, "the target".[9] There are two types of potential acquirers, one that is of good fit—i.e. one that should be able to realize high synergies from merging with the target ("high type")—and one that is less fitting ("low type").[10] Let π^H and π^L be the post-merger joint profits if the acquirer is of high and low-type, respectively, with $\pi^H > \pi^L$. Let π^T be the target's and π^A the acquirer's profit in the absence of a merger. We denote the net merger gain of a high-type merger by $\Delta\pi^H$, i.e. $\Delta\pi^H \equiv \pi^H - (\pi^T + \pi^A)$. Similarly, let $\Delta\pi^L$ be the net merger gain of a low-type merger.

The acquirer has informational advantages about the profitability of the transaction. Indeed, having better information is consistent with acquirers being, on average, substantially larger, older, and more experienced in merger activities than targets (see e.g. Rhodes-Kropf et al., 2005). Furthermore, the acquirer knows better than the target how much synergies can be realized, since it will be in charge of post-merger operations and synergy realizations.[11] Formally, the common prior probability that the acquirer is of

[9] Our paper follows much of the literature in assuming that there is an exogenously assigned target and acquirer(s). (In Section 4 we consider multiple potential acquirers.) While it would be interesting to also endogenize the choice of the target, we think that the case with an exogenous target is an important and realistic one, at least in the short term. The rationale behind this assumption is that some firms—the potential acquiers—are at a point in time higher valued (e.g. Shleifer and Vishny, 2003; Rhodes-Kropf and Viswanathan, 2004), more productive (e.g. Fauli-Oller, 2000; Jovanovic and Rousseau, 2002), and/or better managed (e.g. Lambrecht and Myers, 2007) than others —the potential targets. See Inderst and Wey (2004) and Toxvaerd (2004) for further motivation of this assumption.

[10] For ease of exposition, we present the two-type model. Our main insights can be replicated for a continuous distribution of types.

[11] Hirshleifer and Titman (1990) and Shleifer and Vishny (1986) also introduced acquirer informational

high type is $q \in (0, 1)$. Prior to the merger process, however, the acquirer receives a more precise signal about whether it is a high- or a low-type acquirer. For simplicity, we assume the extreme case where the acquirer receives a perfect private signal, while the target receives no or a completely uninformative signal.

The target, however, extracts information by setting a price, r, at which it is willing to sell the company. As for example in Jehiel and Moldovanu (2000), Inderst and Wey (2004), and Pavel and Singh (2006), we thus assume that the target can commit to an optimal reserve price.[12] As Cramton (1998) points out, an implicit reserve price can be set by employing different defense tactics.[13] The use of defense tactics as a successful screening device is also consistent with empirical evidence. In line with our screening theory, Comment and Schwert (1995), among others, show that defense tactics lead (i) to higher takeover prices when the takeover takes place, but (ii) also force some acquirers to abandon mergers they had previously initiated. Overall, however, takeover defenses appear to be successful devices: takeover premia are higher on average, even after taking into account abandonments.[14]

The timing of the takeover process is as follows. First, the target sets a reserve price at which it is willing to sell the company. Second, the acquirer either accepts or rejects. If it accepts, the merger is carried out—i.e. the target receives a payoff of r and the acquirer obtains the target's production facility. Otherwise, the merger is abandoned. Finally, the above specified profits are obtained. Notice that by allowing the target to make a

advantages in takeover models. This informational advantage is often invoked to explain the empirical finding that acquirers sometimes realize gains from a takeover (see Barney, 1986, for an early discussion).

[12]Pavel and Singh (2006) assume that one of the potential bidders has superior information about the target and investigate the optimal selling procedure in this case, which can be implemented as a sequential auction that may require a reserve price.

[13]Cramton (1998) states that "A target's board has a great deal of discretion in establishing procedures...This power arises from the target's prior issuance of a poison pill... poison pills afford the board a (limited) ability to set a reserve price."

[14]Other commentators, however, have argued that takeover defenses might also be used for the benefit of the target's management, while being harmful for its shareholders. See Heron and Lie (2006) for a recent discussion on this issue.

take-it-or-leave-it offer, we choose a simple incomplete information bargaining model in which the target has all the bargaining power in the merger process.[15]

2.2 Merger gains and economic conditions

Profits from merging, as well as the profits in absence of a merger, depend on the underlying economic conditions (e.g. consumer demands, production costs, etc.). Let the economic conditions be parameterized by a real variable $b \in [b_{\min}, b_{\max}]$ with the interpretation that firms' profits—with and without a merger—are higher if b is greater. For a given economic condition b, we denote the high and low-type merger gains as a function of the economic conditions by $\Delta\pi^H(b)$ and $\Delta\pi^L(b)$, respectively, with $\Delta\pi^H(b)$ and $\Delta\pi^L(b)$ being continuously differentiable and $\Delta\pi^H(b) > \Delta\pi^L(b)$ for any b.

We next present the two assumptions that drive our main results. They specify a relation between the net gains from merging and economic conditions in a general framework, without specifying a market model. Below in Sections 3.2 and 3.3, we will show that these conditions are satisfied for a variety of horizontal, conglomerate and vertical merger models.

Our first condition postulates that net profit differences between high- and low-type mergers are less pronounced when economic conditions are better.

Assumption 1 *The ratio between the net merger gains of a high-type merger and a low-type merger decreases as the economic condition b becomes better. Whenever $\Delta\pi^L(b) \neq 0$,*

$$\frac{\partial}{\partial b}\frac{\Delta\pi^H(b)}{\Delta\pi^L(b)} < 0. \tag{1}$$

Empirical evidence suggests that this condition is satisfied in practice. In economic downturns (i) the more efficient firms produce a relatively higher share of total output (Lee, 2007), and (ii) the total factor productivity rates are more dispersed (Eisfeldt and

[15] Defense tactics enhance the bargaining power of the target with respect to the acquirers, as practitioners and researchers have long acknowledged. As for example Fuller et al. (2002) state "In the 1980s, takeover defenses adopted by firms, state antitakeover laws, and judicial decisions protecting targets all developed to further shift the bargaining balance from bidders to targets."

Rampini, 2006).[16] An increased output dispersion in downturns in favor of the more efficient firms is also consistent with the so-called "cleansing effect" of downturns, predicted by, among others, Caballero and Hammour (1994).

Boone (2000, 2007) shows that firms are punished more harshly for being inefficient in more "competitive markets", which he defines as markets with more output reallocation. In particular, Boone (2000) shows in a number of specific horizontal market models that the relative profits of an efficient firm with respect to a less efficient firm are increasing in the level of reallocation. Boone (2007) then shows in a general framework that the relative profit differences of an efficient firm and a less efficient firm—with respect to a third firm in the industry—are also increasing in the level of reallocation. Given that more output reallocation coincides with worsening economic conditions (Lee, 2007; Eisfeldt and Rampini, 2006), our condition can be viewed as adopting Boone's (2007) result to a merger context. That is, we postulate that the net profits of a (hypothetical) high-type merger increases relative to those of a (hypothetical) low-type merger when the economic conditions become worse—consistent with the observation that relatively more output is reallocated towards high-type firms when economic conditions are worse. This reallocation effect is reinforced if mergers involve significant, mainly fixed up-front restructuring costs,[17] which also work in favor of Assumption (1).[18]

Our second condition states that if a given merger is profitable for a certain economic condition, then it is strictly profitable when economic conditions are better. Since the

[16] Lee (2007, p1) states that: "Output shares are reallocated from less-productive to more-productive plants during recessions, so that during recessions, less productive firms produce less of the total output, but during expansions they produce more." Eisfeldt and Rampini (2006, p371) furthermore state that: "Our finding of countercyclical productivity dispersion across firms and sectors adds to the empirical support for increases in heterogeneity in recessions."

[17] Lambrecht (2004), for example, highlights that mergers involve significant one-of costs, such as legal fees, fees to investment banks and other merger promoters, and the costs of restructuring and integrating the two companies (see also Houston et al., 2001).

[18] To see this, abstract from the reallocation effect and suppose that merger profits absent the fixed up-front restructuring costs R are positive and proportional to the economic condition b for both types, i.e. $\Delta\pi^j(b) = b(\Delta\pi^j(b_{min}) + R) - R$ for $j \in \{L, H\}$. In this case Assumption (1) holds whenever $R > 0$.

high-type is always more profitable than the low-type merger, the condition can be stated in terms of the high-type merger.

Assumption 2 *If a high type merger is profitable, $\Delta\pi^H(b) \geq 0$, for a given economic condition b, then it is strictly profitable for any economic condition $b' > b$.*

In contrast to the "economic shock" theories that we discuss in the introduction, in our model it is unnecessary that the net gains from merging are increasing in the economic condition. As we will show in the next section, it is not even necessary that better economic conditions make previously unprofitable mergers profitable.

3 Screening and merger clusters

3.1 The screening mechanism

We now explain how the "bare bones" of our screening mechanism work, using Assumption (1) and a sufficient condition for Assumption (2); namely, we assume that all mergers are profitable. This highlights the two main differences between our framework and the economic shock theories. First, in our mechanism, some profitable mergers are abandoned. Second, it is unnecessary that mergers become *more* profitable as the economic conditions improve.

Proposition 1 *If Assumption (1) is satisfied and mergers are profitable for any economic condition, i.e. $\Delta\pi^L(b) \geq 0$ for any b, then there exists $\bar{b} \in [b_{\min}, b_{\max}]$ such that if $b < \bar{b}$ only high-type mergers take place, whereas if $b > \bar{b}$ all mergers take place.*

Although mergers involving both type of acquirers are profitable, the target might set a reserve price that does not accommodate low-type acquirers. By screening the acquirer through a "high reserve price", the target can extract all post-merger efficiency gains if it, indeed, meets a high-type acquirer. But, by doing so, the target risks that the takeover will be abandoned because low-type acquirers are unwilling to pay such a high reserve price. On the other hand, to ensure that the takeover gets consummated, the target needs to set a "low reserve price", which all types of acquirers are willing to accept.

If the economic conditions are "bad", $b < \overline{b}$, the merger gains with a low-type acquirer are small and, hence, the opportunity cost of setting a high price is low. The target thus screens acquirers when the economic conditions are sufficiently bad. As the economic conditions become better, high- and low-type mergers become more similar (Assumption 1). Setting a price that is also acceptable to low-type acquirers becomes therefore more and more attractive as lower types become relatively more similar to higher types. Thus, above a critical economic condition, $b > \overline{b}$, the target strictly prefers to set a pooling reserve price. This has two immediate implications. As the economic conditions improve, targets become less selective and, hence, also merge with acquirers when synergy gains are lower. Also, because better economic conditions ($b > \overline{b}$) imply less screening, the (average) reserve price is lower than if the target had complete information about the potential synergy gains.

In a second step, using assumptions (1) and (2), we present our main result, which accommodates a "full" wave—i.e. an increase from no merger activity to maximum merger activity when economic conditions improve.

Proposition 2 *If Assumptions (1) and (2) are satisfied, there exist* $\underline{b}$ *and* $\overline{b} \in [b_{\min}, b_{\max}]$ *such that if* $b < \underline{b}$ *no merger takes place, if* $\underline{b} < b < \overline{b}$ *only high-type mergers take place, and if* $b > \overline{b}$ *all mergers take place.*

Thus, our screening model predicts that as economic conditions improve target firms set a reserve price such that no, some or all acquirers find it acceptable. At first, for bad economic conditions, mergers are unprofitable and, hence, any merger would involve losses for either the target or the acquirer, or both. The target sets a reserve price that is unacceptably high for any acquirer. For better economic conditions, the target sets a separating and for even better conditions a pooling reserve price. Thus, we have a full model of merger waves.

The proposed screening mechanism is consistent with the fact that relatively more mergers are abandoned during relatively worse economic conditions (see Figure 1). An acquirer, with positive information about an eventual merger, might approach a potential target. But the latter—e.g. by using defense tactics—sets a reserve price that is too high for a low-type acquirer. In contrast, when the economic conditions are better, the reserve price is chosen such that all potential acquirers find it acceptable. This predicts not only more mergers but also that less previously initiated mergers are abandoned.[19]

3.2 Market power and efficiency gains: conditions and examples

We have already argued that Assumptions (1) and (2) are consistent with the empirical findings on the intensity of competition during booms and recessions. We now decompose the gains from horizontal mergers into those from enhanced market power and those from efficiency gains. This decomposition allows us to derive simple sufficient conditions, which are naturally satisfied by a wide variety of oligopolistic merger models and ensure that Assumptions (1) and (2) hold.

