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Getting a Better Price: Strategic Behavior before Changes in Ownership of Corporate Assets

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Abstract

We propose a model of investments prior to corporate ownership changes. We derive conditions under which the selling of a firm triggers overinvestment by both the seller and the buyer prior to the asset transfer. In a setting with Cournot competition, we show that these incentives can drive the consumer prices in a post-acquisition duopoly below those of an ongoing triopoly. Our analysis warns against a mechanical use of pre-merger benchmarks in ex post merger evaluations.

JEL codes: L13, L40, L66

Keywords: Mergers & Acquisitions, Ownership, Auctions, Strategic investments, Merger evaluations

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1 Introduction

> "Selling a company is like going "all in" in a game of poker. It is a single final decision that will irrevocably determine the value of the investment for shareholders. The stakes could not be higher to maximize the value of a deal."
> Michael S. Frankel, "Mergers and Acquisitions Basics" (2005), p. 108.

Mergers and acquisitions are common events and frequently involve large sums of money. During 2007, there were more than 30,000 mergers and acquisitions with a total value of 4.8 trillion U.S. dollars. The largest deal during 2007 was valued at close to 100 billion dollars (the takeover of ABN Amro).[1] Maksimovic and Phillips (2001) find that close to 7 percent of the plants change ownership annually through mergers, acquisitions and asset sales in peak expansion years in the economy.[2] In this paper, we explore how strategic investment decisions are affected by the selling of a firm. We develop an illustrative oligopoly model where a seller and a buyer have up-front possibilities to invest, in order to affect the subsequent stage, where alternative buyers compete to acquire the seller's assets.[3] The seller invests to maximize the acquisition price, net investment costs. The buyer invests to maximize product market profits – net investment costs and the acquisition price. This is – to the best of our knowledge — the first paper to examine the investment behavior before an acquisition when both the seller and the buyer can invest.

In the main case that we analyze, the seller has an incentive to overinvest from the perspective of the buyer. If the buyer could decide the investment level of the seller, the buyer would like to set the investment level maximizing the profits of the combined unit. The seller, in contrast, takes into account how the *acquisition price* is affected. In equilibrium, the acquisition price is shown to equal the alternative buyer's valuation of

[1] Source: Dealogic and Congressional Research Service.

[2] They analyze the market for firms, divisions and plants of manufacturing firms using a large sample of plant-level data for the period 1974-92.

[3] Boone and Mulherin (2007) document that the typical sale of a firm features several bidders.

obtaining the target firm which, in turn, consists of the profit for this firm of obtaining the target firm net its profit, if it is obtained by a rival firm. The seller thus internalizes that investments increase the acquisition price, not only by generating an increase in the buyer's profit but also through the negative impact on the non-acquirer's profit (due to the development of more competitive assets).

We also show that the buyer has an incentive to overinvest in its own firm prior to the asset transfer. By increasing competition in the market, the buyer's investment decreases a rival's value of obtaining the seller's assets, which reduces the acquisition price. Taken together, these incentives to overinvest prior to the asset transfer lead to higher equilibrium investments in the market than if strategic motives are not present. The main feature that drives these results is that investment makes you "tough" – higher investments by one party drive down the profits of other parties. To illustrate the existence of the mechanisms identified above, we examine investments in a setting with quantity competition in homogenous goods with linear demand and quadratic investment costs. In this case, overinvestment drives down the price in the product market whereas the takeover in itself generates the standard effect of concentration on price. In particular, we show that these incentives can drive the consumer prices in a post-acquisition duopoly below those of an ongoing triopoly.

The framework presented here can be related to that of Fudenberg and Tirole (1984)). Consider, for instance, an "opposite" alternative when investment makes you "soft" – investments have a positive effect on rivals where investments are strategic complements for the seller and strategic substitutes for the buyer. It then follows that both the buyer and the seller have an incentive to underinvest. More generally, the main point of this paper is that firms that are about to merge or transfer assets are not likely to maximize the same static profit function as in ordinary times. This has implications for empirical work. A simple before/after dummy will pick up the behavior leading up to the merger and it will be misleading if we interpret it as reflecting equilibrium changes. Using more finely defined time dummies or letting the window before the merger be sufficiently long

are simple ways of dealing with this.

There are several empirical studies indicating the potential importance of the mechanisms identified in the analysis. One example where pre acquisition investments seem to have been important is in Carlsberg's (Denmark's leading brewer) takeover of Pripps (leading brewer in Sweden at the time), which was first announced in May, 2000. The takeover was approved by the Swedish competition authority half a year later, subject to Carlsberg divesting a number of brands (Carlsberg had a 28 percent market share of the Swedish beer market and Pripps 26 percent pre-merger).[4] In Figure 1, we show the development of the average price of beer for these two firms over the period surrounding the takeover. A simple interpretation of the pattern for price is that (i) the takeover is associated with a price increase and (ii) the price increases before the merger are completed.[5]

A closer look at the data reveals that prices decrease before the merger, and that the price decrease is due to the introduction of a very aggressively priced beer by Pripps and the introduction of a similar beer half a year later by Carlsberg. In Figure 2, we show the market shares in the lager segment of the four largest producers. After a period with the top three players having a market share of some 25-30 percent and a fourth player a share of around 10 percent, we see that the introductions of the low priced brands have large effects on market shares. The aggressive pre-merger investments are consistent with the mechanisms identified in our proposed theoretical framework.

The theoretical literature on mergers has paid little attention to the interaction of investments and merger over time.[6] A small set of papers theoretically examines the

[4] These figures are averages across months for 1999 and refer to beer with an alcohol content of more than 3.5 percent ABV. Source: Systembolaget.

[5] In his survey of price effects of horizontal mergers, Weinberg (2007) finds both of these to be typical responses.

[6] A large set of papers (see, for instance, Salant et al. (1983), Perry and Porter (1985), Deneckere and Davidson (1985) or Farrell and Shapiro (1990)) clarifies how mergers affect prices, profits and welfare,

