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FIRMS MERGE IN RESPONSE TO CONSTRAINTS

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Abstract

Theoretical IO models of horizontal mergers and acquisitions make the critical assumption of efficiency gains. Without efficiency gains, these models predict either that mergers are not profitable or that mergers are welfare reducing. A problem here is the empirical observation that on average mergers do not create efficiency gains. We analyze mergers in a model where firms cannot equalize marginal costs and marginal revenues over all dimensions in their action space due to constraints. In this type of model mergers can still be profitable and welfare enhancing while they create a loss in efficiency. The merger allows a firm to relax constraints. Further, this set up is consistent with the following stylized facts on mergers and acquisitions: M&A's happen when new opportunities have opened up or industries have become more competitive (due to liberalization), they happen in waves, shareholders of the acquired firms gain while shareholders of the acquiring firms lose from the acquisition. Standard IO merger models do not explain these empirical observations.

Keywords: Pro/anti-competitive mergers, efficiency defence, constraints, merger waves, deregulation

JEL codes: G34, K21, L40

1. Introduction

Current competition policy regarding horizontal mergers starts from the trade off between market power and efficiency gains. This trade off was first formalized by Williamson (1968). A horizontal merger without efficiency gains leads to higher prices due to market power and lower welfare due to deadweight loss. To the extent that the merger reduces marginal costs, prices decrease and the merger can raise welfare. As argued below, empirical evidence suggests that for most mergers such efficiency gains do not materialize (in fact, often efficiency is reduced after the merger). Theory suggests that horizontal mergers without efficiency gains are either unprofitable (Salant, Switzer and Reynolds (1983)) or welfare reducing (Deneckere and Davidson (1985)).[1] Taking these models and the empirical evidence seriously, the majority of horizontal mergers should simply be abolished. Unless the firms can convincingly argue that there will be efficiency gains, the prior probability of efficiency gains is small. Most likely then the merger is driven by a desire to increase market power which is welfare reducing. Based on this reasoning it is hard to understand why competition authorities spend so much resources on merger control.[2]

We present a model where firms face constraints that can be alleviated by acquiring assets through mergers. This allows for mergers that do not raise efficiency (or even reduce it) but which are profitable and can still be pro competitive. In this sense, the model here gives a rationale for scrutinizing mergers and acquisitions (M&A's) carefully without relying on efficiency gains. The model is consistent with stylized facts like M&As happen after industry shocks, they tend to happen in waves, target firms gain from an acquisition while acquiring firms loose. These stylized facts tend to be emphasized more in the finance literature (see references below) on M&A's than in the industrial economics literature on antitrust. In this sense, the paper tries to bridge a gap between these two literatures.

The theory presented here can be applied to both horizontal and conglomerate mergers. A conglomerate merger is between firms that are not on the same (relevant) market (would be a horizontal merger) and that are not active in the same value chain (would be a vertical merger).[3] Using the standard framework, a conglomerate merger is only profitable if it either

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[1]Salant, Switzer and Reynolds (1983) derive their result in a Cournot model and Deneckere and Davidson (1985) in a Bertrand set up. However, these results also hold if the mode of competition is generalized to supply functions as shown by Akgün (2004).

[2]Indeed there is a debate in the literature whether money spent on antitrust enforcement is worthwhile; see Crandall and Winston (2003) and Baker (2003) for opposing views on this.

[3]Below we do not explicitly model externalities between the merging firms as in Rey and Vergé (2005).

raises efficiency (*e.g.* through economies of scope) or creates market power (*e.g.* through portfolio effects, see Bishop and Walker (2002, pp. 291)). Thus, if efficiency gains are unlikely (as they seem to be), the market power effect remains and conglomerate mergers tend to be welfare reducing. Again, with the idea that firms merge to alleviate constraints, mergers can be profitable and welfare enhancing without relying on efficiency gains.

We present three examples to motivate that mergers can be driven by constraints faced by firms instead of (potential) efficiency gains. First, when in 1994 Reed Elsevier acquired Mead Data Central, the main reason given was not efficiency gains. Reed Elsevier was a publisher for scientific, professional and business readers and its strength was mainly in print products. With the acquisition of Mead Data Central it sought entry into electronic publishing (see *Reed to pay $ 1.5 billion for Mead Data Central* (1994) and *Reed Elsevier to spend $ 1.5 billion for Mead Data Central* (1994)). In other words, this acquisition opened up an opportunity or a market for Reed Elsevier (electronic publishing) that it did not have before. As Reed Elsevier and Mead Data Central were not active on the same market, this is best characterized as a conglomerate merger. Second, consider the horizontal acquisition in 1989 of Uniroyal Goodrich by Michelin. Michelin had positioned itself in the US as a producer of premium, upscale tires. Yet, the replacement tire sale was the most profitable segment in the US and by the end of the eighties 50% of these sales came from lower-end brands. Hence Michelin needed a way to penetrate that market segment and the acquisition made sure this happened fast (see Rivera Brooks (1989) and Davis (1989)). A third example is the acquisition of Stokely-Van Camp by Quaker Oats in 1983. Quaker was especially (if not only) interested in Stokely's Gatorade brand. Stokely distributed this beverage only regionally and did not market it aggressively. Quaker wanted to apply its advertising capabilities and international distribution network to introduce Gatorade in new markets (*Robust growth of Gatorade nets a payoff to Quaker* (1990) and *Is Stokely worth Quaker's lofty bid?* (1983)). Hence Quaker had capacity left to market and distribute another brand, but its constraint was that it did not have another brand to market. Acquiring Gatorade made sure this capacity could be used again. In each of these examples, the merger was not motivated by efficiency gains but by opening up new markets and opportunities.

As a further illustration of this, Wasserstein (2000, pp. 193) in a popular book on M&A's describes Rosen's Cube which 'shows a company inside the box anxious to burst out and achieve growth, but constrained by external limitations and its resources. Breaking through the box

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Therefore the theory developed here is not directly applicable to vertical mergers. This is left for future research.

of constraints is the obsession of top management.' This idea of acquisitions as opening up new markets and opportunities is in line with the view of Mackey McDonald (chairman and CEO of VF Corporation) that an 'acquisition becomes attractive if it offers us a new consumer segment or geographic market to sell our products to or if it adds new products to one of our core categories' (Carey (2000)). This is the way we model mergers here. A merger does not raise firms' efficiency levels but it allows firms to do something they could not do before.

Two types of constraints that we use as illustrations of the general theory of constraints are capital market constraints and time constraints. Empirical papers showing that firms face capital market constraints include Fazzari, Hubbard and Petersen (1988), Gilchrist and Himmelberg (1994) and Whited (1992) (also see Hubbard (1998) for a survey). The idea of these papers is that (after controlling for investment opportunities) investments are positively correlated with cash flows.[4] That is, if firms have more money, they invest more. This would not happen with perfect capital markets. Capital market constraints as a consideration guiding mergers and acquisitions goes back to the well known Boston Consulting Group (BSC) growth-share matrix (see, for instance, Henderson (1976)). The matrix was developed to help firms create a healthy portfolio of business units where Cash Cows (business units with a high market share that need only little investment) can be used to finance Stars (high market share units that also need substantial investments) and Question Marks (units with small market share that need big investments). The implicit assumption here is a capital market imperfection. If capital markets were perfect, a firm could just borrow from a bank to finance investments in Stars and Question Marks. Acquisitions would not be needed to generate cash. With imperfect capital markets a firm may have profitable business opportunities for which it cannot find the money to invest. Acquiring another firm that does generate cash may then help to finance the new business opportunities. Hubbard and Palia (1999) provide evidence for this internal capital market view for acquisitions in the 1960s.

Most of the assets acquired through a take over can also be obtained by internal growth and investment by a firm. To illustrate, in the Reed Elsevier - Mead Data Central example above, Reed Elsevier could have decided to generate the required knowledge for electronic publishing by internal training of existing workers and hiring of new employees. However, in the words of Alex Mandl (chairman and CEO of Teligent) the 'plain fact is that acquiring is much faster than building. And speed –speed to market, speed to positioning, speed to becoming a viable company– is absolutely essential in the new economy' (see Carey (2000)). Hence the initial

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[4]Also Schroth and Szalay (2005) show that firms invest more in R&D if they have more cash available.

constraint of lacking expertise or certain products is transformed into a time constraint and M&As form a swifter route to a solution than in-house expansion of expertise and products. Below we explicitly model this type of time constraint.

As mentioned, merger models without constraints need efficiency gains to make mergers profitable and welfare enhancing. Although there are indeed mergers generating efficiency gains for the merging firms (see, for instance, Focarelli and Panetta (2003)), the evidence on this issue is actually not overwhelming. Many papers surveyed in Mueller (1997) and Röller, Stennek and Verboven (2000) are not able to detect efficiency gains on average, others actually find that mergers on average lead to efficiency losses. Mueller (1997, pp. 663/4) concludes that the 'pattern of merger activity in the United States and the United Kingdom over the past century is inconsistent with the hypothesis that mergers are primarily intended to increase efficiency'. Similarly, Röller, Stennek and Verboven (2000, pp. 36) find that 'there seems to be no support for a general presumption that mergers create efficiency gains ... in particular cases, however, mergers do create efficiencies'. Gugler, Mueller, Yurtoglu and Zulehner (2003, pp. 649) in an international study find that 'Roughly the same fraction of mergers reduced efficiency as increased it'. They further find that roughly half of the mergers that raised profits did so by increasing market power. Finally, Scherer and Ross (1990, pp. 174) conclude that 'statistical evidence supporting the hypothesis that profitability and efficiency increase following mergers is at best weak. Indeed, the weight of the evidence points in the opposite direction: efficiency is reduced on average following merger'. Mueller (1985, pp. 266) considering mergers in the US in the period 1950-1972 concludes that 'no support was found for the hypothesis that mergers improve efficiency by consolidating the sales of the acquired companies on their most efficient product lines'.