Define the hypothetical profits of a merged firm if there were no efficiency gains or losses as π^N. Then one can decompose the net profits of a horizontal merger into efficiency and market power gains, $\Delta\pi^H = \Delta\pi^{E,H} + \Delta\pi^M$, where $\Delta\pi^{E,H} \equiv \pi^H - \pi^N$ and $\Delta\pi^M \equiv \pi^N - (\pi^T + \pi^A)$; and with equivalent definitions $\Delta\pi^L = \Delta\pi^{E,L} + \Delta\pi^M$. Suppose throughout this subsection that the high-type merger generates efficiency gains $\Delta\pi^{E,H} > 0$, but that the low-type leads to either efficiency gains or losses. The following corollary provides sufficient conditions for Assumptions (1) and (2).

Corollary 1 *Assumptions (1) and (2) are satisfied if (3a) $\Delta\pi^M(b) > 0 \quad \forall b$ and if the following two ratios are decreasing for better economic conditions b, at least one of them strictly; i.e. whenever defined,*

$$\text{(3b)} \quad \frac{\partial}{\partial b}\frac{\Delta\pi^{E,H}(b)}{\Delta\pi^{E,L}(b)} \leq 0 \quad \text{and (3c)} \quad \frac{\partial}{\partial b}\frac{\Delta\pi^{E,H}(b)}{\Delta\pi^{M}(b)} \leq 0.$$

Assumption (2) is trivially satisfied because positive efficiency gains $\Delta\pi^{E,H} > 0$ together with market power gains (3a) make the high-type merger always profitable. Suf-

[19] As argued in Section 5, a more direct empirical test of our proposed mechanism would be to ask whether defense tactics are indeed employed more often when economic conditions are relatively worse.

ficient conditions for (1) can be obtained by comparing the relationship between the economic cycle and the relative importance of efficiency gains and market power gains. In particular, Condition (3b) tells us that the efficiency gains of a low-type merger increase relative to a high-type merger for better economic conditions (despite always being lower). Thus, whether one merges with a high or a low type matters relatively less during booms. Condition (3c) tells us that profits from efficiency gains become relatively less important than profits from market power. Both ratios together, therefore, state that when economic conditions improve, it becomes less important to merge with the most efficient firm.

We now present some merger models that satisfy the conditions of the corollary and provide counterexamples. In particular, we first show that several models of price competition satisfy the sufficient conditions of our corollary. We then show that for a simple model of conjectural variations condition (3b) is always satisfied, while conditions (3a) and (3c) are satisfied as long as market power gains are positive. As a special case we establish a counterexample: if firms compete in a homogenous good market à la Cournot with constant marginal cost condition (3c) is violated and, in fact, also Assumption (1) is violated. We finally, however, establish that if absent efficiency gains a merger is profitable in a Cournot environment, the conditions of the corollary hold. For each example in this section, we give details of (i) the market model, (ii) the impact of the merger process, and (iii) the economic conditions in the model (our general variable b). All claims related to the examples are proven in the Appendix B.

Deneckere and Davidson (1985) argue that merger models based on price competition with differentiated good can explain observed horizontal merger activity. We begin our discussion of horizontal merger models with their classic setup. This setup satisfies conditions (3a), (3b) and (3c).

Example 1 Bertrand with differentiated goods (Deneckere and Davidson, 1985): *(i) Consider an industry with n single-product firms competing in prices and producing, at constant and identical unit costs c, differentiated products where the demand for firm i is given by $x_i = \frac{1}{n}\left(\upsilon - p_i(1+\gamma) + \frac{\gamma}{n}\Sigma_{j=1}^{n} p_j\right)$, where $\upsilon > c$ and $\gamma \geq 0$, which represents the* *degree of substitutability between the n products.*[20] *(ii) Consider a bilateral merger that reduces the marginal costs of the merging firms to a proportion e_H or e_L of the pre-merger level, depending upon whether the merger is a good or a bad fit, where $e_H < e_L < 1$. (iii) Suppose that the economic condition b is parameterized by the common intercept of the individual demand functions.*

We next consider other forms of competition than price competiton. We continue with a stylized (behavioral) model of horizontal competition with differentiated products that satisfies conditions (3a), (3b) and (3c).

Example 2 Conjectural variations with market power gains (Kwoka, 1989): *(a) Consider an industry with n single-product firms producing, at constant and identical unit costs c, differentiated products where the inverse demand for firm i is given by $p_i = M - \Sigma_{j=1}^{n} q_j$ where $M > c$. Suppose that the sum of the rivals' reactions to an increase in a firm's quantity (i.e. the ith firm's conjectural variation with respect to the rest of the industry, $\Sigma_{j=1,j\neq i}^{n} \frac{\partial q_j}{\partial q_i}$) is constant across firms and denoted by V. Firms' conjectural variations range from -1 to $(n-1)$. A conjectural variation of -1 represents a competitive environment; regardless of the number of firms present, each expects an "accommodating" output response from the rest of the industry. Hence, each is induced to produce up to the point where price equals marginal cost. At the other extreme, the fully collusive result emerges with a conjecture of $(n-1)$. This represents the anticipation that the remaining firms will fully match output changes by a particular firm. These extremes bracket among others the Cournot case, where $V = 0$. In this familiar example, output may vary from the monopoly level (when $n = 1$) to the competitive outcome (when n increases without limit). (ii) Consider a bilateral merger that reduces the marginal costs of the merging firms to either $\underline{c} < c$ or $\bar{c} > \underline{c}$. Firms' behavior—given by V—remains identical after the merger. Finally, suppose that mergers are profitable absent efficiency gains, i.e. that $1 + 2(n+V) - (n+V)^2 > 0$.*[21] *(iii) The economic condition b is parameterized by the common intercept of the individual demand functions or the stand-alone marginal cost c,*

[20] This demand function can be obtained from a quasi-linear utility function (see Motta, 2004).

[21] For $n = 2$, a merger without efficiencies is always profitable (indeed $V \leq n - 1 = 1$). For $n = 3$, the

in which case $b = -c$ *and* $0 < \underline{c} = \overline{c} - k_1 = c - k_1 - k_2 < M$*, for some positive constants* k_1 *and* k_2*.*

The assumption that mergers absent efficiency gains are profitable is not innocuous however. For example, the Cournot competition is a special case of the above setup and, as demonstrated in Salant et al. (1983) for $n \geq 3$, a bilateral merger absent efficiency gains is unprofitable in this model. Indeed, neither our screening conditions nor Assumptions (1) and (2) are satisfied in this particular Cournot merger model in which—as first demonstrated by Fauli-Oller (2000)—merger activity coincides with low demand.

Example 3 Cournot model with homogenous goods (Fauli-Oller, 2000): *(i) Consider an industry with* 3 *firms competing in quantities and producing, at constant and identical unit costs* c*, homogeneous products where the inverse demand for firm* i *is given by* $p_i = M - b\Sigma_{j=1}^{n} q_j$ *where* $M > c$*. (ii) Suppose that there is a single bilateral merger, which reduce the merging firms marginal costs to* $\underline{c} < c$ *or* $\bar{c} > \underline{c}$*. (iii) Suppose that the economic conditions are parameterized by the common intercept of the individual demand functions.*

As the above counterexample illustrates, if firms compete a la Cournot, merger waves due to less screening may not coincide with better economic conditions.[22] If, however, due to convexities in the cost function or product differentiation, mergers that do not induce efficiency gains are profitable in Cournot setup, then conditions (3a), (3b) and (3c) hold as we illustrate in the next two examples. As noted by Perry and Porter (1985), increasing marginal costs (or product differentiation) are crucial for yielding sensible descriptions of

previous equation is only satisfied if $V < 0.58$ and it is never satisfied for $n = 4$ or more (see also Kwoka, 1989).

[22] The most common interpretation of the "constant-marginal-cost" Cournot merger model is that the merger leads to the closure of the less efficient merger participant (see Perry and Porter, 1985). From this perspective, Fauli-Oller (2000) provides a rationale for elimination of excess capacity in declining industries. A case study of Dutz (1989) and casual evidence in Lambrecht and Myers (2007) indicate that this has occurred in some particular troubled industries. The systematic evidence on merger waves, however, clearly indicates that merger activity is on average highly procycliclal (see e.g. Gugler et al, 2006).

mergers in a Cournot framework. In contrast to Example 3, the new entity can produce with a better technology then either of the merging firms in the Perry and Porter model because it combines the assets of the merging firms. Creating a single firm that owns the capital of the merging firms is equivalent to setting up a new entity that manages the forming firms as plants and has therefore lower marginal costs. In contrast, in a model with constant or decreasing average costs, possibly varying across firms, mergers would lead to the shutdown of all but one plant(s), which is almost never observed in real mergers. Similarly, in the differentiated products interpretation, the merged entity could produce several differentiated products rather than a single homogeneous good as firms absent a merger do, and thus a merger changes the production technology (Vives, 2002). As the following two examples illustrate, plausible Cournot merger models satisfy Conditions (3a), (3b) and (3c).

Example 4 Differentiated Cournot model with market power gains: *(i) Consider an industry with n firms competing in quantities and producing, at constant and identical unit costs c, differentiated products where the inverse demand for firm i is given by $p_i = \beta - (1+\frac{\lambda}{2})q_i - \Sigma_{j\neq i} q_j$ where $\beta > c$ and λ represents the (symmetric) degree of differentiation between the products. (ii) Consider a bilateral merger that reduces the merging firms marginal cost to either $\bar{c} < c$ or $\underline{c} < \bar{c} < c$. Finally, suppose that the product differentiation is sufficiently high so that mergers are profitable absent efficiency gains. (iii) The common intercept of the individual demand functions β parameterizes the economic condition.*

Example 5 Cournot model with increasing marginal costs and market power gains (Perry and Porter, 1985): *The above differentiated product model can be reinterpreted as a Cournot market with homogeneous goods and increasing marginal costs. Following Perry and Porter (1985), suppose marginal cost curves are linear and strictly increasing, $MC_i(q_i) = c + \lambda q_i$. Then profits of a single-plant firm i can be rewritten as $\pi_i = \left(\beta - \Sigma_{j=1}^{n} q_j\right) q_i - \left(c + \frac{\lambda}{2} q_i\right) q_i$, and the analysis is equivalent to the one with differentiated products. Finally, we suppose that the cost functions are sufficiently convex so that mergers are profitable absent efficiency gains.*

We now discuss a simple, but fairly general, multi-product setup that satisfies conditions (3a), (3b) and (3c) in which we realistically assume that a merger involves up-front restructuring costs. A special case of this example, Salop (1979)'s circular-city model with quadratic transportation costs was analyzed in an earlier version of this paper (Banal-Estañol et al. 2006).

Example 6 Multiplicative demand with synergies *(i) Consider a differentiated-product industry with n-multi-product firms that compete in prices. Let* $D_l(p, S) = SD_l(p)$ *be the demand for a product* l *for a given price vector* p *and market size* $S \in [\underline{S}, \overline{S}]$*, where we without loss of generality normalize* $\underline{S} = 1$*. Let* c_l *be the marginal cost of producing good* l*. Let* I *denote the set of products produced by* i *and* J *denote the set of products produced by firm* j*. Suppose—as will be the case for a well-behaved demand system—that absent a merger there is a unique equilibrium price vector* p *of the market game in which firm* i*'s profits are* $\pi_i(p^*, S) = \sum_{l \in I}(p_l^* - c_l)D_l(p^*, S)$*. (ii) Consider a bilateral merger between firms* i *and* j *that requires fixed restructuring costs* $R > 0$ *and leads to a vector of marginal costs that is either* $\underline{c} \in R_+^{IxJ}$ *or* $\overline{c} \in R_+^{IxJ}$*. Suppose furthermore—as will be the case for a well behaved demand system—that there exists a unique equilibrium price vector following a merger. Without loss of generality, suppose that the merged firm's profits are higher for the realization of marginal costs* $\underline{c}$*, i.e.* $\pi^H(p^{*,H}, \underline{S}) > \pi^L(p^{*,L}, \underline{S})$*. Suppose that mergers are profitable, i.e.* $\pi^L(p^{*,L}, \underline{S}) > \pi_i(p^*, \underline{S}) + \pi_j(p^*, \underline{S})$*, which absent changes in marginal costs is typically the case in a differentiated price competition model. Finally, we impose that after a hypothetical merger that requires restructuring costs* R *but leaves marginal cost unchanged, there exists a unique equilibrium price vector for which the merged firm's profits are lower than when the marginal cost vector changes to* $\underline{c}$*, i.e. for which* $\pi^N(p^*, \underline{S}) < \pi^H(p^*, \underline{S})$*. This generalizes the idea of synergy gains to a multi-product environment.*[23] *(iii) Here, the market size* S *parameterizes the economic condition* b*.*

[23] Of course, it is unnecessary that the marginal cost vector $\underline{c}$ has component-wise lower marginal costs than c to satisfy this condition. Interestingly, if one relaxes the assumption that there are synergy gains after a high-type merger—i.e. suppose that even a high-type merger leads to an increase in marginal costs but mergers are profitable due to market power gains– then this example would violate the conditions of the corollary but it would nevertheless satisfy Assumptions (1) and (2).