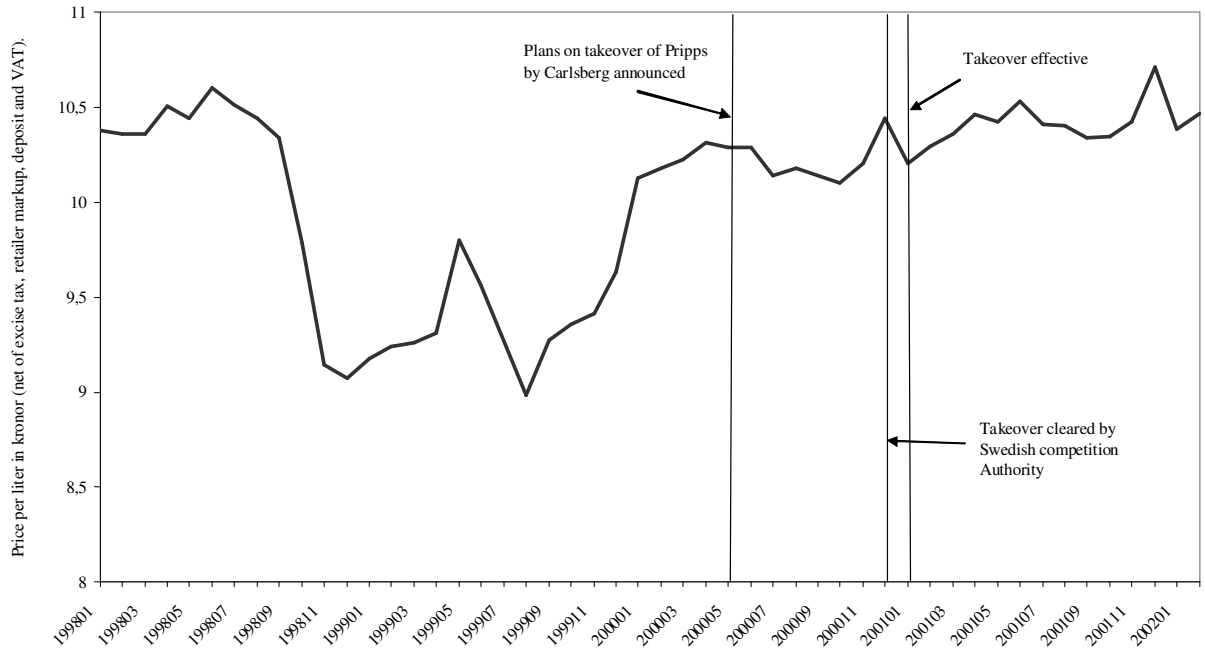

Figure 1: The average price of beer for Pripps and Carlsberg in the Swedish market before and after the takeover of Pripps by Carlberg.

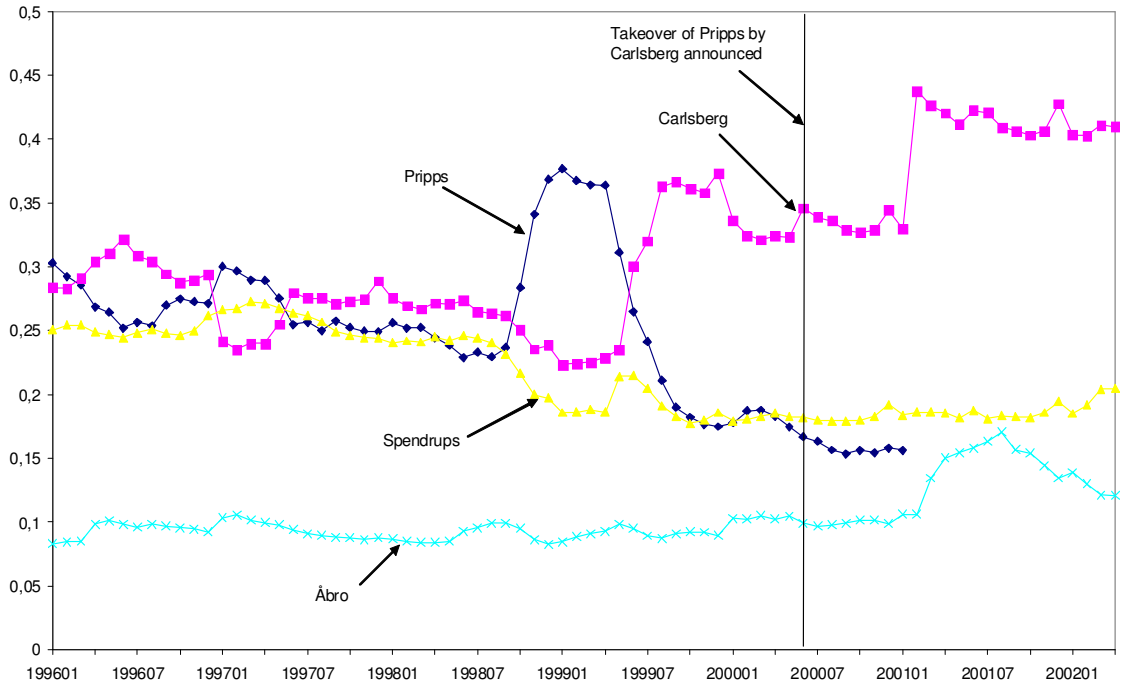

Figure 2: The market shares in the lager segment of the four largest producers before and after the **takeover** of Pripps by Carlberg.

evolution of industry investment over time and allows for mergers or takeovers. Pesendorfer (2005), for instance, shows that a merger today may become profitable by triggering future mergers. He uses exogenous merger criteria and the acquisition price is thus not determined in the model. Using numerical methods, Gowrisankaran (1999)[7] models the evolution of an industry allowing for entry, exit and investments as well as mergers. He uses a setting with a dominant firm and a competitive fringe that are price takers both in the capital and the product market. Consequently, the strategic effects on which we focus in our study are abstracted from in those studies.

A precursor lies in work focusing on predatory pricing before a takeover to improve the terms of the deal (see Yamey (1972) for informal discussions or Burns (1986) for empirical evidence on this type of behavior by American Tobacco Co.). A formalization of a similar outcome is Saloner (1987)[8] who shows that in a signaling model, a duopolist might want to expand output to signal that it is a low-cost firm and thereby improve the terms of the takeover. However, in these studies, the seller cannot invest which is possible in our setting.

The paper is also related to the papers by Bulow and Klemperer (1996, 2008) and Bulow, Huang, and Kemperer (1999). Their focus is on how to sell or buy a given set of assets, our focus is on how the seller and buyer should strategically invest prior to the assets being sold in an auction acquisition model.

This paper could also be seen as a contribution to the literature on auctions with externalities, see, for instance, Jehiel, Moldovanu and Stacchetti (1996) and Jehiel and

depending on the market structure in various static oligopoly models. Such papers are sometimes referred to as the exogenous merger literature – the firms that merge are exogenously chosen. They are silent on the terms of the deal and do not address the kind of strategic concerns on which we focus. Recently, a literature on endogenous mergers has emerged: Who merges with whom is a central question and there is explicit modeling of the acquisition game (see, for instance, Horn and Persson (2001)). In this vein, Fridolfsson and Stennek (2005) show how unprofitable mergers may occur if being an outsider is even worse than being an insider. The kind of strategic behavior on which we focus is not present, however.

[7] The model builds on Pakes and McGuire (1994).

[8] See also Persson (2004) for a formalization in a multi-firm predation context.

Moldovanu (2000). We add to this literature by endogenizing the productivity of the assets sold in an environment where this productivity can be affected by an ex ante investment of the buyer and the seller.[9]

In section 2, we present our model and make a number of assumptions regarding the effects of investments on profits. These assumptions are made to illustrate how overinvestment by both the seller and the buyer can result from strategic behavior to affect the sales price. In section 3, we consider how the results change under different assumptions of the effect of investments on profits. Section 4 provides an example with Cournot competitors facing linear demand functions, where the assumptions of section 2 hold. It also shown that the overinvestment incentives of the seller and the buyer can drive the post-acquisition duopoly price below that of an ongoing triopoly. Section 5 draws out the implications of our work for the interpretation of the empirical literature and we conclude the paper in section 6.

2 The model

We consider an oligopoly industry served by a set $\mathcal{I}$ of incumbent firms, where $\mathcal{I} = \{S, B, A\}$. Firm S is the potential *seller*, firm B the potential *buyer* and firm A the *Alternative* buyer. There are three periods. In a first period, firms may invest in new capital. To simplify the presentation, we assume that only firm S and firm B have the option of investing in new capital, k_S and k_B, respectively. The cost of investing is given by $C(k_i)$ with $C'(k_i) > 0$. In a second period, firm S is up for sale: The buyer and the alternative buyer are the potential acquirers. In a final period, the buyer and the alternative buyer compete in oligopoly fashion, given their total capital holdings where the total capital holding is denoted K_i. The game is solved backwards.