Another source of evidence on mergers' efficiency and profitability is the literature on firms' performance on the stock market. Agrawal, Jaffe and Mandelker (1992) find that 'stockholders of acquiring firms suffer a statistically significant loss of about 10% over the five-year post-merger period'. Agrawal and Jaffe (2000) provide an extensive review of the literature examining long-run stock returns following acquisitions. They conclude that there is 'strong evidence of abnormal under-performance following mergers'. Also Pautler (2001, pp. 29) concludes in his survey of the literature that 'multi-industry studies find that mergers are unprofitable in a significant percentage of instances'. Further, Moeller, Schkingemann and Stulz (2005) report that in the 1990s acquiring (US) firms' shareholders lost an aggregate $216 billion. In addition they claim (pp. 759) that 'The large losses from 1998 through 2001 cannot be explained by a

wealth transfer from acquiring-firm shareholders to acquired-firm shareholders. We find that the aggregate combined value of acquiring and acquired firms falls by a total of $134 billion for the sample of public firm acquisition announcements from 1998 through 2001'. This has led some commentators to the conclusion that merger decisions are actually not taken in a rational way. Hubris and empire building are often mentioned (Roll (1986) and Shleifer and Vishny (1988)) as explanations why managers undertake such mergers. Below we analyze rational mergers and explain why the empirical researcher looking at the data may still conclude that the merger was not profitable. Yet, it seems fair to conclude that (on average) efficiency gains cannot be strong otherwise one would see profitable mergers more often.

Based on this observation, we argue that standard industrial economics models of mergers miss important aspects. If the trade off is only between market power and efficiency gains, it is hard to understand why competition authorities allow so many mergers that do not raise efficiency and hence are motivated by market power. Of course, competition authorities do not scrutinize all mergers (only the ones where market shares involved are high) and they decide under uncertainty. Similarly, firms decide under uncertainty. Hence ex ante efficiency gains may be expected that are not materialized ex post. Yet, the evidence cited above does suggest some mergers are motivated by other factors than efficiency gains and market power. This paper looks at constraints as such a factor.

In a model where firms face constraints we can understand why mergers (are allowed to) happen even if they do not generate efficiency gains. We also consider the following stylized facts that cannot be dealt with in the standard Cournot/Bertrand-Nash framework. First, a consistent finding in the finance literature (see Pautler (2001)) is that shareholders of target firms tend to gain (handsomely sometimes) while the shareholders from the acquiring firm do not gain much and sometimes even lose from the merger. Second, mergers often happen after new opportunities open up, for instance after the government liberalizes a sector or after new technological breakthroughs open up new markets (see Andrade, Mitchell and Stafford (2001) and Wasserstein (2000)). Sometimes both phenomena are linked as in the case where the government auctions frequencies for mobile telephony. Third, historically, mergers have happened in waves (see Andrade, Mitchell and Stafford (2001) and Weston, Siu and Johnson (2001)).

This paper is related to the theoretical industrial economics literature on mergers. As noted by Salant, Switzer and Reynolds (1983) mergers without efficiency gains are actually unprofitable in Cournot equilibrium. The reason is that the output level of the merged firm is

smaller than the sum of output levels of the firms before the merger. This has triggered a number of reactions deriving conditions under which a merger is profitable. Deneckere and Davidson (1985) show that mergers in a Bertrand game are profitable due to upward sloping reaction functions (see below). Perry and Porter (1985) explicitly introduce a capital stock variable to model that the merger may increase the size of the firm. McAfee, Simons and Williams (1992) consider a model of spatial competition between firms. A merger then combines the outlets of the firms at different locations and thus leads to a bigger firm. Farrel and Shapiro (1990) explicitly model three types of cost savings from a merger: the merged firms can rationalize output across their plants, they can shift capital to its most productive uses and they can learn from each other's experiences. These possibilities allow for mergers that are profitable and welfare enhancing. However, as mentioned, empirical evidence suggests that many mergers are not motivated by efficiency gains. Further, these papers do not explain why mergers happen in waves or why acquiring firms see their profits reduced after the merger.

Another literature on mergers without efficiency gains looks at mergers as a way to reduce overcapacity in declining industries, see for instance Dutz (1989), Fridolfsson and Stennek (forthcoming) and Lambrecht and Myers (2005). Such mergers also give the impression that mergers are not profitable if one does not correct for the fact that they happen in declining industries. However, if the firm had not merged, its profits would have been (even) lower. Other arguments why mergers happen although there are no efficiency gains in production are taxation and implicit contracts. Sometimes there are tax advantages to be gained from a merger. However, as argued by Weston, Siu and Johnson (2001, pp. 149) taxes 'are likely to be a reinforcing influence rather than the major force in sound merger'. Further, Shleifer and Summers (1988) discuss the idea that a (hostile) takeover can be profitable because the new owner does not honor the implicit contracts with other stakeholders in the firm. Although this can create hold up problems as stakeholders cannot be sure that their implicit contracts will be honored in the future, it can still be profitable (at least in the short run). As an example, one can think of promised wage increases that are not granted by the new management. From the point of view of our framework, this is still an example of an efficiency gain as labor becomes cheaper (in the short run where the hold up problem is expected to be less severe). Hence this motive for mergers suffers from the same critique as above that efficiency gains are actually not that prevalent (alternatively, the efficiency losses due to breaking the implicit agreement dominate, but then this cannot justify a rational merger).

This paper is organized as follows. The next section considers a simple model of capital

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market imperfections and illustrates the main results. Section 3 presents a general model of mergers when firms face constraints. In such a model, mergers can reduce efficiency (raise marginal costs) and still be profitable and welfare enhancing. Then we analyze the timing of mergers and why rational mergers can be followed by a reduction in firms' profits. Section 5 presents a more detailed model of capital market imperfections and a model of time constraints. Section 6 concludes the paper.

2. Three simple examples with capital market constraints

In this section, we consider three simple examples to show how constraints causing a wedge between marginal revenue and marginal costs can explain the following stylized facts (SF):

SF.1 M&A's do not raise productivity on average;

SF.2 M&A's happen after new opportunities have opened up;

SF.3 M&A's happen after the sector has become more competitive (say, due to a liberalization);

SF.4 M&A's happen in waves;

SF.5 shareholders of the acquired firm gain from the acquisition;

SF.6 shareholders of the acquiring firm do not gain much and can sometimes lose from the acquisition.

SF. 1 has been discussed and documented in the introduction. Reasons why efficiency decreases after a merger include a clash of company cultures and increased free riding as the size of the firm increases.[5] Mitchell and Mulherin (1996, pp. 194) show for the mergers in the 1980s that SF. 2, 3 and 4 are connected: 'our analysis shows that takeover activity in the 1980s cluster disproportionately at the industry level. Moreover, we find that industries experiencing the greatest amount of takeover activity in the 1980s are those exposed to the greatest fundamental shocks'. As examples of shocks they mention deregulation and technological advancements. They give the following examples of industries with major takeover activity due to deregulation

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[5]This can be formalized as follows. Suppose that performance contracts can only be written on the overall result of the firm. Further, assume that the sum of individual effort levels (e_i for agent i) increase profits. Then in a firm with n employees, each employee gets $\sum_{i=1}^{n} e_i/n$ and an increase in n reduces the return to agent i of his own effort level e_i.

during the 1980s: Air Transport (Airline Deregulation Act of 1978), Broadcasting (Cable Communications Policy Act of 1984), Natural Gas (Natural Gas Policy Act of 1978) and Truck and Transport Leasing (Trucking deregulation of 1980). Further, they mention that sectors where M&A's were triggered due to increased competition (sometimes foreign competition) include Apparel, Metals and Mining and Packaging and Containers.

The constraint we focus on in this section is a capital market constraint. Here we make the extreme assumption that firms cannot borrow at all (below we consider a more elaborate model of capital market imperfections). In particular, we assume the following. It is possible to hold cash money from one period to the next. It is not possible to borrow now and promise to repay in the future (say, due to some moral hazard problem of people taking the money and run). Agents can hold assets, but assets cannot be used as collateral nor is it possible that more than one agent owns the same asset (*i.e.* it is not possible to issue equity).