We next summarize which horizontal market models satisfy the conditions of our general screening setup.

Proposition 3 *The horizontal market models introduced in Examples 1, 2, 4, 5, and 6 satisfy conditions (3a), (3b) and (3c), and therefore Assumptions (1) and (2). As a consequence, in these horizontal merger models there is less screening and higher merger activity during economic booms (i.e. for a higher b).*

Let us give an intuitive explanation of which qualitative features of market competition coincide with our main Assumption (1). Better economic conditions enlarge the size of the market, i.e. the "pie", to be distributed between competitors. Both the merged firm—whether low or high type—and the outsiders to this merger gain more during better economic conditions. Of course, high-type mergers gain a larger share of this pie than low-type mergers. What does potentially change with better economic conditions, however, is *how much* larger a high-type piece of the pie would be relative to a low-type piece of the pie. This change in distribution is determined by outsiders' changing reaction towards the merger. In response to better economic conditions, they may either react more aggressively—"agressive" being defined by increasing production or decreasing prices in response to a merger—or react more softly—"soft" being defined as decreasing production or increasing prices in response to a merger. A more aggressive response during better economic conditions makes relative merger efficiencies more important and thus high- and low-type mergers more different, while a softer response by outsiders makes them less important, in which case Assumption (1) tends to be satisfied.

The responses by outsiders are in turn determined by the type of competition prevailing in the market. First, in the case of price competition (Example 1), when the pie is larger outsiders increase prices more and thus react more softly in response to a merger. Second, in the case when firms compete "fiercely" in quantities, which is the case for homogenous products and constant marginal costs (Example 2), a larger pie induces outsiders to increase production more and thus react more aggressively in response to a merger. If, instead, the merging firms are sufficiently insulated from competitors—due to firms competing in quantities with differentiated products (Example 3) or facing increasing marginal costs (Example 4)—a merger induces a relatively less aggressive response from outsiders.

Third, if outsiders react in the same way towards a merger when the pie becomes larger (Example 5), the relative shares for high- and low-type mergers remain constant across changing economic conditions. But, under the realistic assumption that mergers involve fixed restructuring costs, relative net profits become more similar for better economic conditions. Indeed, fixed restructuring costs always work in favor of Assumption (1).[24]

3.3 Non-horizontal merger models

We next consider a conglomerate and a vertical merger example. In these non-horizontal merger examples only efficiency gains play a role and it is straightforward to establish that Assumptions (1) and (2) are satisfied. Thus, we would expect our results to hold for non-horizontal mergers as well.

To begin with, consider the common case in which firms merge across independent (say geographical) markets. Furthermore, suppose realistically that combining the merging firms involves up-front restructuring costs. In this case, Assumptions (1) and (2) will typically be satisfied as the following example, which always satisfies these assumptions, illustrates.

Example 7 Conglomerate merger*: (i) Initially, both firms (target and acquirer) operate in separate local markets with, say, linear (inverse) demand ($p = \beta - ax$), and constant marginal costs c, where $\beta > c$. (ii) A merger leads to efficiency gains (i.e. a reduction in the marginal cost c), but requires a fixed up-front restructuring cost $R > 0$. These*

[24]Denoting the merging gains from a high- and low-type merger gross of fixed restructuring costs R by $\Delta\underline{\pi}^H(b)$ and $\Delta\underline{\pi}^L(b)$, one has

$$\frac{\partial}{\partial b}\left(\frac{\Delta\underline{\pi}^H(b)-R}{\Delta\underline{\pi}^L(b)-R}\right)=\left(\frac{\partial}{\partial b}\frac{\Delta\underline{\pi}^H(b)}{\Delta\underline{\pi}^L(b)}\right)\frac{\Delta\underline{\pi}^L(b)}{\Delta\underline{\pi}^L(b)-R}+\left(\frac{\partial}{\partial b}\frac{R}{\Delta\underline{\pi}^L(b)}\right)\left(\frac{\Delta\underline{\pi}^H(b)}{\Delta\underline{\pi}^L(b)}-1\right)\left(\frac{\Delta\underline{\pi}^L(b)}{\Delta\underline{\pi}^L(b)-R}\right)^2.$$

If the relative gross gains are constant, the relative net gains are decreasing since the first term in the second summand is negative and the other two are positive. For the same reason, even if the relative gross gains are positive, the relative net gains can be negative.

efficiency gains can be either low, leading to post-merger marginal costs $\overline{c} < c$*, or high, leading to* $\underline{c} < \overline{c}$*. (iii) Suppose that the economic conditions* b *are parameterized by the demand intercept, i.e.* $b = \beta$ *or the stand-alone marginal cost* c*, i.e.* $b = -c$ *and* $0 < \underline{c} = \overline{c} - k_1 = c - k_1 - k_2 < \beta$*, for some positive constants* k_1 *and* k_2*.*

Next, consider a variant of the classical vertical merger model with unknown synergy gains. As the following example demonstrates such a model also satisfies Assumptions (1) and (2).

Example 8 Vertical merger: *(i) Initially, there are two firms—an upstream firm* U *and a downstream firm* D*. The downstream firm produces the final product for consumers, using one unit of the upstream firm's product to produce one unit of output. We assume that the upstream firm produces its output at constant marginal cost* c *and that the only costs of the downstream firm are the payments made to the upstream firm. The upstream firm sets a (linear) price* p_U *at which it sells its output to the downstream firm. After observing* p_U*, the downstream firm sets a price* p_D *to final consumers. The demand in the downstream market is* $x = \beta - p_D$*, where the demand intercept* $\beta > c$*. (ii) Suppose the downstream firm is the (potential) target while the upstream firm is the (potential) acquirer. The acquirer can be a high-type acquirer—in which case the post-merger marginal cost are* $\underline{c}$*—or a low-type acquirer with marginal cost* $\overline{c}$*, where we assume that* $c \geq \overline{c} > \underline{c}$*. (iii) Suppose that the economic conditions are parameterized by the demand intercept or the stand-alone marginal cost* c *as in Example 7.*

We now briefly extend our model to show its robustness.

4 Extensions

4.1 Multiple Bidders

As mentioned before, Andrade et al. (2001) describe the prototypical takeover in the 1990s as a transaction with one publicly bidding firm. More recently, however, Boone and

Mulherin (2007) report that around half of the 400 transactions in their 1990s sample were *privately* auctioned among multiple bidders prior to the *public* announcement of takeover bids. In this section we extend our model to accommodate multiple bidders.

Boone and Mulherin (2007) also find that the choice between a negotiation with a single bidder and an auction with multiple bidders depends on the "information costs" of organising an auction. Indeed, the costs of giving away confidential information to multiple bidders may sometimes outweight the higher revenues from setting up an auction. Industry factors such as the level of R&D and product standardisation, for instance, are important determinants of these information costs (Shleifer and Vishny, 1992). As a result, selling firms in industries such as banking, electricity and telecommunications are reluctant to set auctions. Here, motivated by evidence and simplicity,[25] we take the number of *potential* bidders as an exogenous (i.e. industry-specific) factor that is independent of the economic conditions.

Suppose there are n potential bidders and that the efficiency gains from a merger are independently distributed across the potential bidders. As before, let q again be the probability that a given (potential) bidder is of good fit in which case efficiencies are high and post-merger profits are $\pi^H(b)$. With the complementary probability, efficiencies are low and post-merger profits are $\pi^L(b) < \pi^H(b)$. Absent being involved in a merger, potential bidders earn $\pi^A(b)$ and the potential target earns $\pi^T(b)$. This assumption, of course, rules out externalities between the bidders. Such externalities would arise naturally if both potential acquirers and the target compete in the same industry—a case we consider afterwards.

For simplicity, we model the takeover process as a second-price sealed-bid auction with a publicly known reserve price, which is set by the target. We focus on equilibria in which

[25] The proportion of auctions and negotiations in Boone and Mulherin's (2007) sample for example is constant over time, despite containing the recession of the early 1990s and the economic boom of the mid to end 1990s. The number of initiated takeovers, instead, increases five-fold from 1989 to 1998, consistent with other empirical evidence. Unfortunately, Boone and Mulherin (2007) do not report how the distribution of withdrawn/completed takeovers changes over time, only that 23 out of a total of 400 takeover attempts are withdrawn in their sample.

bidders use weakly undominated bidding strategies in all bidding subgames and, thus, bid their net value of a merger (i.e. $\pi^H(b) - \pi^A(b)$ if being a high efficiency type and $\pi^L(b) - \pi^A(b)$ if being a low type) whenever this net value is greater than the reserve price.[26]

As before, in any subgame perfect equilibrium, the optimal reserve price is either a "pooling reserve price",[27] $r^p \leq \pi^L(b) - \pi^A(b)$, which ensures that a sale takes place; a separating reserve price, $r^s = \pi^H(b) - \pi^A(b)$, which extracts all the rents from a high-type bidder; or a prohibitive reserve price at which no bidder is willing to submit a bid. A prohibitive reserve price remains optimal if and only if a high-type merger is unprofitable. Having multiple potential bidders affects now whether a separating or a pooling reserve price is optimal. But, as shown in the next proposition, this does not alter the comparative statics results of our main result.

Proposition 4 *Consider the case with n potential bidders and no bidding externalities. If Assumptions (1) and (2) are satisfied, there exist $\underline{b}$ and $\overline{b}(n) \in [b_{\min}, b_{\max}]$ such that if $b < \underline{b}$, no merger takes place, if $\underline{b} < b < \overline{b}(n)$, only high-type mergers take place, and if $b > \overline{b}(n)$, all mergers take place.*

This result allows us to investigate how the thresholds are related to the market conditions via the number of potential bidders. First, $\underline{b}$ does not depend on the number of potential bidders. When the high-type merger becomes profitable, the target sets the reserve price such that all high types would accept. The choice between separating or pooling, however, depends on the number of potential bidders. There are two effects at play. First, the higher the number of potential bidders, the lower the probability that all of these are of low type; thus, the probability of being able to sell when setting a separating

[26]Of course, if firms are modeled as being active in a market game following the bidding stage, the usual argument about weakly dominated strategies needs to be augmented to one in which bidders use subgame perfect strategies, which are weakly undominated in the "reduced game".

[27]In this case it is unnecessary to set a reserve price because absent a reserve price bidders bid at least $\pi^L(b) - \pi^A(b)$ in equilibrium. Therefore—although our terminology might suggest otherwise—we do not predict the use or threat of defence tactics in this case.

price increases with the number of potential bidders. This effect induces the separating threshold $\bar{b}(n)$ to decrease with a higher number of potential bidders. Second, the higher the number of potential bidders, the higher the probability that two potential bidders are high type, which would lead to a beneficial bidding war if a pooling reserve price is set. This effect tends to increase the threshold $\bar{b}(n)$ for a higher number of potential bidders. The first effect, however, dominates the second. Intuitively, the possibility of not selling with a separating reserve price is only relevant if all bidders are of low type, whereas a pooling price induces no bidding war both when all bidders are low type and when all but one are of low type. Since the probability of having no bidding war is reduced more slowly as n increases, separating becomes more attractive.

Corollary 2 *Consider the case with n potential bidders and no bidding externalities. For interior thresholds ($b_{\min} < \underline{b}, \bar{b}(n) < b_{\max}$), $\underline{b}$ and $\bar{b}(n)$ are implicitly defined through*

$$\Delta\pi^H(\underline{b}) = 0 \text{ and } \frac{\Delta\pi^H(\bar{b}(n))}{\Delta\pi^L(\bar{b}(n))} = \frac{1-q+nq}{nq}.$$

While $\underline{b}$ is independent of n, $\bar{b}(n)$ is increasing in n.

The more potential bidders there are, the longer a target waits to switch from a screening to a pooling reserve price when economic conditions improve. This result has a perhaps surprising and noteworthy feature. There exist certain economic conditions for which the target would prefer to attract a bid from each of a given number of potential bidders—set a pooling and sell for sure—but only from the high types if there were a higher number potential bidders—set a separating and potentially not sell the firm. It may therefore be that for certain economic conditions a higher number of potential bidders leads to a lower number of completed deals. Thus, there is no straightforward relation between the number of potential bidders and the number of completed deals.