[9] Moreover, it has been shown that a selling independent investor has a stronger incentive to invest than an incumbent firm, due to strategic effects on the sales price (Katz and Shapiro (1986) and Norbäck and Persson (2008)). However, in these studies the buyer **cannot** invest, which is possible in our setting.

2.1 Stage 3: product market interaction

Firm i chooses an action $x_i \in R^+$ to maximize its product market profit, $\Pi_i(x_i, x_{-i}, K_i, K_{-i})$ which depends on its own and its rivals' market actions, x_i and x_{-i}, as well as the total amount of capital holdings by firm i, K_i, and the capital holdings of its rivals K_{-i}. Action, x_i, can, for instance, be setting a price or a quantity. Assume that there exists a unique and stable Nash-Equilibrium in actions, $x(K_i, K_{-i})$, defined from the first-order conditions[10]:

$$\frac{\partial \Pi_i(x_i, x_{-i}; K_i, K_{-i})}{\partial x_i} = 0. \tag{1}$$

In our main analysis, the market is a duopoly in period 3. From (1), define $R_i(K_i, K_{-i}) = \Pi_i(x_i(K_i, K_{-i}), x_{-i}(K_i, K_{-i}), K_i)$ as a reduced-form profit for firm i, $R_i(K_i, K_{-i})$.

2.2 Stage 2: The acquisition process

Let us now turn to the equilibrium ownership of firm S. Throughout, we use $+$ as superscripts of A and B to denote situations where the firm in question has acquired S and $-$ to denote the situation where the rival has acquired S. Thus, K_{B^+} is the total amount of capital owned by firm B when firm B acquires firm S. Without an acquisition, firm A simply uses its initial assets which we normalize to 0, $K_{A^-} = 0$. We also normalize firm S's and firm B's initial asset holdings to zero. If firm B obtains firm S, the asset holdings of firms are:

$$\begin{cases} K_{B^+} = k_B + k_S \\ K_{A^-} = 0 \end{cases}. \tag{2}$$

If firm A obtains firm S, the capital holdings are

$$\begin{cases} K_{B^-} = k_B \\ K_{A^+} = k_S \end{cases}. \tag{3}$$

k_B and k_S are endogenous and determined in period 1.

[10] See Dixit (1986) for an analysis of the stability condition in oligopoly models.

We model the acquisition process as a perfect information auction, where the two incumbents, firm B and firm A, simultaneously post bids on the assets of firm S, k_S. Each incumbent firm announces a bid, b_i, where $\mathbf{b} = (b_B, b_A) \in R^2$ is the vector of these bids.[11] The acquisition price is denoted by P. Each incumbent firm faces an individual fixed cost of the acquisition, f_i.

We now turn to firms' valuations of obtaining firm S. Starting with firm B's valuation, we have:

$$v_B = R_B(K_{B^+}, K_{A^-}) - R_B(K_{B^-}, K_{A^+}) - f_B, \tag{4}$$

where the first term shows the profit for firm B when possessing the target firm S and the second term shows the profit if S is acquired by the rival firm.

Similarly, firm A has the following valuation:

$$v_A = R_A(K_{A^+}, K_{B^-}) - R_A(K_{A^-}, K_{B^+}) - f_A. \tag{5}$$

Then, we assume that f_A is greater than f_B and that the difference is sufficiently large to ensure that $v_B > v_A$.[12] It is then straightforward to derive the following lemma[13]:

Lemma 1 *The target firm is acquired by firm B at a price equal to the valuation by firm A, i.e. P=ν_A.*

Proof. See the Appendix. ■

2.3 Stage 1: Optimal investment.

Let us now characterize firms' investments. We focus on investments in the case of interest – when firm S is to be put up for sale in period 2. We compare these investments to two benchmarks: The case where firm A controls firm S in period 1 and onwards (denote this

[11] The acquisition is solved for Nash equilibria in undominated pure strategies. There is a smallest amount, ε, chosen such that all inequalities are preserved if ε is added or subtracted.

[12] This will hold for all $f_A - f_B \geq 0$ in the Cournot model in section 4.

[13] The correct acquisition price P^* is $v_A - \varepsilon$ but, to simplify the presentation, we use v_A.

duopoly case DA) and the case where firm B controls firm S in period 1 and onwards (denote this duopoly case DB). Cases DA and DB will thus feature the effect on investments of going from triopoly to duopoly, but strategic behavior to influence the sales price will not be relevant. In section 4, we also make a comparison to a triopoly benchmark. Throughout this section, we confine the attention to interior solutions such that $k_i > 0$.

The seller's incentive We now study the seller's investment incentives when it intends to sell. Using Lemma 1 and (5), the seller will maximize the net sales price:

$$\begin{aligned} \max_{k_S} \quad & : \quad P^* - C(k_S) \\ s.t \quad & : \quad P^* = v_A = R_A(K_{A^+}, K_{B^-}) - R_A(K_{A^-}, K_{B^+}) - f_A. \end{aligned} \tag{6}$$

To ensure that there is an interior solution to this problem, we assume that $P - C(k_S)$ is strictly concave in k_S. The optimal investment for firm S is given from the first-order condition:

$$\frac{\partial R_A(K_{A^+}, K_{B^-})}{\partial k_S} - \frac{\partial R_A(K_{A^-}, K_{B^+})}{\partial k_S} - C'(k_S) = 0. \tag{7}$$

To evaluate (7), we then assume:

Assumption S1: $\frac{\partial R_A(K_{A^-}, K_{B^+})}{\partial k_S} < 0$.

In the words of Fudenberg and Tirole (1984), we thus assume that investment makes the seller "tough": An increase in firm S's ownership of capital strictly decreases the alternative buyer's profits. A comparison of (7) to benchmark DA (where A would set k_S such that $\frac{\partial R_A(K_{A^+}, K_{B^-})}{\partial k_S} - C'(k_S) = 0$) clearly shows the incentives to "over-invest" in order to achieve a higher acquisition price: In (7), firm S does not only internalize the marginal change in profit for the acquiring firm A, $\frac{\partial R_A(K_{A^+}, K_{B^-})}{\partial k_S}$, firm S also takes into account the term $-\frac{\partial R_A(K_{A^-}, K_{B^+})}{\partial k_S} > 0$, reflecting the fact that firm A is also willing to pay in order to avoid a weak position as non acquirer. For a given level of k_B, a sale of firm S is thus associated with a higher level of investment by the seller than in the case DA.

The buyer's incentives: Let us now examine the investment incentives for an incumbent firm that will buy the assets of firm S in period 2. Using Lemma 1 and (5), firm B solves:

$$\max_{k_B} \quad : \quad R_B(K_{B^+}, K_{A^-}) - P^* - C(k_B) \tag{8}$$

$$s.t \quad : \quad P^* = v_A = R_A(K_{A^+}, K_{B^-}) - R_A(K_{A^-}, K_{B^+}) - f_A, \tag{9}$$

where we assume that $R_B(K_{B^+}, K_{A^-}) - P^* - C(k_B)$ is strictly concave in k_B.