We consider a three period model, first with three agents denoted a, b and c. Table 1 summarizes the ownership structure of these agents. Agent a holds at $t = 1$ five units of cash money and an asset that will yield 7 units of cash in $t = 2$. Agents b and c hold no cash at $t = 1$ but each has an asset. Agent b's asset will yield 7 in the next period and c's asset will yield 13. Each of these assets yields zero in $t = 3$. At the end of the second period (*i.e.* after the returns in table 1 have been realized) a new asset will be auctioned that yields v/δ units of cash in $t = 3$ (this return is the same for each agent to keep things simple). For concreteness, assume that a second price auction will be used to allocate this new asset at the end of $t = 2$.[6]

Each agent has the following utility function $u(c_1, c_2, c_3) = c_1 + \delta c_2 + \delta^2 c_3$ where $\delta \in \langle 0, 1 \rangle$ denotes the discount factor. Assume that $v > 7$. Then the discounted value of the agent's firm (defined as cash holdings plus the asset owned by the agent) equals

$$V_a = 5 + \delta 7 \tag{1}$$

$$V_b = \delta 7 \tag{2}$$

$$V_c = \delta(13 - 7) + \delta^2 \frac{v}{\delta} \tag{3}$$

At the end of period 2, firm c bids its valuation (which then equals $\delta v/\delta =$) $v > 7$ (and at maximum its cash holdings 13) for the new asset. Thus firm c always outbids the other two firms and hence there is no reason for firm a to hold its cash till period 2. Since a knows he

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[6]One can think here of a government using an auction to allocate a license. Alternatively, the auction can be seen as a simple model of competition for a market, like an R&D race where the firm that spends the most on R&D wins the patent or a price war where the firm with the lowest price wins the market in a war of attrition framework.

	$t = 1$	$t = 2$
a	5	7
b	0	7
c	0	13

Table 1: *Cash and asset returns for the agents a, b and c.*

cannot gain by outbidding c at the end of $t = 2$ (even if he would save his cash flow from the first period), a consumes his cash in the first period. Consequently, the highest bid that agent c faces is 7 to get an asset worth $v > 7$.

Now assume that agent a uses his cash money at $t = 1$ to buy the asset from agent b at price p.[7] This is an acquisition. Clearly, b is only willing to sell if $p \geq 7\delta$ and the maximum amount a can pay equals a's cash holding 5. Thus $p \in [7\delta, 5]$ (note that no acquisition is possible if $5 < 7\delta$). If a acquires b and assuming that $v > 13$, the values of the two remaining firms equal

$$V_{ab} = 5 - p + \delta(14 + v - 13) \tag{4}$$

$$V_c = 13\delta \tag{5}$$

Now firm ab has an amount of cash equal to 14 at $t = 2$ and thus can outbid firm c to obtain the asset worth $v > 13$. Clearly, the acquisition is profitable for firm a if $V_{ab} > V_a$, which is the case for v big enough.

Using this example, we can already understand a number of the stylized facts above. First, note that we do not assume that the merger leads to efficiency gains. The return to the assets of a and b at $t = 2$ are assumed to be unchanged. In fact, we can even assume that there is an efficiency loss due to the merger so that the returns at $t = 2$ equal $7 - \varepsilon$ for some $\varepsilon > 0$.[8] Hence this idea that firms are constrained (here due to a cash constraint) can make M&A's rational while satisfying stylized fact SF.1. Second, if $v \leq 13$ there is no reason to merge. If firms' current activities generate enough cash to continue business in new projects (buy new assets), there is no reason to undertake M&A. Only when business is not as usual in the sense that new opportunities pop up that are worth far more than current business generates in cash returns, there is an incentive to acquire other firms to overcome your constraints. This is how we interpret SF.2. When new opportunities appear that are exceptional compared to past

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[7]We assume that b's asset is indivisible and hence it is not possible to buy part of the asset.

[8]Of course, the efficiency loss ε cannot be too big since the merged entity ab must still be able to outbid c. For v big enough, ε has to satisfy $19 - p - 2\varepsilon > 13$.

business there is an incentive to merge.[9] Further, note that firm a is willing to pay its whole cash holdings (equal to 5) to acquire b if v is big enough. Although we have not modeled the bargaining here between a and b, it is clear that $p > 7\delta$ is certainly possible here. If there was another firm like a with cash, they could bid up the price for b to 5. This explains SF.5: the acquired firm owner gains handsomely from the M&A. The cash constraint also explains the popular notion that it is 'eat or be eaten' in the M&A market. Because of the cash constraint at $t = 1$ it is less likely that bigger firms can actually be afforded in an acquisition. Finally, the reason why acquiring b helps a in alleviating the cash constraint is that b on its own cannot profit to the same extent from the new opportunity as a can (here, in fact, b cannot benefit at all from the new opportunity). The other three stylized facts we consider below.

First, consider why constraints are important here. The constraint here is that firms cannot borrow to buy the new opportunity with value $v > 13$. Since 13 is the highest bid, there is a wedge $v - 13 > 0$ which explains why firms are willing to lose efficiency in an acquisition to circumvent their (cash) constraint. With a perfect capital market, a firm just borrows the amount of money it wants to bid in the auction and hence there is no reason to acquire another firm; certainly not if an acquisition reduces efficiency.

To understand how competition plays a role in M&A, we consider the situation where the new opportunity is allocated in an uncompetitive way. For ease of exposition, consider the extreme case where in an industry with N firms, each firm has probability $1/N$ to win the next opportunity.[10] This could be the situation before the market is liberalized and the government allocates the new opportunity randomly. After the liberalization, the new opportunity is auctioned in the way described above. Although this comparison between auction and lottery is a bit extreme, it does capture the following property of more intense competition. As competition intensifies, firms' actions affect the outcome more. In the lottery, every firm has the same probability of winning, irrespective of its investment in the new project. In an auction, the

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[9]Another interpretation is that the economy emerges from a recession and is about to enter a boom. Then the cash generated in the past may not be enough to finance the more profitable business opportunities in the future. There is indeed some evidence that mergers are pro cyclical, see for instance Weston, Siu and Johnson (2001).

[10]The second price auction and the lottery can be seen as special cases of the following function determining firm i's probability of winning $s_i^\theta / (s_1^\theta + s_2^\theta + s_3^\theta)$ as a function of cash s_i invested in the project by i. With $\theta = 0$, this is a lottery with probability of winning equal to $1/3$ for each firm. With $\theta \to +\infty$ the firm with the highest (bid) s_i wins with probability 1 as in the second price auction. We assume firms pay nothing to participate in the lottery and the winner pays the second highest bid in the auction. However, this could be generalized to situations where money has to be sunk to enter the lottery and where each firm pays its own bid in the auction. The point is how sensitive the outcome is to the firms' actions.

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firm with the highest willingness to invest in the project wins. This we call a more competitive process.

Is there an incentive to merge in the uncompetitive (lottery) situation? If firm a merges with b, the probability of winning the new opportunity equals $1/2$ instead of $1/3$, however this merger is never profitable as the following calculation of firms' values shows:[11]

$$V_a = 5 + \delta(7 + v/3) \tag{6}$$

$$V_b = \delta(7 + v/3) \tag{7}$$

$$V_c = \delta(13 + v/3) \tag{8}$$

If a acquires b, he has to pay at least $p \geq \delta(7 + v/3)$ but then clearly $V_{ab} \leq 5 - \delta(7 + v/3) + \delta(14 + v/2) < V_a$. Hence there is no merger in this case. Thus we find that a switch from an uncompetitive (lottery) system to a competitive auction system leads to more mergers. More generally, in a more competitive environment constraints facing the firm become more binding. Hence there is a bigger incentive to circumvent such constraints through M&A. This is our interpretation of SF.3 in this set up.

This example can also be used to reiterate the point that acquiring another firm only alleviates the acquiring firm's cash constraint if the merged entity can deploy the resources more successfully in winning the new opportunity. In the lottery example, the target b also has a chance of winning the new business opportunity and hence it becomes too expensive to acquire profitably. In the auction set up, b has no chance of winning and hence the value of the new opportunity v does not affect V_b. Therefore, a can afford to acquire b and the merger becomes profitable. In case of a lottery, v does increase V_b making it too expensive for a to acquire no matter how high v is.

In order to analyze why mergers happen in waves and why acquiring firms may lose, we extend the set up. We now consider four firms and at $t = 2$ there are two states of the world, denoted s_1, s_2, which are equally likely. Holdings of cash and assets are given in table 2. Only firms a and c hold cash $m > 0$ at time $t = 1$. Assets yield different returns in different states of the world in the second period. The assets of the four agents yield no return in $t = 3$, but there is the new opportunity that yields v/δ in period $t = 3$ (with probability 1). This opportunity is auctioned off at the end of period 2 (using a second price auction).

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[11]There is a parallel here with the Salant, Switzer and Reynolds (1983) result that mergers (without efficiency gains) are not profitable under Cournot competition. The combined probability of winning for a and b is higher (2/3) before the merger than after the merger (1/2).