So far we have assumed that each target has an independent pool of bidders at its disposal, thereby ignoring competition for high-type acquirers. Some acquirers, however, may also be interested in other targets, inducing targets to compete for them. Suppose, for simplicity, that two targets face three potential acquirers, which with a given independent probability are an equally good fit with both targets and with the complementary probability are an equally low fit with both targets. As before, think of the takeover market as a second-price sealed-bid auction in which targets simultaneously set reserve prices and focus on equilibria in which acquirers use weakly undominated strategies for any given pair of reserve prices. If high-type mergers are unprofitable, targets will select a prohibitive reserve prices. If high-type mergers are profitable but low-type mergers unprofitable, the targets will select reserve prices that accommodate only high-type mergers. In equilibrium, however, targets cannot select the separating price $\pi^T(b) + \Delta\pi^H(b)$ because then a target could minimally undercut its rival and ensure a sale in case there is only a single high-type bidder. Thus, in equilibrium targets choose a reserve price distribution. Both targets must, indeed, select a non-degenerate pricing distribution up to a critical economic condition $\bar{b}$ above which both targets setting the pooling price becomes an equilibrium. The only difference to before is that now we cannot rule out that targets may put some positive mass also on the pooling price below the critical economic condition $\bar{b}$ inducing only partial screening. Our main insights and predictions, however, carry over to this case also. Also, if the competition between targets becomes to fierce—e.g if there were two targets and only one potential bidder—than Bertrand-type reasoning implies that targets set a serve price $\pi^T(b)$ and all profitable mergers occur. More generally, however, as long as the number of potential bidders outnumbers the number of potential targets, we hypothesis that our mechanism still holds: for bad enough economic conditions, no merger occurs, for intermediate conditions targets (partially and competitively) screen, and for high enough economic conditions, all targets prefer to set a pooling reserve price.

Our consideration of multiple bidders so far has abstracted from externalities between the potential acquirers. Takeover games with product market externalities are subtle (see the pioneering work by Jehiel and Moldovanu, 2000) and have been extensively discussed in the merger literature.[28] We will briefly identify some conditions under which our analysis extends to the case of product market externalities focusing again on the case of

[28]Even absent screening considerations, the literature identified equilibria in which profitable mergers do not occur (see Inderst and Wey, 2004) due to free-rider problems as well as other cases in which unprofitable mergers occur (see Molnar, 2003 and Fridolfsson and Stennek, 2005).

a single target.

Consider first the case of negative externalities between bidders. For simplicity, we focus on the symmetric single-product version of the multiplicative demand example presented in the previous section (Example 6), which satisfied Assumptions (1) and (2). Absent a merger, denote again the reduced form equilibrium profits of the product market game by $\pi^T(b)$ for the target, and by $\pi^A(b)$ for the acquirers, which are now symmetric. Following a merger with a high-type acquirer, denote the merged firms profits by $\pi^H(b)$ and the outsider's profits by $\pi^o_H(b)$. Define $\pi^L(b)$ and $\pi^o_L(b)$ similarly, and observe that since a high-type merger has lower marginal costs, $\pi^H(b) > \pi^L(b)$ and $\pi^o_H(b) < \pi^o_L(b)$. Negative externalities between bidders are introduced by assuming that an outsider's profits fall if the merger takes place (i.e. $\pi^A(b) > \pi^o_L(b)$). This occurs if the synergies are so high that the post-merger equilibrium involves lower prices.[29]

As compared to the case of no externalities, acquirers have a higher willingness to pay for the target since becoming an outsider is now worse. This entices acquirers to submit higher bids, increasing the revenues for the target, both if it sets a pooling or a separating reserve price (the prohibitive reserve price is suboptimal since mergers are always profitable). Indeed, suppose first that the target sets a pooling reserve price. Then both bidders realize that a merger will take place and the bidding process simply determines whether they will be an insider or an outsider. Since the value of wining is less for a low-type bidder, she will bid less than a high-type bidder. In equilibrium, a low type will never overbid a high type. Hence, a low type will bid the difference in value between winning and receiving the merged firm's profits and receiving the outsider's profits when her rival is a low-type bidder, i.e. $\pi^L(b) - \pi^o_L(b)$. Similarly, a high-type bidder will bid $\pi^H(b) - \pi^o_H(b)$ in a symmetric equilibrium. This is of course larger than in the case of no externalities, in which they would bid $\pi^L(b) - \pi^A(b)$ and $\pi^H(b) - \pi^A(b)$, respectively.

In the case in which the target sets a separating reserve price, not only the bids but

[29] In this case a merger would increase the consumer surplus. From a legal perspective, antitrust authorities in the US and Europe should allow horizontal mergers only if they increase consumer surplus. Hence, focusing on negative externalities can be justified by the assumption that antitrust authorities and courts make appropriate merger control decisions. Obviously, however, this is a strong assumption.

also the reserve price might be higher. Indeed, suppose that a bidder expects her rival to bid if and only if she is a high-type bidder. Then she is willing to submit a bid as long as $\pi^H(b) - r \geq q\pi_H^o(b) + (1-q)\pi^A(b)$, and in this case the optimal separating reserve price is $r = q[\pi^H(b) - \pi_H^o(b)] + (1-q)[\pi^H(b) - \pi^A(b)]$. This is of course larger than the reserve price in the no externalities case, which was equal to $\pi^H(b) - \pi^A(b)$. In the following, we will focus on such equilibria with "aggressive-bidding beliefs".[30]

As shown in the next proposition, if one compares the target revenues in both cases, there exists again a critical level of the economic condition above which the target prefers a pooling reserve price and below which it prefers a separating reserve price. This thus establishes that better economic conditions lead to higher merger activity.

Proposition 5 *Consider the case with negative externalities and two bidders that have aggressive-bidding beliefs. Suppose that all firms produce a single differentiated good and compete in prices in a market with multiplicative demand in which, despite restructuring costs, mergers are profitable. Then there exists* $\bar{b} \in [b_{\min}, b_{\max}]$ *such that if* $b < \bar{b}$ *only high-type mergers take place, whereas if* $b > \bar{b}$ *all mergers take place.*

Consider now the other polar case in which there are large positive externalities. Suppose that $\pi_H^o(b)$ is such that $q\pi_H^o(b) + (1-q)\pi^A(b) > \pi^H(b) - \pi^T(b)$. In this case, there always exist an asymmetric equilibrium in which at most one bidder submits a bid. Intuitively, the condition ensures that if a bidder believes that the rival submits a bid (at least if she is a high-type rival) and the reserve price is at least as high as the standalone value of the target, then it is strictly better to stay an outsider rather than take the target over. Indeed, the maximum rent that one can obtain by taking over the target is still lower than the profits of being an outsider. If such an equilibrium is played for

[30] An alternative consistent belief of the potential acquirers is that their rival bids only if the reserve price is such that the takeover is profitable for a high type, i.e if $\pi^H(b) - r \geq \pi^A(b)$ in which case the target would set $r = \pi^H(b) - \pi^A(b)$ and high-type acquirers would bid $\pi^H(b) - \pi_H^o(b)$ whenever $r \leq \pi^H(b) - \pi^A(b)$. If rivals would hold this belief for all levels of the economic condition b, our comparative static result below would be unaffected. With mixed strategies, one could construct even further consistent beliefs and reserve prices but such equilibria seem implausible.

all economic conditions, then obviously our results from the single bidder case carry over unchanged. Despite the potential criticisms, such asymmetric equlibria might be more reasonable than symmetric ones in this setting.[31]

Our analysis of externalities, however, does not cover a variety of intermediate cases such as the case in which low efficiencies lead to positive and high efficiencies to negative externalities. Such an analysis is cumbersome but we expect our analysis to carry over to such cases under reasonable assumptions.

4.2 Cash or Share Deals

It might be that the outcome of the takeover process in our main model is inefficient. For a range of parameters, the target sets a (separating) reserve price that is only accepted by the high-type acquirers, despite the fact that all mergers are profitable.[32] In this case it is natural to ask whether better screening instruments might reduce or eliminate information asymmetries and, therefore, the inefficiencies.

Suppose, for example, that full synergies can still be achieved, even if the target shareholders keep a part of the newly merged entity. Acquirers, thus, can offer the target *shares* in the newly merged firm, which is often observed in takeovers. This additional buying option, in fact, allows the target to offer a menu of prices instead of a single reserve price.[33] Targets can set a low cash payment for those acquirers that leave it with

[31] As usual, one may criticize such asymmetric equilibria on the basis that they require coordination between the bidders. In this particular case, however, it can be in the target's interest to favor one buyer over another in order to ensure that there is only one serious bidder. With positive externalities, if one expects the rival to submit a bid, the value of submitting a bid is lower. This will tend to lower bids. Worse, in symmetric equilibria for a wide range of reserve prices, bidders will only submit bids with probability less than one, as shown by Inderst and Wey (2004) in a model with no uncertainty about acquirers types.

[32] Formally, this range is equal to $[b_{min}, \overline{b}]$ if the conditions of Proposition 1 are satisfied. Let $\widetilde{b}$ be implicitly defined by $\pi^L(\widetilde{b}) = 0$. More generally, this range is equal to $[\max\{b_{min}, \widetilde{b}\}, \overline{b}]$ if Assumptions (1) and (2) hold.

[33] When there is private information about synergy gains only, Brusco et al. (2007) find that an optimal mechanism can be implemented by both merging firms dividing the shares of the new merger-entity, i.e.

a subset of the shares in the new company and a higher cash payment—but lower than the separating reserve price—for those acquirers who want to hold all the shares in the new entity. The key intuition for why this is often optimal is that a high-type acquirer is willing to pay more for owning the additional shares because he realizes that they will be worth more to him. This allows a target that prefers to sell to both types to capture some of the higher benefits if the acquirer is, indeed, a high type, which it cannot do when setting a single reserve price. Observe also that the menu of prices has a natural interpretation in practise: a low-type acquirer pays partly in shares, thereby allowing the target to enjoy part of the future benefits of the merger, while a high-type acquirer pays fully in cash, which gives it the right to 100% of the future earnings.

More formally, assume that an acquirer needs to control at least a fraction $t \in (0, 1]$ of the merged company to be able to realize the synergy gains. Although unnecessary for our analysis, for simplicity we also assume that if indifferent between selling the entire company or a share thereof, the target sells the entire company.[34] This generalizes our main model, which assumed that full ownership, $t = 1$, is necessary to achieve efficiencies. As we show in the next proposition, though, this does not alter our comparative statics results.

Proposition 6 *Consider the optimal selling mechanism. If Assumptions (1) and (2) are satisfied, there exist $\widehat{b}(t) \in (\underline{b}, \overline{b}]$, such that if $b < \underline{b}$, no merger takes place, if $\underline{b} < b < \widehat{b}(t)$, only high-type mergers take place, and if $b > \widehat{b}(t)$, all mergers take place. Furthermore, $\widehat{b}(1) = \overline{b}$ and $\widehat{b}(t)$ is decreasing in t.*

a takeover fully paid with shares. Although this is efficient from the point of view of maximising the entire surplus, however, it is not the best outcome for the target. Therefore, when the target has the possibility to maximise its own expected surplus by setting a reserve price, it will not choose 100% shares as payment.

[34] One can think of this assumption as formalizing the idea that there are small costs to joint ownership, e.g. due to monitoring or coordination costs.

5 Empirical predictions

In this section, we present the observational consequences ("predictions") of our model, and contrast ours with predictions from the existing theories. We furthermore discuss how our predictions match empirical evidence.[35]

Prediction 1 *Targets use defense tactics relatively more often during economic downturns, i.e. screen more, which lead to relatively more initiated mergers to be abandoned.*

We know from Proposition (1) that for relatively bad economic conditions, the target strictly prefers to set a separating reserve price—i.e. we would expect to see that relative to the number of initiated mergers defense tactics are employed more often. From the perspective of economic shock theories, it is unclear why targets would use defence tactics relatively more often in downturns, since acquirers themselves would not initiate mergers when they generate no economic surplus. Similarly, misvaluation theories predict that acquirers themselves would not initiate mergers unless their stocks are overvalued, and thus it is unclear why defense tactics should be employed relatively more often during recessions.

Comment and Schwert (1995) show that defense tactics may lead a potential acquirer to abandon a proposed merger. Furthermore, Figure 1 indicates that relatively more initiated mergers are abandoned when economic conditions are worse. Our model, thus, predicts a combination of these two empirical observations; defense tactics are employed more often in economic downturns, leading to relatively more abandoned mergers.