The first-order condition is:

$$\frac{\partial R_B(K_{B^+}, K_{A^-})}{\partial k_B} - \frac{\partial P^*}{\partial k_B} - C'(k_B) = 0. \tag{10}$$

To evaluate (10), we make the following assumption:

Assumption B1 $\frac{\partial P}{\partial k_B} < 0$.

Assumption B1 then states that the buyer's investment decreases the acquisition price (A's valuation) of the assets of firm S. In the words of Fudenberg and Tirole (1984), we thus assume that investment makes the buyer "tough" towards the seller. Using the expression for the sales price, Assumption B1 can be expressed as $\frac{\partial R_A(K_{A^+}, K_{B^-})}{\partial k_B} - \frac{\partial R_A(K_{A^-}, K_{B^+})}{\partial k_B} < 0$. Assumption B1 posits that the negative impact of the buyer's investment is larger for the alternative buyer when this firm possesses the seller's assets. Intuitively, a large firm is hurt more by an increase in competition due to expansionary investments by rivals than is a small firm, since lower product market prices affect more units in a large firm.

Consider the optimal choice of k_B if B was controlling firm S in period 1 and onwards (case DB).[14] Then, the endogeneity of the acquisition price, that is the mechanism on which we focus, would be absent. In this case (DB), B would set k_B so that $\frac{\partial R_B(K_{B^+}, K_{A^-})}{\partial k_B} - C'(k_B) = 0$. Strategic concerns imply that for a given k_S, firm B will overinvest relative

[14] Note that DB is not a true equilibrium in $K_S - K_B$ space, since K_S is not controled by S in this case and we assume that B's investment only goes through K_B. Nevertheless, DB is useful for determining the location of firm B's reaction function.

to the benchmark, DB. Firm B does not only internalize the change in its marginal profit $\frac{\partial R_B(K_{B^+},K_{A^-})}{\partial k_B}$ from investing, it also takes into account the decrease in the acquisition price, captured by the term $-(\frac{\partial R_A(K_{A^+},K_{B^-})}{\partial k_B} - \frac{\partial R_A(K_{A^-},K_{B^+})}{\partial k_B}) > 0$, thus reflecting the decrease in firm A's valuation.

Equilibrium investments: The equilibrium investments by firms S and B will be dependent on the actions taken by their rival and it is then useful to consider the slope of the firms' reaction functions. Let us start with the seller.

In standard settings, the slope of reaction functions hinges on the sign of cross-derivatives of the profit function and this case is no exception. Here, however, it is the cross-derivative with respect to the acquisition price P (A's valuation) that is crucial.

We assume that:

Assumption S2: $\frac{\partial P}{\partial k_B \partial k_S} < 0$.

This implies that firms' investments are "strategic substitutes" in the acquisition price P (A's valuation): The marginal value for firm S of investing to increase the sales price is lower when firm B invests more. To be explicit about what we assume about revenue functions, note that Assumption S2 can also be expressed as

$$\frac{\partial}{\partial k_B \partial k_S}\left[\partial R_A(K_{A^+}, K_{B^-}) - \partial R_A(K_{A^-}, K_{B^+})\right] < 0.$$

Totally differentiate the first-order condition (7) and rewrite it to arrive at the slope of the seller's reaction function labeled $\mathcal{R}_S(k_S)$, as:

$$\mathcal{R}'_S(k_S) = -\frac{\frac{\partial^2(P^*-C)}{\partial k_S}}{\frac{\partial^2 P^*}{\partial k_B \partial k_S}} < 0. \tag{11}$$

Note that the denominator is negative from Assumption S2 and the nominator is negative from the assumption that $P^* - C(k_S)$ is strictly concave in k_S. $R_S(k_S)$ is illustrated in Figure 3, where we note that the reaction function is downward sloping.

Now, turn to the slope of the buyer's reaction function. Once more, it hinges on the sign of cross-derivatives of the profit function and here, it is the cross-derivative with

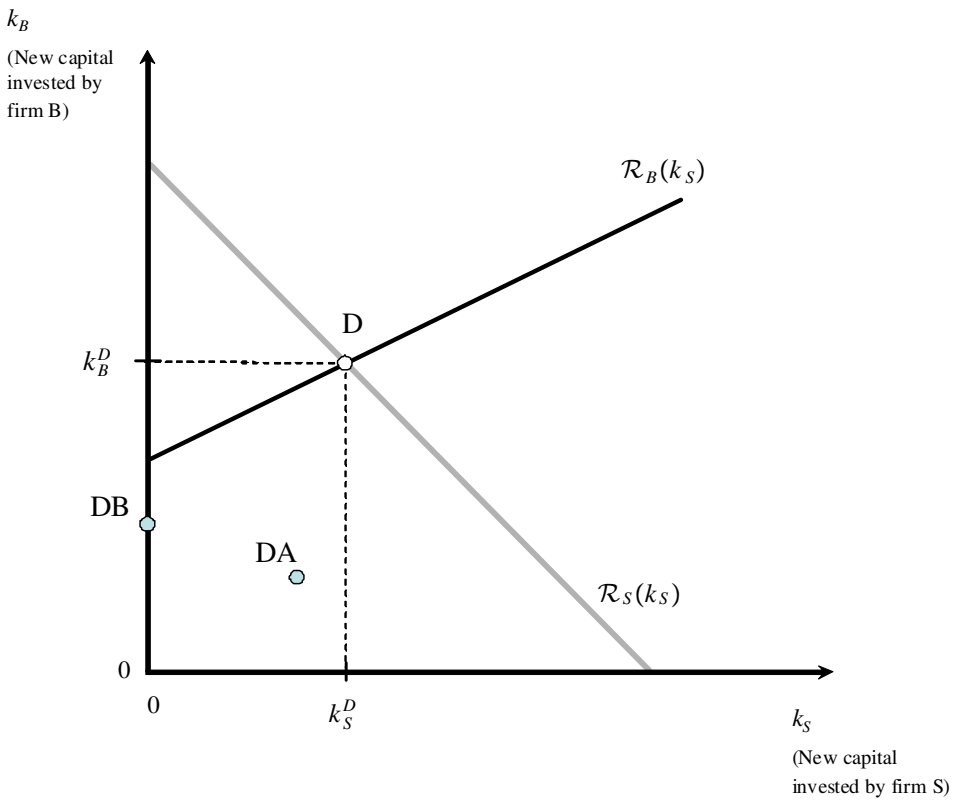

Figure 3: Equilibrium investments and asset transfers under assumptions S1-B2.

respect to the profit of the buyer $R_B(K_{B^+}, K_{A^-}) - C(k_B)$ net the acquisition price P (A's valuation). We assume that:

Assumption B2: $\frac{\partial^2 R_B(K_{B^+},K_{A^-})}{\partial k_B \partial k_S} - \frac{\partial^2 P}{\partial k_B \partial k_S} > 0.$

The second term in Assumption B2, i.e. that investments $-\frac{\partial^2 P}{\partial k_B \partial k_S} > 0$ are strategic substitutes in the acquisition price, is our assumption S2. Assumption B2 then states that the first term, i.e. the marginal value of investing for B, may not decrease too much in S's investments. Complementarities between investments by firms B and S would, for instance, make this first term positive.