	$t = 1$	$t = 2, s_1$	$t = 2, s_2$
a	m	7	13
b	0	7	0
c	m	13	7
d	0	0	7

Table 2: *Cash and asset returns for the agents a, b, c and d.*

If there are no M&As, the values of the firms equal[12]

$$V_a = V_c = m + \frac{\delta}{2}(13 + v) \tag{9}$$

$$V_b = V_d = \frac{\delta}{2}7 \tag{10}$$

since the price for the new asset that a (resp. c) pays in state of the world s_2 (s_1) equals 7. If v is too small to make an acquisition profitable, there are no mergers. If there is an industry shock such that v increases, a merger becomes profitable. Since we want to argue that the acquiring firms can actually lose from the M&A, we assume here that they pay the lowest price possible for targets b and d: $p = \frac{\delta}{2}7$. Clearly, if firms overpay for the acquisition, it is easier to show that acquiring firms lose from M&A. The condition under which a acquires b is

$$V_{ab} = m - p + \tfrac{1}{2}\delta(14 - 13 + 13 - 7) + \delta v > V_a.$$

Firm a has 14 units of cash in state s_1 (in $t = 2$) and hence can out-spend firm c by investing 13. In state s_2, it wins the new opportunity at a price equal to 7 (as before). This inequality holds for v big enough. Firm c acquires d (after a and b merged) if

$$V_{cd} = m - p + \tfrac{1}{2}\delta(13 + 14 - 13 + v) > m + \tfrac{1}{2}\delta(13 + 7)$$

If a and b merge, while c does not merge, the combined firm ab wins the new opportunity in both states of nature. Hence, for v big enough there is a big incentive to merge for c and d as well. This ensures that c wins in state s_1. Thus we find that a sudden increase in v makes an acquisition profitable for both a and c. This is one way to formalize a merger wave consistent

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[12]In the case where $m \geq 6$ we are implicitly assuming that δ is small enough that agents a and c do not want to save m for the future such that they can bid $7 + m > 13$ and win the asset for sale in both states of the world. This simplifies the exposition but is not essential.

with SF.4. Although it is individually rational for each firm to merge, in fact, both firms lose as the following comparison shows

$$m - p + \tfrac{1}{2}\delta(14 + v) < m + \tfrac{1}{2}\delta(13 + v)$$

because $p = \tfrac{\delta}{2}7 > \tfrac{1}{2}\delta$. In other words, the merging game has a prisoners' dilemma structure. There is an incentive for firms a and c to acquire another firm, but with the mergers profits are lower than without mergers. If firms overpay to merge or if a merger leads to an efficiency loss, this effect becomes even stronger. This is how we interpret SF.6 within this framework. The point is that the gain of one merger (winning the opportunity in both states of the world) is undone by the other merger. Hence there is no gain for the firms but the price paid for the new opportunity has gone up (13 instead of 7). Note that it is essential for this argument that mergers happen in waves. An individual merger would still be profitable (otherwise firms would not undertake it in this framework).

The welfare effects of such a merger wave depend on what happens with the increased price for the new opportunity. If this is money wasted on lobbying and rent seeking, the increased price (and thus the merger) can be seen as a welfare loss. If, instead, the increased price is government revenue (say from selling a license) that allows the government to reduce distortionary taxation, the welfare effect can be positive. Similarly, if the increased price represents higher investments in R&D (say, in a patent race setting) that generate positive knowledge spillovers, the welfare effects can be positive. Finally, one can also think of the increased price as an increased investment in a war of attrition setting. Here the idea is that firms compete so aggressively in a price war, that they do not cover their (per period) fixed costs. However, if consumers benefit from this price war, a merger which prolongs the price war can be welfare enhancing.

Above, the merger wave has been modeled as a change in exogenous parameters triggering the mergers. Another way to model a merger wave is upward sloping reaction functions. If your opponent acquires another firm, the incentive for you to acquire another firm goes up. This we consider below.

3. General model

This section generalizes the model above. We derive sufficient conditions for the model to be consistent with the stylized facts discussed above.

There are N firms in the industry under consideration. Firm i has efficiency vector $n_i \in \mathbb{R}^{\nu}$ and chooses a vector of strategic variables $s_i \in S_i \subseteq \mathbb{R}^k$. The set S_i describes the constraints (*e.g.* production capacity) facing the firm. Each firm chooses its s_i to maximize profits:

$$\max_{s_i \in S_i}\{R(s_i, s, \theta) - c(s_i, n_i)\}$$

where $R(.)$ is the revenue function that follows from choosing the vector s_i, the vector $s = s(s_1, \cdots, s_N) \in \mathbb{R}^K$ (where K equals at least 1 and at most Nk) summarizes the effect of all firms' choices on revenue of firm i and $\theta \in \mathbb{R}$ parameterizes a change in the industry (*e.g.* a rise in θ can denote that the industry becomes more competitive). As an illustration, consider a Cournot model with N firms and linear demand for the goods of firm i of the form $p_i = 1 - s_i - \theta \sum_{j \neq i} s_j$ where p_i is the price for product i, s_i is the output level of firm i and $0 \leq \theta \leq 1$. Then we write revenue for firm i as $R(s_i, s, \theta) = s_i(1 - (1 - \theta)s_i - \theta s)$ where $s = \sum_{i=1}^{N} s_i$ denotes total output. An increase in $\theta < 1$ makes goods closer substitutes. This is sometimes interpreted as more intense competition (see, for instance, Aghion, Harris, Howitt and Vickers (2001) and Boone (2000)). Intuitively, with $\theta = 0$ each firm has a monopoly and with $\theta = 1$ firms produce perfect substitutes which reduces their market power.

The function $c(.)$ denotes the cost function which depends on the actions s_i chosen and the efficiency n_i of the firm. We assume that firm i chooses s_i while taking the actions of the other firms $j \neq i$ as given (Nash equilibrium). We put the following structure on this set up.

Assumption 1 *The function $R : S_i \times \mathbb{R}^K \times \mathbb{R} \to \mathbb{R}$ satisfies*

$$\frac{\partial R(s_i, s, \theta)}{\partial s} \leq 0$$

The function $s : S_1 \times \cdots \times S_N \to \mathbb{R}^K$ satisfies

$$\frac{\partial s(s_1, \cdots, s_N)}{\partial s_i} \geq 0 \text{ for each } i \in \{1, \ldots, N\}$$
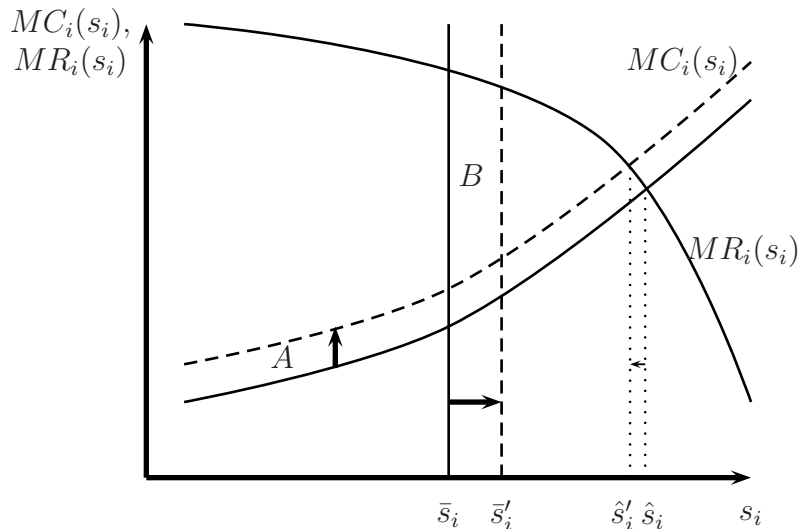
Figure 1: *The effect of a merger on profits and the strategic variable s_i when the merger raises costs and relaxes the constraint $s_i \leq \bar{s}_i$.*

and the cost function $c : S_i \times I\!\!R^\nu \to I\!\!R$ satisfies

$$\frac{\partial c(s_i, n_i)}{\partial n_i}, \frac{\partial^2 c(s_i, n_i)}{\partial s_i \partial n_i} \leq 0.$$

Before interpreting these assumptions, we make the following technical observations. We view $\frac{\partial R}{\partial s}$ for $K \geq 2$ as a column vector. The assumption says that all elements in this vector are nonpositive. For $k, K \geq 2$, the derivative $\frac{\partial s}{\partial s_i}$ is a matrix and the assumption says that each element in this matrix is nonnegative.

We assume that higher values for s reduce revenue for a firm. In this sense we interpret higher s as being a more aggressive outcome. Since each action of each firm contributes (weakly) positively to s, higher choices for s_i are seen as more aggressive behavior by firm i. Hence, if price is firm i's choice variable, then we define s_i as minus the price (or one over the price) such that higher s_i implies a more aggressive action. Finally, higher efficiency leads to (weakly) lower costs and lower marginal costs.

Figure 1 illustrates the effect of a merger if a firm faces the constraint that s_i cannot exceed $\bar{s}_i$. The graph draws marginal revenue $MR_i(s_i) = dR(s_i, s, \theta)/ds_i$ and marginal costs $MC_i(s_i) = dc(s_i, n_i)/ds_i$. We assume that the merger reduces efficiency and hence shifts marginal costs upwards.[13] Further, the merger pushes out the constraint $s_i \leq \bar{s}_i$ towards $\bar{s}_i' > \bar{s}_i$. Note that

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[13]To keep the graph simple we assume that the merger does not affect marginal revenue.

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$MR_i(\bar{s}_i)$ exceeds $MC_i(\bar{s}_i)$. This wedge creates the possibility that an efficiency reducing merger is profitable.[14] Hence, the merger is profitable only if area B (the rise in profits due to increased capacity) exceeds area A (the loss in profits due to higher marginal costs).