Prediction 2 *During economic booms, acquirers extract a larger share of the merger surplus than during economic downturns. Targets, in contrast, extract a larger share in economic downturns.*

[35]Some empirical evidence is based on merger waves that coincide with periods of high stock markets rather than economic booms. These stock market booms, however, are (highly) correlated with economic booms as e.g. Jovanovic and Rousseau (2001) indicate. Furthermore, it must be kept in mind that most of the cited evidence is based on merger event studies, and we assume that the stock market reaction to the event of the merger reveals the potential of the merger. As we explain in Footnote 8, however, event studies may suffer from the fact that the merger-event might reveal other information.

As shown in Proposition (1), the target sets a separating reserve price in downturns and a pooling reserve price in booms. As a consequence, the acquirers earn, on average, more rents during booms because the high-type bidders extract positive rents during booms. In contrast, targets extract a higher share of the merger surplus during economic downturns, since in this case they extract all the rents from the high-type acquirers. It is unclear what existing theories would predict. In Rhodes-Kropf and Viswanathan (2004), if there is only one (potential) bidder, the acquirer would extract all the surplus. With multiple bidders, when there is more variance in valuations, the winning bidder should on average receive a higher information rent; on the other hand if the average valuation of bidders is relatively higher to that of the target, the targets benefits more from selling the firm. Similarly, Jovanovic and Rousseau (2002) assume that technological shocks induce higher ex-ante differences between firms. This may—or may not—lead to a higher share of the surplus for the acquirers. *On the other hand, Rhodes-Kropf and Robinson (2008) claim that economic booms induce a higher assortive matching between merging firms. Given that both merging firms are now more similar in terms of "quality", this leads the more efficient firms (the acquirer in our model) to extract a relatively smaller share of the surplus.*

There is evidence that in a merger wave—which coincides with economic upswings—bidders gain, on average, higher abnormal returns than bidders outside waves. In a series of announcement return regressions for bidders, Harford (2003) sets a dummy variable to one for acquisitions made during waves and finds the dummy to be significantly positive in all specifications. Gugler et al. (2006) find that, for tender offers, returns for wave-acquirers in the month of the acquisition are higher than their non-wave counterparts. Finally, Rosen (2006) discovers that bidder stock prices are more likely to increase when a merger is announced in a "hot" merger market, i.e. in periods when mergers cluster. These observations are in line with our theoretical predictions. To our knowledge, however, there is no direct evidence on how much targets earn along the business cycle. Therefore, a more direct test of our prediction would be analyzing whether the merger surplus between acquirer and target is divided differently when economic conditions change.

Prediction 3 *The variance of the acquirers' rents from mergers is higher in economic upswings than in economic downturns.*

For good economic conditions, both high- and low-type acquirers accept the reserve price of the target. But, while the high-type acquirer earns positive rents, the low-type acquirer does not. Therefore, the lack of screening makes that acquirers' rents show more variance.

Similar as in the first prediction, it is unclear what existing theories would predict. Some of these theories assume that a higher ex-ante firm variance may trigger a merger wave; a more efficient or more overvalued firm buys a less efficient or less overvalued firm. These theories are unclear, however, how this translates into the variance of acquirers' rents post-merger. Note also that in e.g. Jovanovic and Rousseau's (2002) theory, higher ex-ante differences between firms lead to more merger-activity, while in our mechanism, lower differences in the potential to realize synergy gains lead to more merger activity.[36]

There is some evidence that during merger waves—which coincide with economic upswings—high-type acquirers gain more than low-type acquirers at the announcement date.[37] Carow et al. (2004) distinguish high- and low-type acquirers in a merger wave and find that high types' abnormal returns are significantly higher for different (short-term) time windows.[38] A more direct and general empirical test of this prediction would be comparing economic booms and busts in terms of variability of earnings across acquirers at the time of merging.

Prediction 4 *During economic upswings, mergers are on average technologically less efficient than during economic downturns.*

[36]Although, due to the pooling of acquirers during booms, the variance of the *successful* acquirers is still higher in booms than in downturns.

[37]Carow at al. (2004) define types by, among others, the timing of merging in a wave, industry relatedness, and form of payment.

[38]Measured as industry-adjusted returns over the interval of days $[-1, 1]$ around the announcement of the acquisition, high types earn 4.42% more than low types in the wave and this difference is statistically significant; over the longer interval $[-5, 5]$ the difference is still 4.23%.

For good economic conditions, both high- and low-type acquirers are accepted by the target. This lack of screening induces the average quality of consummated mergers to be lower when compared with bad economic conditions, where acquirers are screened such that only high-type mergers occur. This prediction is in contrast with economic shock theories, which predict that better economic conditions lead to more efficiency gains from merging, e.g. due to economies of scale (Lambrecht, 2004) or more efficient firms overturning less efficient firms (Jovanovic and Rousseau, 2002). As discussed below, this prediction may be shared by misvaluation theories.

A direct test of the above prediction would be to measure both pre- and post-merger productivity and compare productivity differences between economic upswings and downturns. To our knowledge, this test has not yet been directly performed. Research has been done on productivity differences due to merging (see e.g. McGuckin and Nguyen, 1995), but no distinction has been made between economic cycles or high versus low merger activity.[39]

One can indirectly relate this prediction with some existing empirical evidence related to firms' stock market performance in the long-run, given that we expect technologically less efficient mergers to perform worse in the long term.[40] Gugler et al. (2006) demonstrate that, in the long term, wave mergers perform on average significantly worse than non-wave mergers: The median abnormal return after three years is more than 11% lower for wave-mergers. This is especially true for tender offers, where the difference becomes 34%. Harford (2003) shows the wave-dummy to be significantly negative for different specifications in long-run bidder performance regressions. Also Rosen (2006) finds that long-run returns are significantly lower for mergers announced in periods when the merger

[39]It must be added that Harford (2005) finds a positive effect for wave-mergers on expected long-term performance. He, however, compares specialists' forecasts right before and right after the merger. A priori, though, specialists' forecasts should be as positive as merging firms at the time of merging.

[40]A natural question to ask is why acquirers do not take this into account, and therefore do not refrain from merging. One can extend our framework to account for the possibility that acquirers correctly foresee that current boom periods may be followed by normal periods in the future. Given that payoffs of the (distant) future are discounted, it is easy to argue that our mechanism still survives (see Banal-Estañol et al., 2006, for more details).

market was booming. Furthermore, also consistent with our model, low-type mergers during waves may be even less efficient than non-merging firms. Carow et al. (2004) find out that the mean low-type mergers suffer a relative loss of more than 17% after three years, with respect to non-merging firms in the same industry.

Prediction 5 *Better economic conditions induce more acquirers to actively participate in the bidding for a target.*

When economic conditions are better, the target sets a pooling reserve price. As shown in Section 4, this pooling reserve price induces an active bidding war if several high-type acquirers are interested in the target. Indeed, a pooling reserve price is lower than the willingness to pay for the participating high-types, who will raise their bids over the initial reserve price. One would not observe bids in excess of the set (separating) reserve price, i.e. during economic downturns. The separating reserve price is either too high (low-type acquirer) or just about the right price (high-type) acquirer; both types have no incentive to raise their bid above the reserve price. Existing theories have no clear prediction on this issue, although it may be argued that when conditions for mergers become better, more aquirers will bid for each target as long as the pool of potential targets is taken as given. This is an easily testable prediction.[41]

One may also tentatively associate the findings in Proposition (6) on the optimal selling mechanism with some observational statements. First, given the offered optimal menu, low-type acquirers prefer to own only a part while high-type acquirers (weakly) prefer to control the entire merged company. Therefore, a low-type prefers to pay partly in shares while a high type prefers to pay in cash. When looking at empirical studies, there is evidence consistent with this reasoning, shortly summarized in Shleifer and Vishny (2003). Loughran and Vijh (1997) for example find that, for a sample of U.S. mergers in the period 1970-1989, stock acquisitions earn a combined 5-year cumulative excess return

[41] Andrade at al. (2001) look at the average number of bids per decade (1973-1979, 1980-1989,1990-1998), and find no real differences; however, they do not distinguish between periods according to economic cycles or merger activity.

of 14.5 percent, while for cash acquisitions the combined return is much higher at 90.1 percent.[42]

Second, given that our model predicts that during downturns only high-type mergers will occur, we should see relatively more cash-financed mergers in these periods if the target offers a menu of prices. There is again evidence consistent with this reasoning, if one takes into account that high stock markets coincide with economic booms. For example, casual observation by Rhodes-Kropf and Viswanathan (2004) suggests that firms tend to use relatively more stock as "acquisition currency" in the high merger activity periods. Indeed, in the "low-activity" year 1990 the percentage of stock as a fraction of total deal value was only 24%, while by 1998, the peak of the 90ties merger wave, the use of stock rose to 68% of the total deal value. Andrade et al. (2001) confirm that the preponderance of stock acquisitions is greater during high-valuation times.

These last predictions are shared by misvaluation theories. The reason offered by misvaluation theories goes as follows: during times of high valuations over-valued acquirers prefer to finance deals with stocks, and targets accept these offers. Our model, thus, offers an alternative logic for these observations. Targets may use a menu of prices where high-types prefer to pay in cash and low-types (partly) in shares, and deals with low-types are more often observed during booms.

More generally, given that there is a high correlation between economic booms and stock market booms, our theoretical predictions partly coincide with those of misvaluation theories. In particular, since misvaluation theories predict that merger intensity correlates with market misvaluation, wave-mergers are also predicted to be less efficient, which coincides with our Prediction 4. Rhodes-Kropf et al. (2005) find in an empirical study evidence for misvaluation theories, but state that: "An alternative explanation [of our empirical findings] is that aggregate merger intensity spikes when short-run growth opportunities are high. However, the long-run growth opportunities go in the opposite

[42]Combined means that both the target and acquirer shareholders' earnings are taken into account. Interestingly, the same study also finds that cash tender *acquirers* earn an excess 70.3 percent, while stock *acquirers* earn -24.0 percent. This observation is consistent with our model that predicts high-type (cash) acquirers to gain more -or, which is the same, to pay relatively less- than low-type (stock) acquirers.

direction; they are negatively associated with merger intensities." This explanation is consistent with our mechanism if one relates short-run growth opportunities with economic conditions and long-term growth opportunities with a firm's efficiency.

6 Conclusions

We constructed a model in which the target, by setting a binding reserve price, screens the acquirer on the effectiveness of realizing synergy gains. We argued that favorable changes in the economic environment tend to make efficiency gains relatively less important in realizing merger profits, leading high-synergy mergers to be more similar to those that are less fitting. We also showed that this would be predicted by most of the commonly used horizontal and non-horizontal mergers models. Then, as economic conditions improve, screening out relatively less-fitting acquirers becomes less desirable. Our mechanism, thus, can explain how a positive change in economic fundamentals may generate a spike in merger activity—in line with the observed procyclicality of merger waves. We furthermore showed that our results still stand when several acquirers can bid for the target and when targets use better screening devices by asking to be paid not only in cash but also partly in shares of the newly merged firm.

Our screening explanation is not only consistent with a variety of stylized facts about takeovers but also generates a number of novel testable predictions—all of which are based targets' incentives to screen more during economic downturns. Among these is the prognosis that targets are more likely to rely on defense tactics when economic conditions are relatively worse, which should lead to relatively more initiated mergers to be abandoned. We further predict that targets extract a larger share of the merger surplus in economic downturns than during economic booms, and that this relationship is inversed for acquirers. As well, worse conditions induce less acquirers to actively participate in the bidding for a target, given that the reserve price set by the target will then be relatively higher.

Similar to ours, other economic shock theories find pro-cyclical merger clustering. Our screening model, however, differs from these models mainly on two accounts. First, our mechanism predicts that, even when all mergers are profitable, a target may screen acquirers and thereby reject some profitable merger proposals. Second, in contrast to other economic shock theories, our wave-mergers are on average less efficient. Given that there is a high correlation between economic booms and stock market booms, however, our prediction of less efficient wave-mergers coincides with those of misvaluation theories (see Shleifer and Vishny, 2003 and Rhodes-Kropf and Viswanathan, 2004). In contrast to the misvaluation theories, we do not rely on systematic stock market misvaluations—even though our mechanism is consistent with them—to predict that wave mergers are less efficient. Also, misvaluation theories make no clear predictions regarding the sharing of the merger rents, the use of defense tactics, and the number of bidders for a given target.

As most other models of merger waves, our theory is essentially *non-strategic* in the sense that the desirability of a potential merger is unaffected by other takeovers. Our merger wave is induced by an exogenous shift in the economic environment—an upward shift in the market demand—that simultaneously changes all merger conditions and makes screening by targets less desirable. While a dynamic takeover model is beyond the scope of the current paper, *strategic* elements can be included in our setting. For example, if all mergers take place in the same industry, screening may be less important in subsequent mergers.[43] We leave a full investigation of this question to future research.