Differentiate (10) and rewrite it to arrive at the slope of the buyer's reaction function, labeled $\mathcal{R}_B(k_S)$:

$$\mathcal{R}'_B(k_S)|_{Sale} = -\frac{\frac{\partial^2 R_B(K_{B^+},K_{A^-})}{\partial k_B \partial k_S} - \frac{\partial^2 P}{\partial k_B \partial k_S}}{\frac{\partial^2}{\partial k_B^2}\left[R_B(K_{B^+},K_{A^-}) - P - C(k_B)\right]} > 0. \tag{12}$$

Assumption B2 signs the nominator and the denominator is negative from the second-order condition. $\mathcal{R}_B(k_S)$ is illustrated in Figure 3. If firm B conjectures that firm S will add more capital, firm B will also invest more, that is, firm B's reaction function is upward-sloping.

We can now infer the effects on investments when firm S exits the market through a sale of its assets, indicated at point D. As illustrated in Figure 3, we have the following result:

Proposition 2 *Assume that S1, B1, S2 and B2 hold (broadly: Investment makes you "tough" and investments are strategic substitutes for the seller and strategic complements for the buyer). Then: i) for a given level of rival investment, the selling of firm S leads to more investment by both the buyer (firm B) and the seller (firm S) than in any of the benchmark cases (DB, DA). ii) Equilibrium investments on the market are greater than in any of the benchmark cases (DB, DA).*

The assumptions make the conditions under which there will be overinvestment due to strategic behavior clear. Just as in the Fudenberg-Tirole (1984) taxonomy of business

strategies, other assumptions are possible and we return to this below. In Figure 3, we compare the Nash-equilibrium in investments under exit by sale in point D to the benchmark outcomes. Points DA and DB in Figure 3 represent the Nash-equilibria in investments in duopoly where firm A and B, respectively, have control of firm S.

From equation (7), the seller's reaction function, $R_S(k_S)$ is always on the right-hand side of point DA, thus illustrating the incentive for the seller to overinvest in order to affect the sales price. Second, since the reaction function $R_B(k_S)$ is also located above point DB, firm B also has an incentive to overinvest in order to reduce firm A's valuation, i.e. to invest in order to reduce the acquisition price. Thus, we have established that the seller's reaction function is on the right-hand side of DA and downward sloping and the buyer's reaction function is above DB and upward sloping. In Figure 3, we have drawn the case where equilibrium investments are greater for both firms but, depending on the steepness of reaction functions, equilibrium D may be associated with a lower equilibrium investment for one of the firms. However, aggregate investment will always be greater than in the benchmarks since the intersection of reaction functions will lie to the northeast of a line connecting DB and DA.

Thus, we have shown the main result of our paper. Having one firm put up for sale changes the investment decisions by firms in the industry. Under the case considered, there was overinvestment from the viewpoint of both the seller and the buyer. The framework is quite general, however, and the results will differ depending on the assumptions with regard to the effect of investments on own and rival's profits. In the next section, we show that the framework can also generate underinvestment.

3 Generality of the framework

As noted, the assumptions made here can easily be related to Fudenberg and Tirole (1984)). Consider, for instance, an "opposite" alternative where investment makes you "soft" – investments have a positive effect on rivals when investments are strategic complements

for the seller and strategic substitutes for the buyer:

Assumption S1': $\frac{\partial R_A(K_{A-},K_{B+})}{\partial k_S} > 0$.

Assumption B1' $\frac{\partial P}{\partial k_B} > 0$.

Assumption S2': $\frac{\partial P}{\partial k_B \partial k_S} > 0$.

Assumption B2' $\frac{\partial^2 R_B(K_{B+},K_{A-})}{\partial k_B \partial k_S} - \frac{\partial^2 P(K_{B+},K_{A-})}{\partial k_B \partial k_S} < 0$.

The first-order conditions for the seller and the buyer are as previously

$$\frac{\partial R_A(K_{A+},K_{B-})}{\partial k_S} - \frac{\partial R_A(K_{A-},K_{B+})}{\partial k_S} - C'(k_S) = 0, \tag{13}$$

$$\frac{\partial R_B(K_{B+},K_{A-})}{\partial k_B} - \left(\frac{\partial R_A(K_{A+},K_{B-})}{\partial k_B} - \frac{\partial R_A(K_{A-},K_{B+})}{\partial k_B}\right) - C'(k_B) = 0. \tag{14}$$

Compared to a duopoly situation, the seller now has an incentive to underinvest since $\frac{\partial R_A(K_{A-},K_{B+})}{\partial k_S} > 0$: Investment by a rival increases the profits. Similarly, the buyer has an incentive to underinvest relative to the duopoly situation. The reaction functions (using (11), (12) and Assumption S2' and Assumption B2') now have the opposite slopes as compared to section 2.3. The situation is illustrated in Figure 4.

Proposition 3 *Assume that S1', B1', S2' and B2' hold (broadly: Investment makes you "soft" and investments are strategic complements for the seller and strategic substitutes for the buyer). Then: i) for a given level of rival investment, the selling of firm S leads to less investment by both the buyer (firm B) and the seller (firm S) than in any of the benchmark cases (DB,DA). ii) Equilibrium investments on the market are lower than in any of the benchmark cases (DB,DA).*

Like in the Fudenberg and Tirole taxonomy of business strategies, we could also consider other combinations of soft/tough and substitute/complements. To illustrate how the setup of this paper works under specific functional forms, we now turn to an example.

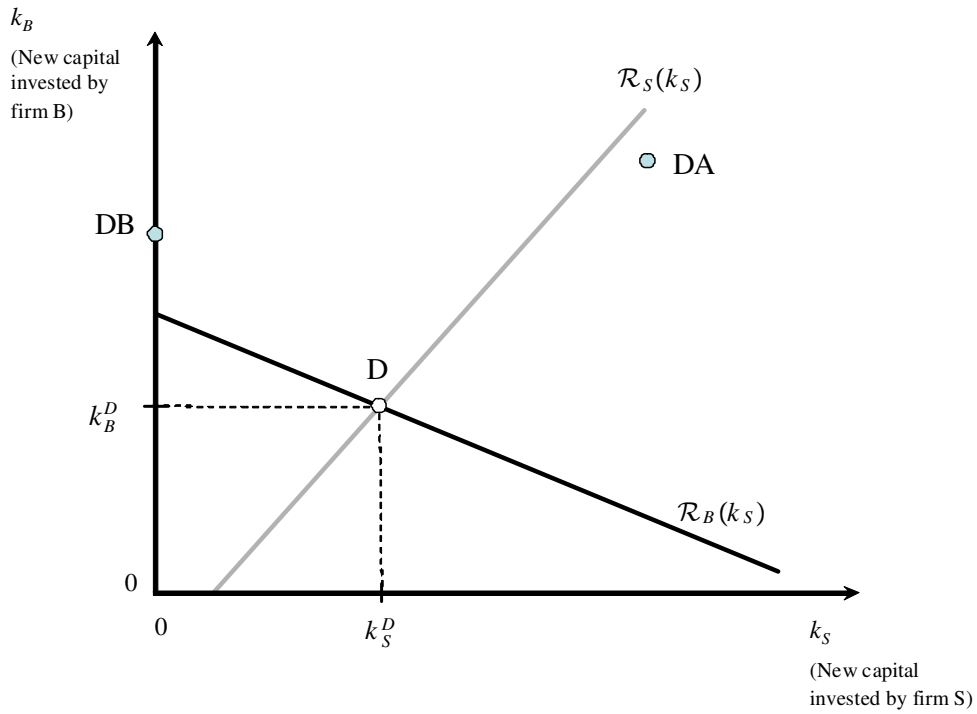

Figure 4: Equilibrium investments under asset transfers when reversing assumptions S1'–B2'.