Such a profitable merger without efficiency gains (or even losses) is more likely (ceteris paribus) the higher the marginal revenue curve. Since firms will tend to raise capacity through internal growth if marginal revenue exceeds marginal costs, this scenario where MR_i exceeds MC_i substantially is most likely to happen just after an industry shock has unexpectedly shifted the MR curve upwards. Hence if more opportunities have suddenly opened up (SF. 2), MR_i shifts upward and mergers become more attractive as area B increases compared to A. Note that an econometrician who measures efficiency (marginal costs) before and after the merger will conclude that efficiency is reduced due to the merger. As mentioned in the introduction that is indeed what is generally found in the empirical literature. However, the merger is still profitable due to the increase in capacity. Further, if welfare is increasing in s_i, then welfare goes up as well in this example due to the merger. Finally, to illustrate the contrast with a model without constraints the figure also shows the effect on s_i when firm i can equalize marginal revenue and marginal costs. Before the merger, firm i chooses $\hat{s}_i$ while after the merger s_i equals $\hat{s}'_i < \hat{s}_i$. Hence the merger leads to a smaller firm, lower profits and lower welfare (assuming that welfare is increasing in s_i).

In this set up, we define an acquisition as follows. If firm a acquires some assets from target firm t, the production possibility set for firm a (t) before the acquisition is denoted by S_a^0 (S_t^0) and after the acquisition by $S_a^1 \supset S_a^0$ ($S_t^1 \subset S_t^0$). For notational convenience we work with partial acquisitions $d\alpha_a = -d\alpha_t = d\alpha > 0$ defined as follows[15]:

$$S_a^\alpha = \alpha_a S_a^1 + (1 - \alpha_a)S_a^0$$
$$S_t^\alpha = \alpha_t S_t^1 + (1 - \alpha_t)S_t^0$$

An increase $d\alpha_a > 0$ implies that the acquiring firm's possibility set expands (as $S_a^1 \supset S_a^0$). Similarly, $d\alpha_t > 0$ implies that the target firm's possibility set shrinks (as $S_t^1 \subset S_t^0$). Let p_a denote the maximum price that the acquiring firm a is willing to pay for a partial acquisition

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[14]Some people may argue that in the graph marginal costs equal marginal revenues if we define $MC_i(\bar{s}_i) = +\infty$ and hence there is no wedge. If one chooses this convention, the point is that in the limit: $\lim_{s_i \uparrow \bar{s}_i} MR_i(s_i) - MC_i(s_i) > 0$. Thus, either (mathematical) convention gives rise to a wedge in the sense that $MR_i - MC_i > 0$.

[15]We give $d\alpha_t$ the opposite sign of $d\alpha_a$ to make the price p_t to be paid for the target positive. See equation (12) below.

$d\alpha > 0$. Then p_a is given by the increase in a's profits due to the acquisition $d\alpha$:

$$p_a = \frac{d(R(s_a, s, \theta) - c(s_a, n_a))}{d\alpha} > 0 \tag{11}$$

Similarly, the price that the target t should at least receive to agree to the acquisition $d\alpha > 0$ equals the loss in profits as a result of selling capacity to a:

$$p_t = \frac{d(R(s_t, s, \theta) - c(s_t, n_t))}{d\alpha} > 0 \tag{12}$$

An acquisition only happens if $p_a - p_t > 0$, that is if

$$\frac{d(R(s_a, s, \theta) - c(s_a, n_a) - [R(s_t, s, \theta) - c(s_t, n_t)])}{d\alpha} > 0$$

We split the price p_a (and similarly p_t) in three terms: a *wedge*, an *efficiency effect* and a *strategic effect*. Note that T denotes the transpose of a column vector.

$$p_a = \left[\underbrace{\left. \frac{\partial(R(s_a, s, \theta) - c(s_a, n_a))}{\partial s_a} \right|_{s_{-a}}}_{\text{wedge}} \right]^T \frac{ds_a}{d\alpha} - \left[\frac{dc(s_a, n_a)}{dn_a} \right]^T \underbrace{\frac{dn_a}{d\alpha}}_{\text{efficiency effect}} + \left[\frac{dR}{ds} \right]^T \underbrace{\left(\frac{ds}{ds_{-a}} \frac{ds_{-a}}{d\alpha} \right)}_{\text{strategic effect}} \tag{13}$$

If the restrictions in the possibility set S_a are not binding, then clearly the wedge is zero in Nash equilibrium (where firm a takes s_{-a} as given when choosing s_a).[16] The firm raises each element in the vector s_a until marginal revenue equals marginal cost. However, if one of the restrictions is binding then although it would be profitable to raise s_{ak} for some k, it is not possible. Hence the wedge in this dimension is strictly positive. If an acquisition allows firm a to raise s_{ak} this yields a gain equal to $\frac{d(R(s_a,s,\theta)-c(s_a,n_a))}{ds_{ak}} \frac{ds_{ak}}{d\alpha} > 0$. We split this effect into a wedge and a strategic effect, where the wedge is the first order condition for firm i when choosing s_a in Nash equilibrium. The strategic effect takes into account that the merger affects s_{-a} in a way that is overlooked by the firm when choosing s_a.[17] The efficiency effect captures

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[16]The equation can be generalized to other equilibrium concepts than a Nash equilibrium in the variables s_a, s_{-a}, like for instance a Stackelberg leadership for firm a. We then write $s(s_a, s_{-a}(s_a))$. In this case there is only a strategic effect if the merger affects s_{-a} in ways that are not incorporated in $s_{-a}(s_a)$. For notational convenience we work with equation (13) in its Nash equilibrium form.

[17]Hence we make the same assumption as in Bulow, Geanakoplos and Klemperer (1985). In the first stage when firms decide whether to merge or not, firms understand how the merger will affect the equilibrium played in the second stage. In the second stage, when each firm i chooses s_i, it takes s_{-i} as given following the Nash equilibrium assumption.

the effect of the merger on the efficiency of the firm. Consider the following two well-known examples as illustrations of equation (13).

Example 1 *Consider a Cournot duopoly with demand of the form $p_i = 1 - s_i - \theta s_j$ where each firm's strategic variable is output and $\theta \in \langle 0, 1]$. Firm i's costs are given by $c(s_i, n_i) = s_i/n_i$. Then we define the aggregate aggression level as the sum of the two output levels, $s = s_1 + s_2$ and write firm i's revenue as $R(s_i, s) = (1 - \theta s - (1 - \theta)s_i)s_i$. Under Cournot competition firm i chooses its output level s_i taking the output level of the other firm as given. Hence $ds/ds_i = 1$. It is routine to verify that the Cournot Nash output level of firm i is given by*

$$s_i = \frac{2 - \theta - \frac{2}{n_i} + \frac{\theta}{n_j}}{(2 + \theta)(2 - \theta)}$$

Now we assume that firm 1 has a capacity constraint such that $S_1 = [0, q]$ where $q < \frac{2 - \theta - \frac{2}{n_1} + \frac{\theta}{n_2}}{(2 + \theta)(2 - \theta)}$ while firm 2 is not constraint ($S_2 = \mathbb{R}_+$). Then it is optimal for firm 1 to choose $s_1 = q$ while firm 2 sets $s_2 = \frac{1 - \theta q - 1/n_2}{2}$. We consider the effect of firm 1 being able to acquire some production capacity from a firm outside this industry such that $dq/d\alpha > 0$. What is the maximum price firm 1 is willing to pay for this acquisition? Following equation (13) above, we write this price as

$$(1 - (2 - \theta)q - \theta s - \frac{1}{n_1})\frac{dq}{d\alpha} + \frac{q}{n_1^2}\frac{dn_1}{d\alpha} - \theta q\left(\frac{ds}{ds_2}\frac{ds_2}{d\alpha}\right)$$

where $ds/ds_2 = 1, ds_2/d\alpha = -\frac{1}{2}\theta(dq/d\alpha)$. Because of the capacity constraint $s_1 \leq q$ the wedge term is strictly positive. We are interested in cases where mergers make sense for firms even if the firms lose efficiency. Hence we focus on the case where $dn_1/d\alpha \leq 0$. The strategic effect here equals

$$-\theta q\frac{ds}{ds_2}\frac{ds_2}{d\alpha} = \tfrac{1}{2}\theta^2 q\frac{dq}{d\alpha}$$

This is the effect of an increase in s_1 on s_2 that firm 1 overlooks in equilibrium when choosing s_1 (because the Cournot Nash assumption here is that output s_2 is given). Hence, even if the merger reduces firm 1's efficiency ($dn_1/d\alpha < 0$) it can still be profitable as firm 1's capacity q is expanded.[18] Moreover, if welfare is increasing in total output s, the merger is welfare enhancing since $ds/d\alpha = (1 - \frac{1}{2}\theta)dq/d\alpha > 0$.

[18]Note that firm 1 here merges with a firm outside of its industry (conglomerate merger). This differs from Salant, Switzer and Reynolds (1983) where two firms in the same Cournot market (horizontally) merge.