[43]This effect would, for example, arise if high-type acquirers move early so that the probability of facing a high-type acquirer, and therefore the benefit of screening, is lower in later mergers.

Appendix A

Proof of Proposition 1

The statement is a particular case of Proposition 6, which is shown below. The proof follows if one takes $t = 1$ and, given that all mergers are profitable, $\underline{b} = b_{\min}$. Q.E.D.

Proof of Proposition 2

The statement is a particular case of Proposition 6 in which $t = 1$. The proof thus follows from the proof of Proposition 6 below. Q.E.D.

Proof of Corollary 1

That Assumption (2) holds is established in the text. We are left to show that Assumption (1) holds, i.e. that $\frac{\partial}{\partial b}\left(\frac{\Delta\pi^{E,H}+\Delta\pi^{M}}{\Delta\pi^{E,L}+\Delta\pi^{M}}\right) < 0$. Differentiating, Assumption (1) is satisfied if and only if

$$\frac{\partial\Delta\pi^{E,H}}{\partial b}\Delta\pi^{E,L}-\Delta\pi^{E,H}\frac{\partial\Delta\pi^{E,L}}{\partial b}+\left(\frac{\partial\Delta\pi^{E,H}}{\partial b}-\frac{\partial\Delta\pi^{E,L}}{\partial b}\right)\Delta\pi^{M}-\left(\Delta\pi^{E,H}-\Delta\pi^{E,L}\right)\frac{\partial\Delta\pi^{M}}{\partial b} < 0. \tag{2}$$

Condition (3b) implies that $\frac{\partial\Delta\pi^{E,H}}{\partial b}\Delta\pi^{E,L}-\Delta\pi^{E,H}\frac{\partial\Delta\pi^{E,L}}{\partial b} \leq 0$ and, since $\Delta\pi^{E,H} > 0$, this is equivalent to

$$\frac{\partial\Delta\pi^{E,H}}{\partial b}\frac{\Delta\pi^{E,L}}{\Delta\pi^{E,H}} \leq \frac{\partial\Delta\pi^{E,L}}{\partial b}.$$

Substituting this above and simplifying using that $\Delta\pi^{M} > 0$, the left hand side of inequality 2 is lower than or equal to

$$\frac{\partial\Delta\pi^{E,H}}{\partial b}\Delta\pi^{E,L}-\Delta\pi^{E,H}\frac{\partial\Delta\pi^{E,L}}{\partial b}+\left(\frac{\Delta\pi^{E,H}-\Delta\pi^{E,L}}{\Delta\pi^{E,H}}\right)\left(\Delta\pi^{M}\frac{\partial\Delta\pi^{E,H}}{\partial b}-\Delta\pi^{E,H}\frac{\partial\Delta\pi^{M}}{\partial b}\right).$$

This term is strictly lower than 0 if $\frac{\partial}{\partial b}\frac{\Delta\pi^{E,H}}{\Delta\pi^{E,L}} \leq 0$ and $\frac{\partial}{\partial b}\frac{\Delta\pi^{E,H}}{\Delta\pi^{M}} \leq 0$, with at least one of these inequalities holding strictly. Q.E.D.

Proof of Proposition 3

This statement follows from straightforward calculations shown in Appendix B. Q.E.D.

Proof of Proposition 4

Denote the net value of the merger to the acquirer as $\hat{\pi}^{H}(b) \equiv \pi^{H}(b) - \pi^{A}(b)$ if she has a high type and as $\hat{\pi}^{L}(b) \equiv \pi^{H}(b) - \pi^{A}(b)$ is she has a low type. The target can set either

(i) a reserve price, $r \leq \hat{\pi}^L(b)$; (ii) $r \in (\hat{\pi}^L(b), \hat{\pi}^H(b)]$; or (iii) $r > \hat{\pi}^H(b)$. In case (i), the reserve price is "pooling" r^p, which now can also be strictly lower than the net gains of a low type merger. Indeed, since bidders bid their net value, the revenue for the target in this case is

$$\left[1-(1-q)^n - n(1-q)^{n-1}q\right]\hat{\pi}^H(b) + \left[(1-q)^n + n(1-q)^{n-1}q\right]\hat{\pi}^L(b).$$

That is, the target obtains the willingness to pay of a low-type acquirer whenever there is at most one high-type acquirer and that of a high-type acquirer otherwise.

We now establish that within case (ii) it is always optimal to set the reserve price at the upper limit of the interval, $r^s = \hat{\pi}^H(b)$, denoted as a "separating" reserve price. Observe that in this case the target's expected profits are

$$(1-q)^n\pi^T(b) + n(1-q)^{n-1}qr + \left[1-(1-q)^n - n(1-q)^{n-1}q\right]\hat{\pi}^H(b),$$

which are strictly increasing in r. Finally, in case (iii) where the reserve price is "prohibitive", $r > \hat{\pi}^H(b)$, the target's profits are $\pi^T(b)$ since no bidder is willing to submit a bid.

Clearly, a prohibitive reserve price is suboptimal if and only if a high-type merger is profitable (i.e. $\hat{\pi}^H(b) > \pi^T(b)$ or $\Delta\pi^H(b) > 0$) in which case the target strictly prefers a separating reserve price to a prohibitive one. By Assumption (2), there exists a unique $\underline{b} \in [b_{min}, b_{max}]$ such that for all $b < \underline{b}$, $\Delta\pi^H(b) < 0$. Thus for such b a prohibiting reserve price is optimal and, hence, no merger takes place.

Supposing that a high-type merger is profitable ($b > \underline{b}$), the target prefers a separating reserve price r^s to a pooling reserve price r^p whenever

$$\begin{aligned} & (1-(1-q)^n)\,\hat{\pi}^H(b) + (1-q)^n\pi^T(b) \\ \geq \; & \left[1-(1-q)^n - n(1-q)^{n-1}q\right]\hat{\pi}^H(b) + \left[(1-q)^n + n(1-q)^{n-1}q\right]\hat{\pi}^L(b), \end{aligned}$$

which is equivalent to

$$nq\Delta\pi^H(b) \geq [1-q+nq]\,\Delta\pi^L(b).$$

Hence, a separating reserve price is preferred if (i) $\Delta\pi^L(b) \leq 0$ or if (ii) $\Delta\pi^L(b) > 0$ and

$$\frac{\Delta\pi^H(b)}{\Delta\pi^L(b)} > \frac{1-q+nq}{nq}. \tag{3}$$

If $\Delta\pi^L(b) \leq 0$ for all b then $\overline{b} = b_{\max}$. If, instead, there exists b^* such that $\Delta\pi^L(b^*) > 0$ then, by Assumption (1), for any $b > b^*$, $\Delta\pi^L(b) > 0$. Again, by Assumption (1), there exists a unique $\overline{b} \in [\underline{b}, b_{\max}]$ such that if $\underline{b} < b < \overline{b}$ the target strictly prefers a separating reserve price and if $b > \overline{b}$ the target strictly prefers a pooling reserve price. Q.E.D.

Proof of Corollary

It follows from the proof of Proposition 4 that $\underline{b}$ and $\bar{b}(n)$ are defined as stated in the Corollary. Since

$$\frac{1-q+nq}{nq}$$

is decreasing in the number of bidders n, Assumption 1 implies that $\bar{b}(n)$ is increasing in n. Q.E.D.

Proof of Proposition 5

Since mergers are profitable the target will always want to sell the firm so a prohibitive reserve price is suboptimal. Suppose now a target set a non-binding or pooling reserve price. As established in the text, if the target sets a pooling reserve price, a high type bidder will submit a bid equal to $\pi^H(b) - \pi^o_H(b)$ and a low type bidder a bid equal to $\pi^L(b) - \pi^o_L(b)$. As a result the profits for the target are

$$q^2[\pi^H(b) - \pi^o_H(b)] + (1-q^2)[\pi^L(b) - \pi^o_L(b)],$$

which using among other things that $\pi^H(b) = b\ [\pi^H(b) - R] + R$ can be rewritten as

$$(b-1)R + bq^2[\pi^H(1) - \pi^o_H(1)] + (1-q^2)[\pi^1(b) - \pi^o_L(1)].$$

As extablished in the text, the optimal separating reserve price is

$$r^s = q[\pi^H(b) - \pi^o_H(b)] + (1-q)[\pi^H(b) - \pi^A(b)].$$

and the target's profits when setting such a reserve price are

$$(1-q)^2\pi^T(b) + 2q(1-q)r^s + q^2[\pi^H(b) - \pi^o_H(b)].$$

Substituting and rewriting, the target prefers a pooling reserve price to a separating reserve price if and only if

$$(1-q^2)[\pi^L(1) - \pi^o_L(1)] + \frac{b-1}{b}R(1-q)^2 \geq (1-q)^2\pi^T(1) + 2q(1-q)\phi,$$

where $\phi = q[\pi^H(1) - \pi^o_H(1)] + (1-q)[\pi^H(1) - \pi^A(1)]$. Since the left hand side of the above inequality is increasing in the economic condition b, there exists a critical level of the economic condition above which the target prefers a pooling reserve price and below which it prefers a separating reserve price. Q.E.D.

Proof of Proposition 6

We will now look for the optimal selling mechanism in this case. To do so, we restate our problem in contract-theoretic terms. Let $\{s^l, r^l\}$ denote a an ownership share $s^l \in [0,1]$ and a price r^l for this ownership share.

By the revelation principle, we can restrict attention to mechanisms in which acquirers truthfully reveal their type. At the optimal solution, the target either does not sell the firm to either type (i.e. sets a prohibitive reserve price r^∞), sells to high-type acquirers only (i.e sets a separating reserve price r^s), or sells to both high and low-type acquirers.

Below, we suppress the dependence of profits on the economic condition b wherever convenient. Suppose first that at the optimal solution the target sells the firm to both low- and high-type acquirers. Then target chooses a menu $\{s^H, r^H, s^L, r^L\}$ that solves

$$\max_{s^H, r^H, s^L, r^L} \quad q\{r^H + (1-s^H)\pi^H\} + (1-q)\{r^L + (1-s^L)\pi^L\} \tag{4}$$

$$\text{s.t } s^H\pi^H - r^H \geq \pi^A, \tag{PC^H}$$

$$s^L\pi^L - r^L \geq \pi^A, \tag{PC^L}$$

$$s^H\pi^H - r^H \geq s^L\pi^H - r^L, \tag{IC^H}$$

$$s^L\pi^L - r^L \geq s^H\pi^L - r^H, \tag{IC^L}$$

$$s^H \geq t,\ s^L \geq t$$

Following the usual approach, we solve the relaxed problem in which the constraint IC^L is ignored and show that the optimal solution satisfies IC^L. Observe that PC^L and IC^H imply PC^H. Hence, we can ignore PC^H. Furthermore, PC^L must hold with equality for otherwise we could increase r^L and thereby increase the objective function and relax IC^H. Since PC^L and IC^H hold with equality, we have

$$r^L = s^L\pi^L - \pi^A,$$
$$r^H = s^H\pi^H - \pi^A - s^L(\pi^H - \pi^L).$$

Substituting these into the objective function, the target' problem is

$$\max_{s^L} \quad q\{\pi^H - \pi^A - s^L(\pi^H - \pi^L)\} + (1-q)\{\pi^L - \pi^A\}$$
$$\text{s.t.} \quad s^L \geq t.$$

Hence, at the optimum $s^L = t$ and $r^L = t\pi^L - \pi^A$. Formally, the optimal s^H is indeterminate because the target is indifferent between selling extra shares above the critical level t at a marginal price of π^H to a a high type-acquirer or keeping them themselves and earning π^H for these shares. But at an optimal solution $r^H = s^H\pi^H - \pi^A - s^L(\pi^H - \pi^L)$ so that of the target chooses to sell only t shares to high-type acquirers then r^H would be equal to r^L while if it sells all shares, then $r^H = \pi^H(1-t) + t\pi^L - \pi^A$. For ease of exposition, we select the latter solution. Observe that the solution also satisfies IC^L justifying the choice of solving the relaxed problem. We refer to this $\{1, \pi^H(1-t) + t\pi^L - \pi^A, t, t\pi^L - \pi^A\}$ as the optimal low-type-accommodating menu.

Suppose now that the target sells only to high-type acquirers at the optimal solution. Then the high-type participation constraint must be satisfied with equality so that $r^H = s^H\pi^H - \pi^A$ and the target's profits if it sells only to high-type acquirers are $q\{r^H + (1 - s^H)\} + (1-q)\pi^T = q(\pi^H - \pi^A) + (1-q)\pi^T$. Again we select the solution in which $s^H = 1$ and refer to the price as the separating reserve price $r^s \equiv \pi^H - \pi^A$.