4 An example: Cournot firms with linear demand and convex investment costs

In the following, we examine a particular case – that of Cournot competition with a linear demand function and convex investment costs, referred to as the LQC model. This set of standard functional forms matches assumptions S1, S2, B1 and B2 and we use this case to compare the outcome from the strategic duopoly to an ongoing triopoly – a comparison that is likely to be in the interest of a policy maker, for instance. Given this setup, the calculations that follow are standard and not all are detailed – full derivations are available in a downloadable appendix.[15] Assume the inverse demand curve to be given by

$$p(q_A, q_B, q_S) = a - q_A - q_B - q_S \tag{15}$$

and that the investment costs are

$$C(k_i) = \frac{\mu k_i^2}{2}. \tag{16}$$

p is price and q_i are quantities produced by firm i (where $q_S = 0$ if the firm is indeed sold). μ is a constant and the other notation is as before. Further, assume that the investment affects profits by reducing the marginal cost from c to $c - K_i$.

4.1 Product market competition and investments when firm S is bought by B

From (1) and linear demand (15), straightforward calculations show that the Cournot-Nash equilibrium for the buyer and the alternative buyer in the duopoly market is:

$$q_B^D(K_{B^+}, K_{A^-}) = \tfrac{\Lambda+2(k_B+k_S)}{3}, \quad q_A^D(K_{A^-}, K_{B^+}) = \tfrac{\Lambda-(k_B+k_S)}{3} \tag{17}$$

$$q_A^D(K_{A^+}, K_{B^-}) = \tfrac{\Lambda+2k_S-k_B}{3}, \quad q_B^D(K_{B^-}, K_{A^+}) = \tfrac{\Lambda+2k_B-k_S}{3}, \tag{18}$$

where $\Lambda = a - c$.

[15] It will be available at www.hhs.se/personal/friberg

From linear demand (15), it follows that reduced-form profits are quadratic in output, i.e. $R_i(K_i, K_{-i}) = (q_i^*(K_i, K_{-i}))^2$. It is then straightforward to prove the following Lemma:

Lemma 4 *Assumptions S1, B1, S2 and B2 are fulfilled in the Linear Qudratic model.*

Let us now turn to the investment stage: The buyer sets k_B to maximize $R_B(K_{B^+}, K_{A^-}) - P - C(k_B)$. With the specific functional forms we assume that the first-order condition for profit maximizing choice of k_B (10) when a sale is expected can be expressed as

$$R_B(k_S) = 2\frac{2\Lambda + 7k_S}{(9\mu - 8)}. \tag{19}$$

The costs of investing must be sufficiently convex for this to be well defined ($(9\mu - 8) > 0 \Longleftrightarrow \mu > 8/9$).[16] We directly see that the seller's reaction function is upward sloping in the seller's investments (since $\mathcal{R}'_B(k_S) = dk_B^*(k_S)/dk_S > 0$).

The seller sets k_S to maximize $P - C(k_S)$. The first-order condition (7) can then be written as

$$\mathcal{R}_S(k_B) = 2\frac{\Lambda - k_B}{3\mu - 2}. \tag{20}$$

As previously established, we see that a higher k_B is associated with a lower k_S – the reaction function is downward sloping. Using (19) and (20), in the case where there is an expected sale of firm S, the equilibrium investments are given by

$$k_S^D = 6\tfrac{\Lambda(3\mu-4)}{27\mu^2-42\mu+44}, \qquad k_B^D = 4\tfrac{\Lambda(3\mu+5)}{27\mu^2-42\mu+44}. \tag{21}$$

Note that the investment cost function must be sufficiently convex for the seller to invest in equilibrium, ($(3\mu - 4) > 0 \Longleftrightarrow \mu > 4/3$).[17]

[16] It can easily be checked that $\mu > 8/9$ is also sufficient for the second-order condition for profit maximization to hold.

[17] The denominator $27\mu^2 - 42\mu + 44$ is positive for all positive values of μ.

4.2 Product market competition and investments in an ongoing triopoly

The specific functional forms allow us to make a comparison with the case with a triopoly. Since firm A is assumed not to invest, it follows that the Cournot-Nash equilibrium is[18]

$$q_B^T = \frac{\Lambda+3k_B-k_S)}{4},\ \ q_A^T = \frac{\Lambda-k_B-k_S}{4},\quad q_S^T = \frac{\Lambda+3k_S-k_B}{4}. \tag{22}$$

Now turn to the investment stage. A Nash-equilibrium when B and S invest to maximize profits now yields symmetric equilibrium investments, since the incentive to affect the acquisition price is now mute:

$$k_B^T = k_S^T = \frac{3}{2}\frac{\Lambda}{4\mu-3}. \tag{23}$$

For comparison, we also consider the duopoly case where firm S exits at the beginning of stage 1 and B and A compete in the product market stage. Thus, this is a duopoly case where there is no strategic behavior to affect a sales prices. In this case, equilibrium investment is given by

$$k_B^{\tilde{D}} = k_A^{\tilde{D}} = \frac{4\Lambda}{9\mu-4}. \tag{24}$$

4.3 A duopoly with strategic pre-sales behavior and an ongoing triopoly: A comparison

Using equilibrium investments and quantities, we can calculate prices, profits and consumer surplus in the cases discussed above. The expressions do become somewhat unwieldy and we use the graph below to illustrate our main points in this section. We relate the price to the convexity of the investment function (μ, we graph price only for values of $\mu > 1.5$ such that equilibrium investments are positive and the price is above the cost of firm A in all cases). The more convex is the cost of investment, the less investment will there be and the higher will be the price.

[18] For ease of comparison, we do not allow the alternative buyer to invest here. This does not eliminate the incentive for strategic overinvestment, however.

As a benchmark, the solid black line in Figure 5 shows the price in a duopoly when there are no strategic investments (we let both firms invest to maximize the profits). The consumer price is then given from the investments in (24). The solid grey line shows the price in a triopoly with no strategic investments (in this case, firms S and B invest only taking into account the effect on their own profit) where the consumer price is derived from the investments in (23)). A comparison of these two lines shows the standard effect that a more concentrated market is associated with higher prices. However, strategic behavior will complicate an evaluation of the effect of a merger.

To see this, note that the dashed black line shows the price under duopoly when there is strategic investment as in the main case in this paper – where B and S invest strategically in period 1 and there is competition between A and the new merged entity (S and B) in the product market stage. This is the consumer price given from the investments in (21). The incentives to overinvest are reflected in a lower price on the market than in a standard duopoly. Even more striking is that for low to intermediate degrees of convexity of the investment function, the price under a duopoly with strategic behavior is lower than the price under triopoly. In these cases, overinvestment is sufficient to outweigh the effect of a greater concentration on price.