Example 2 *Consider the case of a homogenous good market with demand* $q = s$ *where* q *is total output and* s *equals one over the lowest price charged in the market,* $s = 1/p$. *There are* N *firms and firm* i *with output level* q_i *has costs equal to* $c(q_i, n_i) = q_i/n_i$ *with* $n_1 > n_2 > n_3 \geq \ldots \geq n_N > 1$. *Firm* i *chooses price level* $p_i = 1/s_i$. *Then the Bertrand Nash equilibrium price equals* $1/\max\{s_1, \ldots, s_N\} = 1/s_1 = 1/n_2$ *and total output equals* $q = q_1 = n_2$. *Now consider a merger of firms 1 and 2 that does not affect 1's efficiency level. Then the whole effect is strategic.*[19] *Merging 1 and 2 has no effect on cost levels nor on production possibilities. It only offers 1 the opportunity to raise its price to* $1/n_3$. *In this case without efficiency gains, the merger is always welfare reducing.*

The last example considers the simple case of homogenous goods. But as shown in Deneckere and Davidson (1985) the results also hold for Bertrand competition with differentiated products where the merger does not lead to efficiency gains. The result is due to upward sloping reaction functions. In Bertrand equilibrium each firm takes the other firms' prices as given. When two firms merge, they internalize the positive externality of a price increase on their 'partner' firm and hence raise their price. In response, the firms outside of the merger increase their price (upward sloping reaction function) as well, which is the strategic effect. Hence the merger is profitable for the merging firms but welfare reducing.

Considering equation (13) shows why the theoretical literature until now has emphasized efficiency gains due to mergers and acquisitions. If firms face no constraints (as is usually assumed), the wedge equals zero. Then a merger is only profitable if either the efficiency effect is positive or the strategic effect is positive. If the efficiency effect disappears (as seems to be the case on average in the data), mergers are only profitable if they lead to a less aggressive outcome in the industry (lower s). We call mergers reducing (raising) aggregate aggression s anti (pro) competitive.[20] In a Cournot or Bertrand model this implies that total output goes down in an anti competitive merger which is welfare reducing. Hence either a merger raises efficiency or it should be abolished from a welfare point of view. This is summarized in the following proposition.

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[19]Because 1's profit function is discontinuous around a price equal to $1/n_2$, the first derivative is not zero. However, one can still argue that zero is an element of the superdifferential and hence the wedge is zero in equilibrium.

[20]There is an issue here with terminology. Some people call a merger anti competitive if it reduces welfare. This implicitly assumes that mergers which intensify competition also raise welfare. Since there is not such a simple relation between competition intensity and welfare, we prefer to distinguish anti/pro competitive effects of a merger form the welfare effects.

Proposition 1 *Assume $K = 1$. If the wedge is equal to zero and the merger does not raise efficiency then either the merger is not profitable ($p_a < 0$) or it is anti-competitive in the sense that it reduces s. If welfare is increasing in s, then an anti-competitive merger is welfare reducing.*

Allowing for a positive wedge, however, changes this picture. Because of a positive wedge, acquisitions that are pro competitive and efficiency reducing can still be profitable.[21] If the competition authority's objective function assigns positive weight to producer surplus, the efficiency loss is welfare reducing. However, this effect is internalized by the firm. If the merger is profitable it must be the case that the wedge effect outweighs the efficiency effect. If the competition authority just maximizes consumer surplus (and assuming consumer surplus is increasing in aggregate aggression s), then the welfare effect depends just on whether the merger is pro or anti competitive in the sense of increasing or decreasing s.

Thus a positive wedge makes it possible to incorporate stylized fact SF.1 and leave room for a pro competitive merger that is still profitable for the firm. That is, even if a merger does not raise efficiency it is not necessarily the case that every profitable merger reduces welfare and should therefore be abolished by a competition authority. Further, because acquisitions can reduce efficiency, there is not necessarily a tendency to merge for monopoly. Models that assume that mergers raise efficiency tend to predict that firms keep on merging (if not blocked by a competition authority) because both the efficiency gain and the increase in monopoly power are profitable for the firms involved. This prediction is clearly refuted by empirical evidence: many firms could merge (from a competition policy point of view) but don't do so. Since we allow for mergers reducing efficiency, this empirical observation is consistent with the framework here.

4. Timing and profitability of mergers

In this section we consider the other stylized facts in the light of the model introduced above. First, we consider SF.2, SF.3 and SF.4 which deal with the timing when M&A's happen. Then

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[21]In the literature on vertical restraints and vertical mergers (see, for instance, Rey and Vergé (2005) and Motta (2003)) this point is well known. A vertical merger that internalizes an externality between the upstream and downstream firms can be both welfare enhancing and profitable for the firms (without necessarily increasing either firm's efficiency level). The point is that the externality creates a positive wedge for the merged entity. An example here is double marginalization. The idea that the firm is constrained allows us to use the same wedge intuition for horizontal and conglomerate mergers.

we consider the profitability of mergers and the way these profits are distributed between target and acquiring firms (SF. 5 and 6).

4.1. Liberalizing the industry

In our model, firm a only acquires (part of) t if $p_a - p_t > 0$. We assume that firms a and t choose the degree α of the transfer of assets so as to maximize their joint profits:

$$\max_{\alpha \in [0,1]} \left\{ \max_{s_a \in S_a^\alpha} [R(s_a, s, \theta) - c(s_a, n_a(\alpha))] + \max_{s_t \in S_t^\alpha} [R(s_t, s, \theta) - c(s_t, n_t(\alpha))] \right\} \tag{14}$$

where the production possibility set S_a^α (S_t^α) in nondecreasing (nonincreasing) in α. The case $\alpha = 0$ denotes no acquisition of assets by a, while $\alpha = 1$ denotes the case where firm a (t) expands (shrinks) its production possibility set from S_a^0 to $S_a^1 \supseteq S_a^0$ (from S_t^0 to $S_t^1 \subseteq S_t^0$). We take the possibilities created by the merger (*i.e.* S_a^1, S_t^1) as exogenously given. Firms choose the degree α of the transfer to maximize the joint value of the firms. Note that we allow the efficiency of a to fall due to the merger (*i.e.* we allow $n_a'(\alpha) < 0$).

Consequently, the gain firms get from merging equals

$$\Delta = \max_{\alpha \in [0,1]} \left\{ \max_{s_a \in S_a^\alpha} [R(s_a, s, \theta) - c(s_a, n_a(\alpha))] + \max_{s_t \in S_t^\alpha} [R(s_t, s, \theta) - c(s_t, n_t(\alpha))] \right\}$$
$$- \left\{ \max_{s_a \in S_a^0} [R(s_a, s, \theta) - c(s_a, n_a)] + \max_{s_t \in S_t^0} [R(s_t, s, \theta) - c(s_t, n_t)] \right\} \tag{15}$$

In the framework here, changes in the industry, like liberalization and deregulation, are captured by θ. We say that an increase in θ makes an acquisition by a from t more likely if $d\Delta/d\theta > 0$. One way to formalize the idea of acquisitions becoming more likely is the following. For each pair of firms there is a random cost $\gamma \in [0, \bar{\gamma}]$ of negotiating the merger. The distribution function of γ is denoted by $F(.)$. Hence firms a and t only merge if $\Delta > \gamma$. The probability that this happens, is given by $F(\Delta)$. As Δ increases, the probability of a merger increases.

Hence there are negotiating costs (say, due to asymmetric information) that may prevent a merger even though $\Delta > 0$. However, we assume that once firms decide to merge, they choose α such that the total value created by the merger is maximized. This maximizes the probability that a price p can be negotiated such that $p_t < p < p_a$.

The following proposition derives necessary and sufficient conditions for $d\Delta/d\theta > 0$, where R_a^α denotes $R(s_a, s, \theta)$ after a has acquired a fraction α from t's assets, R_a^0 denotes $R(s_a, s, \theta)$ before the merger ($\alpha = 0$) and similarly for R_t^α, R_t^0.

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Proposition 2 *An increase in θ makes a merger between firms a and t more likely if and only if*

$$\frac{\partial[(R_a^\alpha - R_a^0) - (R_t^0 - R_t^\alpha)]}{\partial s}\frac{ds}{d\theta} + \frac{\partial[(R_a^\alpha - R_a^0) - (R_t^0 - R_t^\alpha)]}{\partial \theta} > 0 \qquad (16)$$

Note that the merger between a and t transfers assets from t to a and thus $R_a^\alpha - R_a^0, R_t^0 - R_t^\alpha \geq 0$ as a's production possibility sets expands while t's set shrinks. To get some intuition for equation (16), we consider a number of cases. First, consider a conglomerate merger where the liberalization $d\theta > 0$ takes place in a's sector but where t is not affected either by θ nor by the consequent change in s in a's sector.[22] Such a change in θ makes the acquisition of t by a more likely if and only if

$$\frac{\partial(R_a^\alpha - R_a^0)}{\partial s}\frac{ds}{d\theta} + \frac{\partial(R_a^\alpha - R_a^0)}{\partial \theta} > 0$$

Hence, the merger becomes more likely if the industry shock $d\theta > 0$ has the direct effect of increasing revenue for a after the merger compared to the situation without the merger. Think of the merger between Reed Elsevier and Mead Data Central (see Introduction). As the internet revolution unfolded, Reed Elsevier's lack of knowledge of electronic publishing became more and more a binding constraint. Due to lack of know how, it could not expand in this direction. As more and more people started to use internet, the marginal revenue curve kept on moving upwards (see figure 1) thereby widening the wedge in that dimension. This made the (conglomerate) merger between Reed Elsevier and Mead Data Central more and more attractive.