The target strictly prefers the separating over the prohibiting reserve price if and only if

$$q(\pi^H(b) - \pi^A(b)) + (1-q)\,\pi^T(b) > \pi^T(b),$$

which is equivalent to

$$\Delta\pi^H(b) > 0.$$

By Assumption (2), there exists a unique $\underline{b} \in [b_{\min}, b_{\max}]$ such that if $b < \underline{b}$ the target strictly prefers $r^\infty(b)$ and if $b > \underline{b}$ the target strictly prefers $r^s(b)$. Similarly the target strictly prefers the pooling over the prohibiting reserve price if and only if

$$q\left[\pi^H(b) - \pi^A(b) - t(\pi^H(b) - \pi^L(b))\right] + (1-q)\left(\pi^L(b) - \pi^A(b)\right) > \pi^T(b),$$

which is equivalent to

$$q(1-t)\Delta\pi^H(b) + [1 - q(1-t)]\,\Delta\pi^L(b) > 0.$$

Since, trivially, $\Delta\pi^H(b) > \Delta\pi^L(b)$ the optimal reserve price is prohibitive if $b < \underline{b}$ and if $b > \underline{b}$ the optimal reserve price is either separating or pooling. Notice that if $\underline{b} = b_{\max}$ the target always prefer the prohibiting reserve price and therefore $\widehat{b} = b_{\max}$. Suppose from now on that $\underline{b} < b_{\max}$ and $b > \underline{b}$.

Observe that the separating reserve price is strictly preferred to the optimal low-type-accommodating menu if and only if

$$q(\pi^H(b) - \pi^A(b)) + (1-q)\pi^T(b) > q\left[\pi^H(b) - \pi^A(b) - t(\pi^H(b) - \pi^L(b))\right] + (1-q)\left(\pi^L(b) - \pi^A(b)\right),$$

which is equivalent to

$$tg\Delta\pi^H(b) > \Delta\pi^L(b)[1 - q + qt].$$

Hence, a separating reserve price is preferred if (i) $\Delta\pi^L(b) \le 0$ or if (ii) $\Delta\pi^L(b) > 0$ and

$$\frac{\Delta\pi^H(b)}{\Delta\pi^L(b)} > \frac{1 - q + qt}{qt}. \tag{5}$$

If $\Delta\pi^L(b) \le 0$ for all b then $\widehat{b} = b_{\max}$. If, instead, there exists b^* such that $\Delta\pi^L(b^*) > 0$ then, by Assumption (1), for any $b > b^*$ we have that $\Delta\pi^L(b) > 0$. Again, by Assumption

(1), there exists a unique $\widehat{b} \in [\underline{b}, b_{\max}]$ such that if $\underline{b} < b < \widehat{b}$ the target strictly prefers a separating reserve price and if $b > \widehat{b}$ the target strictly prefers a pooling reserve price.

Since $\widehat{b}$ depends on t, we from now on write $\widehat{b}(t)$. Given that the right hand side of (5) is decreasing in t, we have that $\widehat{b}(t)$ is (weakly) decreasing in t. Denoting $\overline{b} \equiv \widehat{b}(1)$ we have that $\underline{b} \leq \widehat{b}(t) \leq \overline{b}$ for any t. Q.E.D.

Appendix B

Example 1: Bertrand with differentiated goods

Condition (3a) is satisfied as shown in Lemma 5.2 (page 256) of Motta (2004). We next show that Condition (3b) holds. Suppose the merging firms are able to operate at a unit cost ec and rewrite the per-product profit of the merged firm following Motta (2004) (equation 5.40) as

$$\alpha \left(\frac{c\mu(e) + v\varepsilon}{\beta} \right)^2,$$

where $\alpha = n + (n-2)\gamma$, $\beta = 2n^2((n-2)\gamma^2 + 3(n-1)\gamma + 2n$, $\mu(e) = (1-e)(2-3n+n^2)\gamma^2 + n(n-2-3e(n-1))\gamma - 2en^2$ and $\varepsilon = n(2n + (2n-1)\gamma)$. (Above, we correct for a small typo in Motta.) Substituting e for e_H, e_L and 1, yields the merging profits for the high- and low-type acquirers and the hypothetical profits if there were no efficiency gains. Using these profits one can rewrite the following ratio as

$$\frac{\Delta\pi^{E,H}}{\Delta\pi^{E,L}} = \frac{\mu(e_H) - \mu(1)}{\mu(e_L) - \mu(1)} \, \frac{c[\mu(e_H) + \mu(1)] + 2v\varepsilon}{c[\mu(e_L) + \mu(1)] + 2v\varepsilon}.$$

Using $n \geq 2$, $\mu(e)$ is strictly decreasing in e. In addition, $e_H < e_L < 1$ and hence $\mu(e_H) > \mu(e_L) > \mu(1)$. As a result the first ratio of the previous equation is positive and the derivative of the second ratio with respect to the market size v is negative. Therefore, Condition (3b) is satisfied strictly.

We are left to establish that Condition (3c) is satisfied. Using equations (5.28) and (5.33) in Motta (2004), one has $\Delta\pi^M = \varphi(v-c)^2$ where

$$\varphi \equiv \frac{(n + (n-2)\gamma)\left((2n-1)\gamma + 2n\right)^2}{4n^2\left((n-2)\gamma^2 + 3(n-1)\gamma + 2n\right)^2} - \frac{(n + n\gamma - \gamma)}{(2n + n\gamma - \gamma)^2}.$$

Since merging is profitable, we have that $\varphi > 0$. Now, we have that

$$\frac{\Delta\pi^{E,H}}{\Delta\pi^M} = \frac{\alpha}{\beta^2} \frac{\left(c\mu(e_H) + v\varepsilon\right)^2 - \left(c\mu(1) + v\varepsilon\right)^2}{\varphi(v-c)^2},$$

which can be rewritten as

$$\frac{\Delta\pi^{E,H}}{\Delta\pi^M} = \frac{\alpha}{\beta^2} \frac{c[c\mu(e_H) + c\mu(1) + 2v\varepsilon][\mu(e_H) - \mu(1)]}{\varphi(v-c)^2}.$$

Since $\varphi > 0$, $c > 0$, and $\alpha > 0$, and $\mu(e_H) - \mu(1) > 0$, the derivative with respect to the market size υ has the same sign as the derivative of

$$\frac{c\mu(e_H) + c\mu(1) + 2\upsilon\varepsilon}{(\upsilon - c)^2},$$

which in turn has the same sign as $-(c\mu(e_H) + c\mu(1) + \varepsilon(\upsilon + c))$. Using that $\mu(1) = -\varepsilon = 0$, this simplifies to $-(c\mu(e_H) + \varepsilon\upsilon)$. Therefore the derivative is negative, and hence Condition (3c) holds strictly.

Example 6: Multiplicative demand and synergies

The example trivially satisfies (3a). One has,

$$\frac{\Delta\pi^{E,H}(b)}{\Delta\pi^{E,L}(b)} = \frac{\Delta\pi^{H}(\underline{S}) - \Delta\pi^{M}(\underline{S})}{\Delta\pi^{L}(\underline{S}) - \Delta\pi^{M}(\underline{S})},$$

which is independent the market size S and hence (3b) holds weakly. Using that

$$\frac{\Delta\pi^{E,H}(b)}{\Delta\pi^{M}(b)} = \frac{S(\Delta\pi^{H}(\underline{S}) - \Delta\pi^{M}(\underline{S}))}{S(\Delta\pi^{M}(\underline{S})) + R) - R} = \frac{\Delta\pi^{H}(\underline{S}) - \Delta\pi^{M}(\underline{S})}{\Delta\pi^{M}(\underline{S}) + R - \frac{R}{S}},$$

(3c) holds strictly if the above is decreasing in S, i.e. if $\Delta\pi^{H}(\underline{S}) > \Delta\pi^{M}(\underline{S})$ or $\pi^{H}(\underline{S}) > \pi^{N}(\underline{S})$. Thus Condition (3c) is satisfied with a strict inequality.

Example 2: Conjectural variations model

Substituting in equation (3) in Boone (2000) we have that the profits of any firm i in a market of m firms are equal to

$$(1+V)\left(\frac{(1+V)M - (m+1+V)c_i + \sum_{j=1}^{n} c_j}{(m+1+V)(1+V)}\right)^2,$$

where V is the conjectural variation, $V = 0$ is Cournot and m is the number of firms. If we take $m = n-1$ firms (there has been a merger) and $c_j = c$ for the rest of the firms, we have that the profits of the merged firm are

$$(1+V)\left(\frac{(1+V)M - (n-1+V)c_i + (n-2)c}{(n+V)(1+V)}\right)^2$$

Substituting c_i for $\underline{c}$ and $\overline{c}$, in the numerator and in the denominator and simplifying we have that

$$\frac{\Delta\pi^{E,H}}{\Delta\pi^{E,L}} = \frac{[2(1+V)(M-c) + (n-1+V)(c-\underline{c})](c-\underline{c})}{[2(1+V)(M-c) + (n-1+V)(c-\overline{c})](c-\overline{c})}$$

and therefore the derivative is negative.

In order to show part (3c) we can again substract the profits of two firms in a market of $m = n$ firms from the profits of one firm in a market with $m = n - 1$ for the case in which all production costs are equal to c and simplifying

$$\Delta\pi^M = \frac{(M-c)^2(1+V)}{(n+1+V)^2(n+V)^2}\left[1+2(n+V)-(n+V)^2\right]$$

Notice that a merger without efficiencies is profitable if and only if $1+2(n+V)-(n+V)^2 > 0$.

Suppose from now on that $1+2(n+V)-(n+V)^2 > 0$. In this case, condition (3c) is satisfied since

$$sign\left(\frac{\partial}{\partial M}\frac{\Delta\pi^{E,H}}{\Delta\pi^M}\right) = sign\frac{\partial}{\partial M}\frac{[2(1+V)(M-c)+(n-1+V)(c-\underline{c})]}{(M-c)^2},$$

which is negative.

For future reference, notice that in case $1+2(n+V)-(n+V)^2 < 0$, not only is a merger for market power unprofitable (Condition (3a) is violated) but also Condition (3c) does not hold.

Example 3: Cournot counterexample

In the proof of the conjectural variations example, we have shown that if the merger for market power is unprofitable then it does not satisfy Condition (3c) either although it satisfies Condition (3b) of the corollary. An example in which the merger is unprofitable is the Cournot case ($V = 0$) with three firms ($n = 3$). We now show that Assumption (1) does not hold either. Assume for simplicity that $\underline{c} < \overline{c} < c$. Substituting from above

$$\frac{\Delta\pi^H}{\Delta\pi^L} = \frac{\Delta\pi^{E,H}-\Delta\pi^M}{\Delta\pi^{E,L}-\Delta\pi^M} = \frac{8(M+c-2\underline{c})^2-9(M-c)^2}{8(M+c-2\overline{c})^2-9(M-c)^2}$$

which simplifying is equal to

$$\frac{\Delta\pi^H}{\Delta\pi^L} = \frac{32\left[c-\underline{c}\right]^2+32(M-c)\left[c-\underline{c}\right]-(M-c)^2}{32\left[c-\overline{c}\right]^2+32(M-c)\left[c-\overline{c}\right]-(M-c)^2}.$$

Defining $x \equiv (M-c)$ and the appropriate constants, the previous expression can be rewritten as

$$\frac{\Delta\pi^H}{\Delta\pi^L} = f(x) \equiv \frac{k_1+k_2x-x^2}{k_3+k_4x-x^2}$$

We now show that the sign of $f'(x)$ is equal to the sign of $x^2+\left[c-\underline{c}+c-\overline{c}\right]x - 32\left[c-\underline{c}\right]\left[c-\overline{c}\right]$, which is clearly negative if $x = (M-c) = 0$ but then increases and it is positive for a high enough x. Therefore, Assumption (1) is violated.

Now, $f'(x)$ has the same sign as

$$k_2 k_3 - k_1 k_4 + 2x(k_1 - k_3) + x^2 (k_2 - k_4),$$

which, substituting, has the same sign as the polynomial above.