The starkest illustration of a fall in the price as a result of investment is provided if we compare the price when there is a triopoly but the investment levels are those associated with strategic behavior to affect the sales price (the dashed grey line). Note that this lowest level is likely to provide the most accurate description of the price in the periods just before a merger. In terms of the time series pattern of prices surrounding a merger, the logic of this section would imply that the price falls from the solid grey line to the dashed grey line as an effect of investments to affect the sales price. As the merging parties agree, they are likely to start acting as a joint profit maximizer and the price jumps to the black dashed line. A comparison that uses a short time window around the merger would thus indicate an increase in prices associated with the merger (from the grey dashed line to the black dashed line) also in cases where prices are actually reduced by the merger

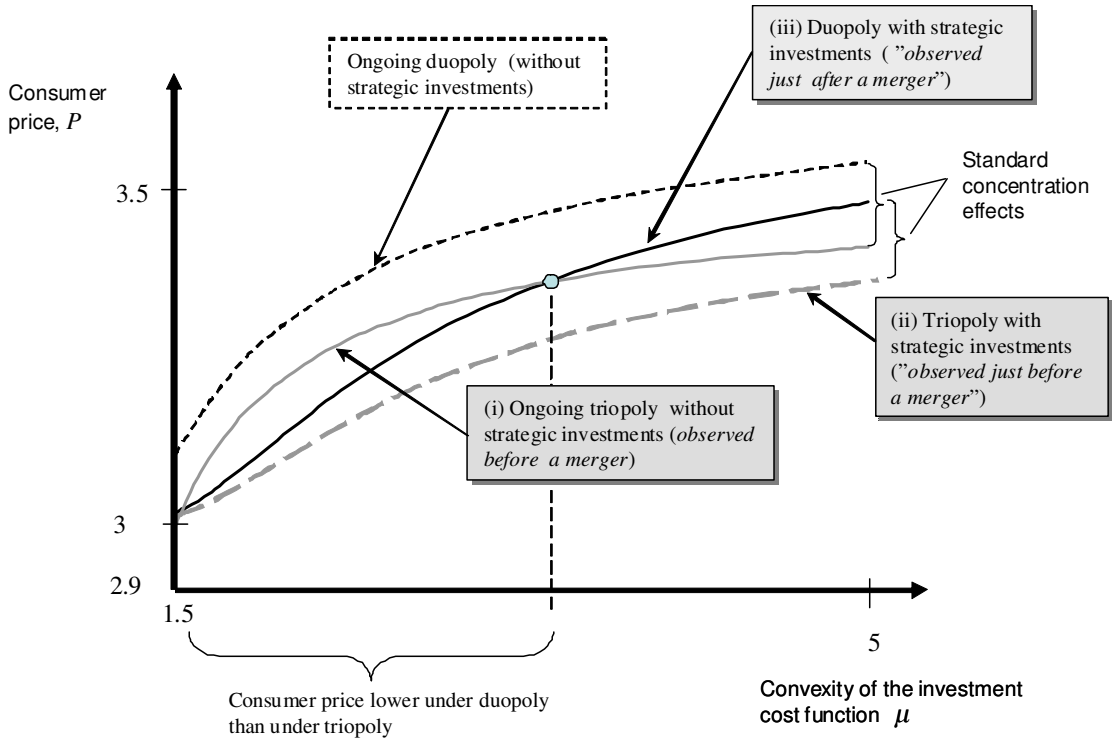

Figure 5: Product market price as a function of the convexity of the investment function, quantity competition with linear demand ($a = 5, c = 3$).

(falling from the solid grey line to the black dashed line). Consequently, we can state the following result:

Proposition 5 *In the LQC model, there exist parameter values where the consumer prices are lower in duopoly with strategic investments than in an ongoing triopoly.*

If we are interested in really long-run effects of the merger, when the investments have fully depreciated, the comparison between the uppermost line and the solid grey line is clearly the relevant one. The most severe misrepresentation of the merger will result if we only consider a short time window before the merger and a very long one afterwards – we would then compare the lowest dashed line to the uppermost line. Against this backdrop, let us now discuss the empirical literature that attempts to measure the impact of mergers.

5 Implications of our analysis for the empirical analysis of mergers

Empirically, there has been a considerable interest in examining the effect of changes in control over firms on various variables; see Pautler (2003) or Whinston (2006) for overviews. Some major strands of the literature are:

- The effect of mergers and acquisitions on accounting profits or stock market valuation (see, for instance, Campbell et al. (1997), Andrade et al. (2001) or Moeller et al. (2005)).
- The effect of mergers on prices (see, for instance, Borenstein (1990), Kim and Singhal (1993), Prager and Hannan (1998), McCabe (2002), Focarelli and Panetta (2003) – Weinberg (2007) provides a survey).
- The effect of privatization on efficiency; see, for instance, Dewenter and Malatesta (2001).

As mergers and privatizations are a central area of policy, we are likely to see more evaluations in the future.[19] Therefore, we want to point out some implications of our analysis for empirical work. For expository purposes, we can consider the above literatures as running a simple fixed effects regression of the type in (25). Let y_{it} be the variable of interest for firm i at time t. β_i is a fixed effect for firm i, γ_t are time effects, and PRE is a dummy that takes the value of one for the period before the merger for firms that merge later and 0 otherwise, with POST defined correspondingly for the period after the merger,

$$y_{it} = \beta_i + \gamma_t + \beta_1 \text{PRE}_i + \beta_2 \text{POST}_i + e_{it}. \tag{25}$$

[19] For instance, Whinston (2006, p 115) notes that "Unfortunately, the economics literature contains remarkably little of this kind of analysis [examining the results of mergers] ... This is clearly an area that could use more research."

The main point of our analysis can be simply stated and concerns the interpretation of a significant coefficient on the PRE or POST dummies. Say that strategic behavior takes the form of lower prices in the period before the merger – even if the merger per se did not at all affect prices, we would still estimate a negative coefficient on PRE and the standard interpretation – which compares the estimated coefficients on the PRE and POST dummies – would be that the merger led to higher prices. Just as in the case with the "Ashenfelter dip" – the drop in wages observed before individuals enroll in job training programs – it would be incorrect to interpret the coefficients as reflecting a causal effect of mergers on the variable of interest.[20]

More generally, we can distinguish two types of barriers to a simple causal interpretation of estimated coefficients in (25). The first regards the fact that merging firms are not a random draw of firms and approved mergers are not a random draw of proposed mergers. Similar issues are faced in many other applications where one tries to gauge the causal effect of some treatment (see, for instance, Angrist and Krueger (1999)). The type of problem for inference in a textbook application would be that more able individuals are more likely to be selected into a treatment that is expected to increase earnings. If we do not address this in some way, the estimated coefficient will be biased. While these aspects are typically not discussed in depth in the above studies, our feeling is that researchers are well aware of them and try to deal with them. For instance, Kim and Singhal (1993) stress

[20]If we take an investor perspective and are interested in the effects on excess returns of a merger announcement, this is not a cause for great concern. It is a matter of serious concern, however, if we as economists want to make statements about the efficiency of mergers and whether they are desirable from a social point of view.

that they examine a period when airline mergers were not contested by the authorities.[21]

The second type of issue is somewhat different. It regards behavior over time: Using only pre-merger and post-merger dummies, as is done in much of the literature, will in our setting generate significant effects of a merger, even where there are none, if play in the period immediately preceding the merger is different than standard static play. These issues are much less explored in the program evaluation literature – Laporte and Windmeijer (2005) provide one analysis of such issues – with an application to the impact of a divorce on general well being over time. Their proposed solution is to include a full set of time effects (divorce – 5 years, – 4 years, etc.). This is typically not done in the merger and privatization literature. Kim and Singhal (1993), for instance, examine prices of merging firms in the quarter before the merger announcement and prices in the quarter after the completion. The quarter before the announcement is likely to be severely affected by the intention to get the best possible deal. This could also explain one puzzling facet of their study – they find that mergers increase the price also in the case where there is no overlap between the routes or hubs of the firms. Kim and Singhal (1993) argue that this puzzle may be explained by increased multi-market contact – but, for us, a simpler explanation is that play right before a merger is not likely to be static Nash. Indeed, they recognize that a failing firm that is taken over may have different incentives to set prices before as compared to after a merger (for a further analysis of the pricing decisions of financially distressed firms see, for instance, Chevalier (1995)).