If we think of $d\theta > 0$ as liberalization/deregulation of the sector, we may expect that s goes up as well: competition becomes more intense. Indeed the goal of liberalization/deregulation often is to get more aggressive conduct and a more competitive outcome in the industry. If this happens, $ds/d\theta > 0$ and this further helps to trigger the merger between a and t if

$$\frac{\partial(R_a^\alpha - R_a^0)}{\partial s} > 0.$$

In this case, the increased aggregate aggression s further stimulates the merger. Firm a after the merger can respond more adequately to increased aggression after the liberalization as the merger alleviates constraints that held firm a back.

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[22] Note that s is a vector which has elements pertaining to a's and t's sector. The elements of this vector s that change (due to θ) do not affect t's profits in this case.

In the conglomerate merger setting, we can also have the case where firm t's sector faces deregulation while a's sector is unaffected by θ. Deregulation in t's sector makes the acquisition by a more likely if

$$\frac{\partial(R_t^0 - R_t^\alpha)}{\partial s}\frac{ds}{d\theta} + \frac{\partial(R_t^0 - R_t^\alpha)}{\partial\theta} < 0.$$

In words, the increase in θ has the direct effect of reducing t's valuation of the assets it can transfer to a. For instance, deregulation may marginalize firm t such that its chances of survival are reduced. If the liberalization leads to a more aggressive outcome in t's sector and

$$\frac{\partial(R_t^0 - R_t^\alpha)}{\partial s} < 0$$

this further marginalizes firm t and the difference between R_t^0 and R_t^α becomes smaller. Hence, it becomes more likely that a and t can agree on a price p to transfer the assets.

In the context of a horizontal merger where both a and t are affected by θ, the interpretation of equation (16) is as follows. The direct effect of an increase in θ is to increase the value of the acquired assets to a, $R_a^\alpha - R_a^0$, relative to the value of these assets to t, $R_t^0 - R_t^\alpha$. Hence the direct effect of the liberalization is to increase the wedge for a between marginal revenues and marginal costs in dimensions where t's assets can alleviate constraints. If the liberalization leads to a more competitive outcome, this further stimulates the merger if

$$\frac{\partial[(R_a^\alpha - R_a^0) - (R_t^0 - R_t^\alpha)]}{\partial s} > 0. \tag{17}$$

The increase in competition s raises the value of the assets for firm a relative to firm t.

This is a generalization of the example in section 2 where the new opportunity was first allocated by lottery to one of the firms a, b and c. In this case, it is not optimal for firms to merge since firm b is too expensive for a to acquire. Then the sector was liberalized and the new opportunity was allocated using an auction. With the auction, firm b has no chance of winning the new opportunity while it has a chance to win with the lottery. Hence the switch from lottery to auction reduces the value of firm b making it more attractive to be acquired by a. Moreover, the switch to the auction allocation makes the target firm more attractive to the acquiring firm a. The return to alleviating a's (cash) constraint is bigger with an auction compared to a lottery to allocate the new opportunity. The liberalization increases the return to a's constraint dimension (cash) compared to t's return in this dimension.

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We focus in this paper on the new idea that deregulation can trigger mergers that are pro competitive but do not raise efficiency. However, the framework here is consistent with the idea in, for instance, Fridolfsson and Stennek (forthcoming) that firms merge to reduce overcapacity in the industry. In this case the change in θ is a reduction in demand. Constraints are not the issue in this case but, instead, overcapacity. Such a merger can be profitable by the strategic effect. Firm a buys assets from t which are reduced in value due to the overcapacity in the sector (say, due to an unexpected fall in demand). Firm a then destroys these assets (or does not use them in this sector) to reduce total output s. Such anti-competitive mergers can indeed be profitable for a and thus are consistent with the framework here.

We conclude the section by looking at merger waves as mentioned in SF.4. In this context there are two reasons why we can get a merger wave after liberalization. First, the increase in θ may increase the difference Δ in equation (15) for a number of pairs of acquiring and target firms. This liberalization then triggers a set of mergers. A second explanation for a merger wave is that the increase in θ causes the firms a and t to merge which in turn increases Δ for another pair of firms a', t'. This explanation of a merger wave can be formalized as follows.

Proposition 3 *Suppose that an increase in θ leads to a merger between a and t. This makes a merger between $a', t' \neq a, t$ more likely if and only if*

$$\frac{\partial[(R_{a'}^{\alpha'} - R_{a'}^0) - (R_{t'}^0 - R_{t'}^{\alpha'})]}{\partial s}\frac{ds}{d\alpha} > 0 \qquad (18)$$

where $\alpha(\alpha')$ denotes the transfer of assets between a and t (a' and t').

Hence, if the merger between a and t is pro competitive then we get a merger wave if inequality (17) holds for the pair a', t': the merger between a and t makes the merger between a' and t' more likely. This generalizes the example in section 2 where the merger between firms a and b makes the merger between c and d more profitable. There aggregate aggression is measured by the price paid for the new opportunity. The merger between a and b intensifies competition by driving this price upward. This makes it profitable for c and d to merge as well. Alternatively, if the merger between a and t is anti competitive ($ds/d\alpha < 0$) then it makes the merger between a' and t' more likely if (17) holds with the opposite sign.

4.2. Unprofitable mergers

In this section we consider the last two stylized facts: SF.5 and 6. The former is quite straight-forward in this context. A target firm always gains as it only sells out if $p > p_t$. Depending

on the bargaining power of t and whether other firms than a try to acquire t as well, the price for t can be substantially above p_t. Especially if an increase in θ opens up new opportunities that t on its own cannot benefit from. If t's assets allow a to benefit more from the new opportunities, the value of t in an acquisition increases. Thus the acquisition price for t's assets can lie substantially above t's own valuation of the assets. Hence, in this context SF.5 is not surprising.

In the same vein, if t has substantial bargain power (*e.g.* because other firms are bidding for t as well), the acquiring firm does not gain much. Moreover, the merger can be rational while the acquiring firm loses if $d\theta > 0$ triggers a merger wave. In our set up, the increase in θ (ceteris paribus) is seen as good news: new opportunities open up. In other words, we allow for the fact that the direct effect of θ is to raise R. Above we have looked at pro-competitive mergers (not anti-competitive to reduce aggregate capacity as in Fridolfsson and Stennek (forthcoming)[23]), we find profit reductions due to mergers in the following way.

An increase in θ which raises aggregate aggression from s to $s' > s$ due to a pro competitive merger wave leads to both rational mergers and mergers that reduce profits if

$$
\max_{s_a \in S_a^0}[R(s_a, s, \theta) - c(s_a, n_a)] \ >
$$
$$
\max_{s_a \in S_a^\alpha}[R(s_a, s', \theta) - c(s_a, n_a')] - \left\{ \max_{s_t \in S_t^0}[R(s_t, s', \theta) - c(s_t, n_t)] - \max_{s_t \in S_t^\alpha}[R(s_t, s', \theta) - c(s_t, n_t')] \right\} \ >
$$
$$
\max_{s_a \in S_a^0}[R(s_a, s', \theta) - c(s_a, n_a)]
$$

The expression in the second line is the firm's profit after the acquisition of firm b (where $\max_{s_t \in S_t^0}[R(s_t, s', \theta) - c(s_t, n_t)] - \max_{s_t \in S_t^\alpha}[R(s_t, s', \theta) - c(s_t, n_t')]$ is the (minimum) price firm a has to pay to buy t).[24] The profit level on the first line is the profit level without the (pro competitive) merger wave (where s remains low). Hence the first inequality implies that the mergers lead to lower profits for the firms. However, the inequality on the second line tells us that the merger is rational in the sense that profits of firm a are higher after the merger with t than it would be without the merger. Hence although the increase in θ leads to new opportunities for the firms, the competition for these opportunities (including the mergers) competes these rents away. As a result, profits are lower for the firms than in the case without

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[23]In Fridolfsson and Stennek (forthcoming) an increase in θ is actually bad news about the sector (recession) which triggers mergers to reduce excess capacity and reduces profits. Hence empirical researchers that cannot control very well for the industry specific effect (recession) find the correlation between merger activity and reduced profits.

[24]Again we assume that a pays the lowest price at which t is willing to sell. With a higher acquisition price it is easier to show that the merger reduces profits.

mergers. The merger game has a prisoner's dilemma structure in this case. If the higher s is beneficial for consumers, then the mergers are welfare enhancing.

For an example of this prisoner dilemma structure, see section 2 where the mergers between a and b and between c and d are rational but the mergers do lead to lower profits for both the combinations $a\&b$ and $c\&d$.

5. Constraints facing the firm

The two main motivations for constraints that we mention in the introduction are capital market imperfections and time to market. Above we have derived results in a general model, here we illustrate how capital market constraints and time to market can be formalized in simple models. In both cases, the imperfection leads to a wedge between marginal costs and marginal revenue for the firm.