Examples 4 and 5: Differentiated/Convex Cournot

The example trivially satisfies (3a). We now establish that it satisfies Conditions (3b) and (3c). The net profits from merging are given by

$$\frac{(4+\lambda)\left[(b-c_m)(1+\lambda)+(c-c_m)(n-2)\right]^2}{S(n,\lambda)^2} - \frac{(b-c)^2(2+\lambda)}{(n+\lambda+1)^2}$$

where

$$S(n,\lambda) \equiv (4+\lambda)(1+\lambda)+(n-2)(2+\lambda).$$

Substituting c_m for c we have that without efficiency gains merger is profitable (there are market power gains), $\Delta\pi^M > 0$, if and only if

$$T(n,\lambda) \equiv (1+\lambda)^2(4+\lambda)(n+\lambda+1)^2 - (2+\lambda)S(n,\lambda)^2 > 0.$$

Substituting c_m for $\underline{c}$, $\overline{c}$ and c, we have that

$$\frac{\Delta\pi^{E,H}}{\Delta\pi^{E,L}} = \frac{\Delta\pi^H - \Delta\pi^M}{\Delta\pi^L - \Delta\pi^M} = \frac{\left[(2b-c-\underline{c})(1+\lambda)+(c-\underline{c})(n-2)\right](c-\underline{c})}{\left[(2b-c-\overline{c})(1+\lambda)+(c-\overline{c})(n-2)\right](c-\overline{c})},$$

and therefore the derivative with respect to the market size is equal to

$$\frac{\partial}{\partial b}\frac{\Delta\pi^{E,H}}{\Delta\pi^{E,L}} = -\frac{(1+\lambda)2\,(c-\underline{c})\,(\overline{c}-\underline{c})\,(n+\lambda+1)}{\left[(2b-\overline{c}-\underline{c})(1+\lambda)+(c-\overline{c})(n-2)\right]^2(c-\overline{c})} \leq 0$$

given that $\underline{c} < \overline{c} < c$.

Similarly, substituting c_m for $\underline{c}$, $\overline{c}$ and c, we have that

$$\frac{\Delta\pi^{E,H}}{\Delta\pi^M} = \frac{\left[(b-\underline{c})(1+\lambda)+(c-\underline{c})(n-2)\right](4+\lambda)\,(c-\underline{c})\,(n+\lambda+1)^2(n+\lambda-1)}{(b-\underline{c})^2 T(n,\lambda)},$$

and therefore the derivative with respect to the market size is equal to

$$\frac{\partial}{\partial b}\frac{\Delta\pi^{E,H}}{\Delta\pi^M} = -\frac{2\left[(b-\underline{c})(1+\lambda)+(c-\underline{c})(n-2)\right](4+\lambda)\,(c-\underline{c})\,(n+\lambda+1)^2(n+\lambda-1)}{(b-\underline{c})^3 T(n,\lambda)} \leq 0$$

given that $\underline{c} < \overline{c} < c < b$.

Example 7: Conglomerate merger

The net profits from merging are given by

$$\Delta\pi_m^*(c_m) = 2\left(\frac{(\beta - c_m)^2}{4a} - \frac{(\beta - c)^2}{4a}\right) - R.$$

Taking the first derivative with respect to β of a high-type firm and simplifying, one has

$$\frac{\partial\left(\Delta\pi_m^*(\underline{c})\right)}{\partial b} = \frac{c - \underline{c}}{a} > 0,$$

and thus Assumption (2) holds since $c > \underline{c}$. Taking the derivative with respect to β of the following equation

$$\frac{\Delta\pi_m^*(\underline{c})}{\Delta\pi_m^*(\overline{c})} = \frac{(\beta - \underline{c})^2 - (\beta - c)^2 - 2aR}{(\beta - \overline{c})^2 - (\beta - c)^2 - 2aR}$$

establishes that Assumption (1) holds.

Example 8: Vertical merger

References

[1] Andrade, G., M. Mitchell and E. Stafford 2001, "New Evidence and Perspectives on Mergers", *Journal of Economic Perspectives*, Vol. 15, pp. 103-120.

[2] Andrade G., and E. Stafford, 2004, "Investigating the Economic Role of Mergers", *Journal of Corporate Finance*, Vol. 10, pp. 1-36.

[3] Banal-Estañol A., P. Heidhues, R. Nitsche and J. Seldeslachts, 2006, "Merger Clusters during Economic Booms", *Working Paper WZB SP II 2006-17.*

[4] Barney J., 1988, Returns to Bidding Firms in Mergers and Acquisitions: Reconsidering the Relatedness Hypothesis, *Strategic Management Journal*, Vol. 9, pp. 71-78.

[5] Boone, J., 2000, "Competition", *Mimeo Tilburg University.*

[6] Boone, J., 2007, "A New Way to Measure Competition", *Economic Journal*, forthcoming.

[7] Brusco, S., G. Lopomo, D. Robinson and S. Viswanathan, 2007, "Efficient Mechanisms for Mergers and Acquistion", *International Economic Review*, Vol. 48(3), pp. 995-1035.

[8] Caballero, R. and M. Hammour, 1994, "The Cleansing Effect of Recessions", *The American Economic Review*, Vol. 84 (5), pp. 1350-1368.

[9] Carow K., R. Heron, and T. Saxton, 2004, “Do Early Birds Get the Returns? An Empirical Investigation of Early-Mover Advantages in Acquisitions”, *Strategic Management Journal*, Vol. 25, pp. 563-585.

[10] Comment R. and Schwert, 1995, “Poison or Placebo? Evidence on the Deterrence and Wealth Effects of Modern Anti-Takeover Measures”, *Journal of Financial Economics*, Vol. 39 (1), pp. 3-43.

[11] Cox A.J. and J. Portes, 1998, “Mergers in regulated industries: The uses and abuses of event studies.”, *Journal of Regulatory Economics* Vol. 14, pp. 281–304.

[12] Cramton P., 1998, “Auctions and Takeovers”, in: Peter Neuman: *New Palgrave Dictionary of Law and Economics*, MacMillan Press, London p. 122-125.

[13] Davidson C. and R. Deneckere, 1985, “Incentives to Form Coalitions with Bertrand Competition”, *Rand Journal of Economics*, Vol. 16, pp. 473-486.

[14] Dutz, M., 1989, “Horizontal Mergers in Declining Industries”, *International Journal of Industrial Organization,* Vol. 7, pp. 11-33.

[15] Eisfeldt, A. and A.Rampini, 2006, ”Capital Reallocation and Liquidity”, *Journal of Monetary Economics,* Vol. 53, pp 369-399.

[16] Fauli-Oller, R., 2000, “Takeover Waves”, *Journal of Economics & Management Strategy*, Vol. 9(2), pp. 189-210.

[17] Fridolfsson, S. and J. Stennek, 2005, "Why Mergers Reduce Profits and Raise Share Prices—A Theory of Preemptive Mergers", *Journal of the European Economic Association*, Vol. 3(5), pp. 1083-1104.

[18] Fuller K., J. Netter and M. Stegemoller, 2002, "What Do Returns to Acquiring Firms Tell Us? Evidence from Firms That Make Many Acquisitions", *The Journal of Finance* Vol. 57 (4), pp. 1763–1793.

[19] Gugler K., D. Mueller, and B. Yurtoglu, 2006, "The Determinants of Merger Waves", *Working Paper WZB SP II 2006-01.*

[20] Harford J., 2003, "Efficient and Distortional Components to Industry Merger Waves", *Mimeo University of Washington.*

[21] Harford J., 2005, "What Drives Merger Waves?", *Journal of Financial Economics*, Vol. 77, pp. 529-560.

[22] Heron, R. and E. Lie, 2006, On the Use of Poison Pills and Defensive Payouts by Takeover Targets, *Journal of Business*, Vol.79 (4), pp.1783-1807.

[23] Hirshleifer D. and S. Titman, 1990, "Large Shareholders and Corporate Control", *Journal of Political Economy*, Vol. 98(2), pp. 295-324.

[24] Houston J., M. Christopher, and M. Ryngaert, 2001, "Where do Merger Gains Come from? Bank Mergers from the Perspective of Insiders and Outsiders", *Journal of Financial Economics*, Vol. 60, pp. 285-331.

[25] Inderst R., and C. Wey, 2004, "The Incentives for Takeover in Oligopoly", *International Journal of Industrial Organization*, Vol 22, pp. 1067– 1089.

[26] Jehiel, P., and B. Moldovanu, 2000, "Auctions with Downstream Interaction among Buyers", RAND Journal of Economics, Vol. 31 (4), pp. 768-791.

[27] Jovanovic B., and J. Rousseau, 2001, "Mergers and Technological Change: 1885-1998", *Working Paper Vanderbilt University.*

[28] Jovanovic B., and J. Rousseau, 2002, "The Q-Theory of Mergers", *American Economic Review*, Vol. 92(2), pp. 198-204.

[29] Kwoka, J., 1989, "The Private Profitability of Horizontal Mergers with Non-Cournot and Maverick Behavior", *International Journal of Industrial Organization*, Vol. 7, pp 403-411.

[30] Lambrecht B., 2004, "The Timing and Terms of Mergers Motivated by Economies of Scale", *Journal of Financial Economics*, Vol. 72(1), pp. 41-62.

[31] Lambrecht B., and S. Myers, 2007, "A Theory of Takeovers and Disinvestment", *Journal of Finance*, Vol 62(2), pp. 809-845.

[32] Lee, Y., 2007, "The Importance of Reallocations in Cyclical Productivity and Returns to Scale: Evidence from Plant-Level Data", U.S. Bureau of the Census CES WP 07-05.

[33] Loughran, T. and A. Vijh, 1997, “Do Long-Term Shareholders Benefit From Corporate Acquisitions?”, *Journal of Finance*, Vol. 52(5), pp. 1765-1790.

[34] Maksimovic, V., and G. Philips, 2001, “The Market for Corporate Assets: Who Engages in Mergers and Asset Sales and are there Efficiency Gains?”, *Journal of Finance*, Vol. 56, pp. 2019-2065.

[35] Martynova, M., and L. Renneboog, 2005, “Takeover Waves: Triggers, Performance and Motives,*Working Paper Tilburg University*.

[36] McGuckin, R. and S. Nguyen, 1995, On Productivity and Plant Ownership Change: New Evidence from the Longitudinal Research Database, *The RAND Journal of Economics*, Vol. 26 (2), pp. 257-276.

[37] Molnar, J., 2003, “Preemptive Horizontal Mergers: Theory and Evidence”, *Mimeo London Buisness School*.

[38] Motta, M., 2006, “Competition Policy: Theory and Practice” , Cambridge University Press.

[39] Perry, M., and M. Porter, 1985, “Oligopoly and the Incentive for Horizontal Merger”, *American Economic Review*, Vol. 75, pp. 219-227.

[40] Povel and Singh (2006), “Takeover Contests with Asymmetric Bidders”, *Review of Financial Studies,* Vol. 19(4), pp. 1399-1431.

[41] Rhodes-Kropf, M., D. Robinson and S. Viswanathan, 2005, "Valuation Waves and Merger Activity: The Empirical Evidence", *Journal of Financial Economics*, *Journal of Financial Economics*, Vol. 77 (3), pp. 561-603.

[42] Rhodes-Kropf, M., and D. Robinson, 2008, "The Market for Mergers and the Boundaries of the Firm", *Journal of Finance*, Vol. LXIII, pp. 1169-1211.

[43] Rhodes-Kropf, M., and S. Viswanathan, 2004, "Market Valuation and Merger waves", *Journal of Finance*, Vol. LIX, pp. 2685-2718.

[44] Rosen, R., 2006, "Merger Momentum and Investor Sentiment: The Stock Market Reaction to Merger Announcements", *Journal of Business*, Vol. 79, pp. 987–1017.

[45] Salop, S., 1979, "Monopolistic Competition with Outside Goods", *Bell Journal of Economics*, Vol. 10(1), pp. 141-156.

[46] Shleifer, A., and R. Vishny, 1989, "Management Entrenchment: The Case of Manager-Specific Investments", *Journal of Financial Economics*, Vol. 25, pp. 123-139.

[47] Shleifer, A., and R. Vishny, 1986, "Large Shareholders and Corporate Control", *Journal of Political Economy*, Vol. 94(3), pp. 461-478.

[48] Shleifer, A., and R. Vishny, 2003, "Stock Market Driven Acquisitions", *Journal of Financial Economics*, Vol. 70, pp. 295-311.

[49] Toxvaerd, F., 2004, “Strategic Merger Waves: A Theory of Musical Chairs”, *Journal of Economic Theory*, forthcoming.

[50] Vives, X., 2002, “Private Information, Strategic Behavior, and Efficiency in Cournot Markets”, *Rand Journal of Economics*, Vol. 33(3), pp. 361-376.

[51] Weston, F., S. Kwang and S. Hoag, 1990, “Mergers, Restructuring, and Corporate Control”, Prentice Hall, Englewood Cliffs.