This paper points to that firms that are about to merge or change hands have incentives to let this affect investment behavior - which in turn will affect product market competition. An implication for empirical work is that one should be careful in deter-

[21] Fridolfsson and Stennek (2005) point out that if an efficient stockmarket anticipates the acquisition, the new information in the acquisition announcement is which firms are insiders and which are outsiders. Under this assumption, they show that preemptive mergers could explain the empirical evidence that mergers reduce profits and raise share prices. Using the same approach, Fridolfsson and Stennek (2000) show the limits of using effects on rivals' share prices to determine the competitive effect of a merger.

mining the pre-acquistion benchmark - using finely defined time dummies (as in Laporte and Windmeijer (2005)) or letting the window before the merger be sufficiently long are simple ways to avoid strategic behavior in the runup to the acquisition to affect estimation results. There is also reason to expect the strategic motives that we consider to be less pronounced in some cases. For instance, if ownership is widely dispersed, then owners are likely to be less effective in affecting strategy in order to maximize the sales price. It may also be of interest to study operations that are part of the merger but peripheral to the main businesses of the merging firms.

Finally, let us note an alternative way of evaluating mergers that circumvents the issues outlined above: building a model of the industry and comparing the pre-merger situation to a simulated equilibrium (or comparing a post-merger situation to a simulated pre-merger situation). This method has been applied to several product markets and mergers (beer in Hausman et al (1994) or Pinkse and Slade (2004), breakfast cereal in Nevo (2000) and trucks in Ivaldi and Verboven (2005)). These models offer an interesting alternative to the before/after type of study. However, at present, there is not a sufficient number of studies for us to be able to talk of stylized facts. There have also been few evaluations of how the merger simulations compare to what actually happened, as discussed by Whinston (2006). The results in Peters (2006) and Slade (2006) point to the sensitivity of results to the exact specification. We should note that static Bertrand or Cournot (which are the standard assumptions in this literature) are not workable descriptions of the industry, if the strategic concerns we raise are important. Indeed, the present project was initially intended to make an ex post evaluation of merger simulations using data from the Swedish beer market. However, as we started to examine the data, it seemed that a standard form of merger simulation was unlikely to be able to match what appeared to be driving the results in the market, which lead us to the present inquiry.

6 Conclusions

In this paper, we show that firms involved in transfers of corporate assets have incentives to strategically invest prior to the assets transfer. In particular, sellers may have an incentive to "overinvest" to strategically increase the sales price and, despite the fact that they will later buy the assets, buyers may have an incentive to "overinvest" to strategically reduce the acquisition price. These findings have implications for empirical work on mergers and takeovers. A simple before/after dummy will pick up the behavior leading up to the asset transfer (merger) and will be misleading if we interpret it as reflecting the total equilibrium effect of changed ownership. Using more finely defined time dummies or letting the window before the merger be sufficiently long are ways of dealing with this.

A welfare evaluation is outside the scope of this paper. However, let us point out some welfare implications for future research. Let us start with consumer surplus effects. The consumer surplus will be at least as high when firms invest strategically prior to the asset transfer in the model of section 4. This follows from the investment levels being higher in the strategic investment environment. On the other hand, by definition, overinvestments decrease the producer surplus and depending on the parameter values, it can be shown that the total surplus can decrease as well as increase from these strategic investments.

What are the implications for policy? The identified strategic overinvestment incentive for the seller and the buyer indicates that there is no a priori reason to have general policies trying to prevent such strategic investments. However, if the selling of the asset takes place in isolation, these strategic overinvestment incentives will not be present. Consequently, ensuring bidding competition over the selling firm is crucial for generating a higher consumer surplus. Having policies which give many potential buyers the opportunity to participate in the acquisition market therefore seems warranted from a consumer surplus perspective.

Moreover, the results in the paper lend support to the view that informational constraints are important when deriving an optimal merger policy. As with the ex post

evaluations of mergers, a mechanical acceptance of the pre-merger situation as reflecting an equilibrium without mergers can be misleading. How misleading such an analysis is will also depend on how the value of the asset depreciates over time: In the long run, these strategic "overinvestments" will not have any effect on the asset holdings in the industry.

In the analysis, we have assumed the assets to be industry specific, i.e. the assets are likely to be designed to fit the production in a particular industry and the cost of restructuring them into suitable assets in other industries is assumed to be high.[22] If the assets were not industry specific, the strategic mechanisms identified above would not be present since the buyer would then resell the assets at their "cost value". Finally, note that we have abstracted from why the seller sells its assets. One reason is that the sale is profitable due to market power and synergy effects which, in turn, will depend on the demand and cost structure in the industry. Another reason is that the seller has an outside option with a higher return and a sale is necessary to exploit this outside opportunity due to managerial or financial constraints. Moreover, there will be situations with no bidding competition over the seller's assets. In that case, the sales price will be the seller's reservation price and the seller will then not have a strategic overinvestment/underinvestment incentive. However, the buyer will still have a strategic incentive to affect the sales price. Studying these aspects in detail is left to future research.

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7 Appendix:

Proof of Lemma 1

Let $v_i > v_j$ without loss of generality. First, consider the equilibrium candidate where firm i acquires the seller's assets. Consider equilibrium candidate b^*, where $b_i^* > b_j^*$, $j \neq i$. Let owner i be the owner obtaining the seller's assets. Note that $b_i^* > v_i$ is a weakly dominated strategy, since no owner will post a bid over its maximum valuation of obtaining the assets. If $b_i^* < v_j$, firm j benefits from deviating to $b_j^{**} = b_i^* + \varepsilon$, since it then obtains the assets and pays a price for the assets which is lower than its valuation of obtaining them. Last, consider candidate $b_i^* = v_j$, $b_j^* = v_j - \varepsilon$. Then, no owner has an incentive to deviate. Thus, this is a Nash equilibrium and the only NE where firm i obtains the assets.

Let us now show that this is the only Nash equilibrium. First, consider the situation where firm j obtains the assets. Consider equilibrium candidate b^*, where $b_j^* > b_i^*$, $j \neq i$. But we know that in equilibrium, $b_j^* < v_j$, since firm j otherwise plays a weakly dominated strategy. But if $b_j^* < v_j$, firm i benefits from deviating to $b_i^{**} = b_j^* + \varepsilon$, since it then obtains the assets and pays a price lower than its valuation of obtaining them. Thus, firm j obtaining the assets is not an equilibrium.

Second, note that the situation where neither firm i nor firm j obtains the assets cannot occur if there is no reservation price at the auction. ■