5.1. Capital market imperfections

Here we formalize a moral hazard story (in line with Gale and Hellwig (1986)) leading to capital market imperfections. Assume that a firm has an amount of money m and needs to invest $p > m$ to buy an asset that will yield a pay off in the next period (where we ignore discounting for ease if exposition). Hence the firm has to borrow an amount equal to $p - m > 0$ to finance the asset. If the entrepreneur invests effort at cost $e > 0$, there is a probability $\pi \in \langle 0, 1 \rangle$ that the project is successful and yields pay off $V > 0$; with probability $1 - \pi$ the project is not successful and yields 0. If the entrepreneur shirks, he has no effort cost and the probability of success is 0 (*i.e.* pay off to the project is always 0).

To motivate the entrepreneur to invest effort, the return to the entrepreneur should be s where s satisfies

$$\pi s \geq e$$

because otherwise the entrepreneur will shirk. With limited liability, return to the bank is $\pi(V - s)$. Hence the bank only lends money to the firm if

$$\pi(V - e/\pi) \geq p - m$$

or equivalently

$$\pi V - p \geq e - m$$

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If $e - m > 0$ then it follows that $\pi V - p > 0$ and hence there is a wedge due to the capital market imperfection. In principle, all projects with a positive net present value, $\pi V - p \geq 0$ should be financed but due to the moral hazard problem only projects with $\pi V - p \geq e - m > 0$ are actually financed. This wedge creates the possibility that firms merge although the merger itself reduces efficiency. If the merger increases either the assets m or the return V (as more projects are managed), the merged firm can borrow more to finance new projects as the merger relaxes the constraint $\pi V - p \geq e - m$.

Alternatively, the merger could create more collateral for the firm that can be used for a mortgage. This also makes the shirking option less attractive and helps the firm to overcome the capital market constraint. Indeed, Weston, Siu and Johnson (2001) review some empirical studies indicating that the debt capacity of the combined firm can be greater than the sum of the two firms' capacities before the merger. Hence the results derived in section 2 with an extreme form of capital market imperfection (no borrowing at all) can be generalized to more realistic situations where firms can borrow to some extent as long as the capital market is not perfect. The assumption needed is that the firm has a strictly positive wedge in some dimension and a capital market imperfection generates such a wedge.

5.2. Time to market

As mentioned in the introduction, time to market is an important consideration in M&A's. Most constraints can be solved using internal growth, but acquisitions relax constraints faster (also see Weston, Siu and Johnson (2001, pp. 143)). This time gain is so important in some markets that firms are willing to sacrifice efficiency just to reduce time to market. The trade off we consider here is the following. When solving a constraint through internal growth, the solution can be geared to the way the organization works and will therefore be efficient. However, finding all the right employees and other ingredients and putting them together will take time. If the firm acquires another firm (or part of that firm), the constraint is taken care of more quickly but the new firm may not fit perfectly into the existing organization and therefore a loss of efficiency may result.

For concreteness, think of a firm that wants to enter a new market segment, say it wants to introduce an improved version of a DVD player. To do this, it needs to undertake R&D to invent the better player. The knowledge for such an innovation is currently not present in the firm. Hence the firm can open up vacancies for R&D personnel and in this way create an R&D department. It can then hire people that fit the culture of the organization etc. Selecting

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and hiring all these employees will, however, take quite some time. Alternatively, the firm can decide to acquire a small start up firm that works in the area in which the firm expects the breakthrough for the new player. In that way the R&D department will be up and running sooner. However, the fit with the rest of the organization will be smaller which may lead to efficiency losses.

More formally, assume that firm i wants to bring a new product to the market. If it does develop all relevant capabilities internally, it can start selling the new product from time t_i onwards at a cost of $I(t_i)$ with $I(0) = +\infty, I'(.) < 0, I''(.) > 0$. Starting production today is prohibitively expensive and the longer one waits with the introduction, the cheaper it becomes. Profits per period for the firm of selling the new product are determined by its own time to market t_i, the vector of competitors' time of introducing a comparable product t_{-i} and firm i's efficiency, n_i: $\pi(t_i, t_{-i}, n_i)$ where

$$\frac{\partial \pi(t_i, t_{-i}, n_i)}{\partial t_i} < 0$$

$$\frac{\partial \pi(t_i, t_{-i}, n_i)}{\partial t_j} > 0 \text{ for } j \neq i$$

$$\frac{\partial \pi(t_i, t_{-i}, n_i)}{\partial n_i} > 0$$

The sooner i is in the market, the higher its per period profits. For instance, there could be switching costs and/or network effects. Hence, if i is in the market sooner, it is more likely that consumers buy from i as well in the future (because of switching costs most existing customers replace their product by a new one from i; because of network effects new consumers tend to buy product i as well if their friends use i already etc.). In the same vein, if competitor j comes earlier into the market, profits for i go down. Finally, as above, higher efficiency levels lead to higher profits.

The firm when deciding on t_i solves the following problem

$$\max_{t_i} \int_{t_i}^{+\infty} e^{-\rho\tau} \pi(t_i, t_{-i}, n_i) d\tau - I(t_i)$$

The first order condition for this can be written as

$$-e^{-\rho t_i} \pi(t_i, t_{-i}, n_i) + \int_{t_i}^{+\infty} e^{-\rho\tau} \frac{\partial \pi(t_i, t_{-i}, n_i)}{\partial t_i} d\tau - I'(t_i) = 0$$

Because of the $I'(t_i) < 0$ term, there is a wedge and the firm is willing to sacrifice efficiency n_i to get to the market more quickly. Suppose that firm i merges with an R&D lab that provides

the relevant capabilities. In this way, it can get to the market at time $t_i^m < t_i$ but reduces the efficiency to $n_i^m < n_i$. Then such a merger is profitable if

$$\int_{t_i^m}^{+\infty} e^{-\rho\tau}\pi(t_i^m, t_{-i}, n_i^m)d\tau - p > \max_{t_i} \int_{t_i}^{+\infty} e^{-\rho\tau}\pi(t_i, t_{-i}, n_i)d\tau - I(t_i)$$

where p is the price to acquire the R&D lab. Due to the positive wedge, the merger can be profitable although it reduces efficiency.

If other firms acquire business units as well to get to the market faster, we can get a merger wave if t_i and t_j ($j \neq i$) are strategic complements

$$\frac{\partial^2 \pi(t_i, t_{-i}, n_i)}{\partial t_i \partial t_j} > 0$$

The sooner your opponent gets to the market, the higher the return to being fast yourself. In this way, one merger may trigger another. If consumers appreciate being served sooner, welfare may go up although efficiency is reduced and firms can loose from such a merger wave, as shown above.

6. Conclusion

This paper has introduced the idea that firms cannot equalize marginal costs and marginal revenues in all dimensions of their action space. In other words, firms face constraints. If a merger alleviates a constraint, a merger can be both profitable and welfare enhancing even though the merger does not raise (or even reduces) efficiency. In this way, we move away from the more traditional IO models of mergers that depend on efficiency gains to understand how mergers can be both profitable and welfare enhancing (and thus should be allowed by a competition authority). The problem with these theoretical models is that there is no empirical evidence showing that most (or even many) mergers actually raise efficiency.

Using this idea that firms merge in response to constraints that they face, we can explain a number of stylized facts concerning mergers. Mergers happen after new opportunities have opened up and after the sector has become more competitive, say due to deregulation and liberalization. The idea is that such industry shocks shift the marginal revenue curve upward, increasing the shadow value of the constraint and thereby making mergers to alleviate the

constraint more profitable. Mergers happen in waves where one merger triggers the next merger. If firms' choice variables are strategic complements (upward sloping reaction functions), then if a merger allows one firm to spend more on, say, R&D or to introduce its products sooner this will raise the incentives for other firms as well to spend more on R&D using acquisitions. Finally, merger waves can explain why rational mergers can be associated with a reduction in profits after the merger. Pro competitive mergers help firms to compete more fiercely, thereby competing the rents away that were created by deregulation of the sector.

The implications for competition policy of the framework introduced here are as follows. First, given the empirical literature on efficiency gains of mergers, less emphasis should be placed on an efficiency defence. Without efficiency gains, the traditional literature suggests that horizontal mergers should be abolished as they can only be motivated by market power. In a world where firms face constraints, however, there are other arguments that the firms can use to defend their merger. They should argue that the acquisition allows them to expand in areas (either geographically or in product space) that they otherwise would not be able to exploit. For instance, the merger allows them to invest in R&D as it alleviates a capital market constraint or the merger allows them to invent a new product more quickly than the firm would otherwise be able to do. If the firms can argue that these new opportunities opened up by the merger create surplus for consumers, then the merger should be allowed, even though it does not increase efficiency. These gains should then be weighed against the strategic effect if the merger increases market power. In line with the existing literature, we also find that anti competitive effects of mergers are more likely with horizontal mergers than conglomerate mergers.

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Appendix A. Proofs of results

Proof of proposition 2

Deriving $d\Delta/d\theta$ while using an envelope argument for α and s_a, s_t (both before and after the merger) leads to expression in the proposition. If one of these variables (that are optimally chosen) has an interior solution in equation (15), the first derivative equals zero and a small change in this variable has no effect on Δ. If a variable has a corner solution, like s_a hitting a constraint in some dimension k or $\alpha = 1$, then a small change in θ will not affect the optimal value of this variable. *Q.E.D.*